Appendix 1

Wastewater Discharge Assessment Report

Irish Water

PROJECT:

Newmarket-on-Fergus Agglomeration

DOCUMENT:

Wastewater Discharge Assessment Report

Irish Water
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NEWMARKET-ON-FERGUS WASTEWATER AGGLOMERATION DISCHARGE ASSESSMENT

SECTION 1 – INTRODUCTION

1.1 Purpose

The purpose of this report is to review and consider alternative options for the primary effluent and storm water discharge for the existing Waste Water Treatment Plant at Newmarket-on-Fergus, Co. Clare. This report includes the following:

- Review of existing treatment and discharge locations.
- Options regarding discharge to alternative surface water bodies.
- Recommendation of discharge and monitoring locations for both primary effluent discharge and storm overflow
- Recommendation of any required upgrades to the storm water facilities
- Recommendation of final effluent standards for recommended primary discharge location
- Storm water discharge locations
- Preparation of a cost comparison for primary discharge options

1.2 Background

Clare County Council submitted an application to the EPA in 2008 for a wastewater discharge licence for the Newmarket-on-Fergus agglomeration. This licence application is still under review, as part of which the EPA requested a Tier 3 hydrogeological assessment for the site based on the "*Guidance on the Authorisation of Discharges to Groundwater (2014 and 2011)*" [9, 10]..

Newmarket-on-Fergus, Co. Clare. Newmarket on Fergus is located approximately 11.5 km southeast of Ennis, circa 7 km north north-east of Shannon Airport and 21 km (approx.) north west of Limerick City.

The wastewater treatment plant which serves the agglomeration is located (ITM Coordinates 539445, 667951) in the townland of Boheraroan to the southwest extent of Newmarket-on-Fergus, as shown on the figure overleaf.

This plant constructed in the 1980's. and subsequently upgraded in 2010. The plant currently includes primary, secondary and ferric sulphate treatment (phosphate reduction introduced as part of the upgrade in 2010) processes. The WWTP's original design capacity of 3,500-population equivalent (PE) and was upgraded to treat a PE of 5,000. The final treated effluent from the WWTP discharges to an adjacent watercourse known as 'Mill Stream', which flows into Lough Gash (a Turlough and SAC) located immediately to the west.

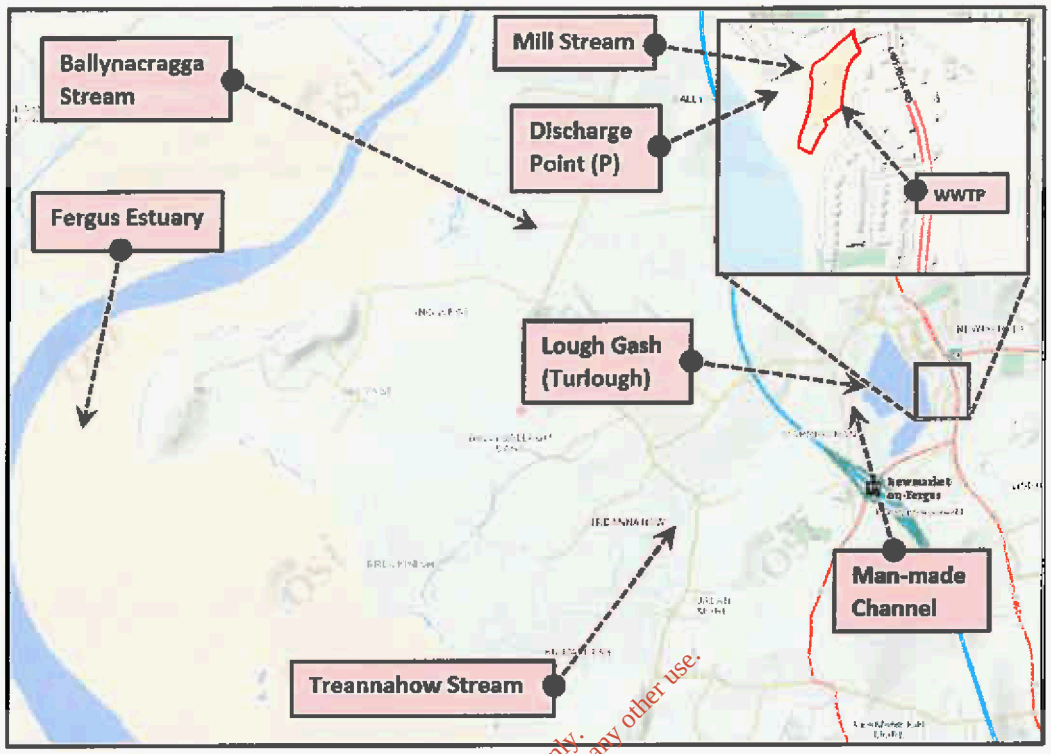

Figure 1.1: Location of Newmarket-on-Fergus WWTP [1]

1.3 Legislation

The relevant legislation considered in this report is as follows:

- Habitats Directive (92/43/EEC; 2000)
- Birds Directive (Directive 2009/147/EC)
- The Water Framework Directive (2000/60/EC)
- Urban Waste Water Treatment Directive (91/271/EEC; 1991)
- Groundwater Directive (2006/118/EC)
- Dangerous Substances Directive (2006/11/EC)
- Waste Water Discharge (Authorisation) Regulations 2007 (S.I. No. 684 of 2007)

1.4 Sources of Information

The primary sources of information used in compling this report were as follows:

- Environmental Protection Agency [9, 10]
- Geological Survey of Ireland [11, 12]
- National Parks and Wildlife Service [13]
- Office of Public Works (OPW) [14, 15, 16]
- Water Framework Directive 'Water Maps' [17]
- Visit to WWTP and walk-over survey

1.5 Procedure/Methodology

This report comprises and initial review of the hydrogeological assessment. Thereafter the report considers what alternative options are available for the wastewater discharge locations, and what effluent standards might apply to those options. The report finally considers the cost implications of the different options.

SECTION 2 – IDENTIFICATION OF RECEIVING WATERS

2.1 Introduction

The local environment is predominantly underlined with Karst Limestone. Karst features such as sinkholes, springs, swallow holes, dolines and turloughs are prevalent. Drainage is characterised by interactions between surface water and groundwater. Surface water rivers and streams can disappear down swallow holes and emerge again from springs. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Groundwater flow through karst areas is extremely complex and difficult to predict. The subterranean flows are often determined by discrete conduits, and subterranean flow directions will not necessarily be perpendicular to the assumed water table contours. Flow velocities can be rapid and variable.

Turloughs are a karst feature that is common in the karst limestone environments of the west of Ireland. They are depressions in the landscape that are flooded with groundwater (with a surface water component also). The water level in the Turlough reflects the local groundwater table. During dry summer periods the water table can recede to below the base of the Turlough and surface entering the depression drains to the underlying groundwater through the swallow hole that feeds it. During winter conditions the water level will rise to level where it can overflow into a surface water channel becoming part of the surface water drainage system.

2.2 Existing Discharge

2.2.1 Introduction

The final treated effluent from the WWTP discharges to a local watercourse (see Figure 2.1 (i)) adjacent to the treatment plant known as the 'Mill Stream' (ITM coordinates E: 539357.68, N: 667938.45) which flows into Lough Gash in a south-westerly direction approximately 50m from the discharge location. According to Clare County Council, the Mill Stream maintains a flow rate throughout the year.

Lough Gash is a Turlough and during dry summer conditions water can disappear to groundwater through a network of swallow holes associated within the underlying karst limestone bedrock (Figure 2.1 (ii)).

When Lough Gash is flooded, the discharge from the Turlough is by surface water to a manmade channel at the head of the Treannahow Stream, which is located to the west. It should be noted that during a site visit on 13th November 2014 that the Turlough was full and discharging to the Treannahow Stream. The discharge from the Turlough into the manmade channel was observed to disappear down a swallow hole approximately 170 metres downstream of the Lough Gash outlet. The path of the groundwater is not known after entering the swallow hole but it is probable that it ultimately discharges to Fergus Estuary. It is probable that it emerges downstream of the swallow hole as a spring and flows as surface water in the Treannahow stream into the estuary.

Visean undifferentiated Dinantian bedded limestones to the north and the Waulsortian Limestones to the South dominate the regional geology of the existing receiving water area. The groundwater vulnerability rating is extreme which indicates that a karst environment exists. Lough Gash is situated on a geological boundary and the underlying aquifer on the northern side is classified as a regionally important aquifer with conduit flow. The aquifer underlying the southern extent of Lough Gash is a locally important aquifer – bedrock which is generally moderately productive. It is believed

that the swallow hole in the Turlough is located at the boundary and drains to the regionally important aquifer. The regional groundwater flow will be to the west towards the River Fergus. Dye tests have indicated this to be the case.

The closest groundwater well (according to the GSI data base) is located approximately 1.2km southeast of the primary discharge point with a well accuracy within 500m to 1000m. The Mill Stream discharges to Lough Gash, which is a designated SAC and pNHA site (see Appendix A for GSI mapping). There are no wells recorded on the GSI database to the west between the Turlough and the River Fergus.

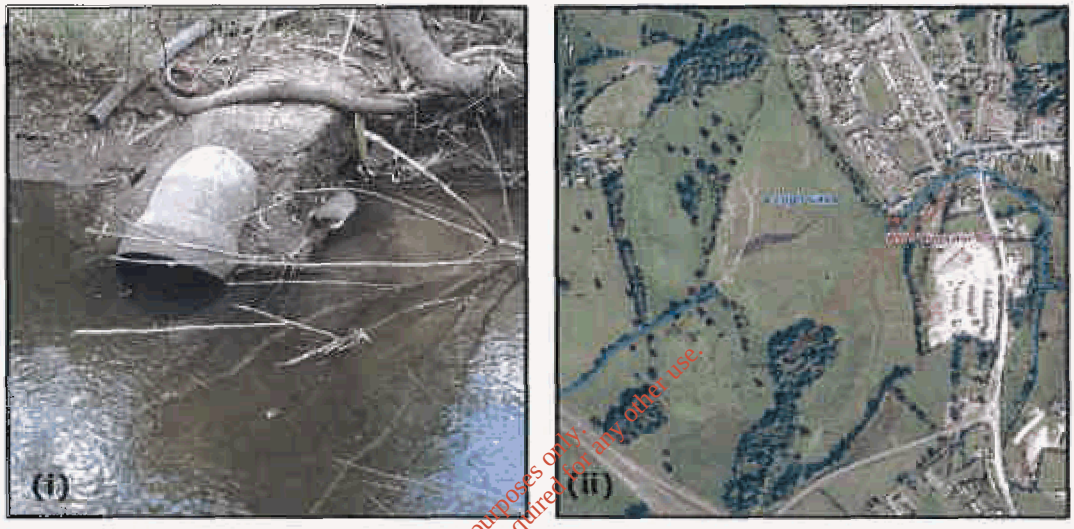

Figure 2.1: (i) Primary Discharge to Mill Stream and (ii) Typical Turlough characteristics in dry weather, picture taken in June 2010 (*source: Clare County Council*)

The newly launched Flood Studies Update web portal [15] contains an interactive application, which enabled the catchment area of the existing receiving water to be determined. A catchment area of 4.86km^2 for Lough Gash was calculated (Figure 2.2). The 50-percentile flow rate for this catchment is 0.116 m^3/s, which was obtained from flow duration curves for ungauged catchments (see Appendix B for full EPA report [21]). However, the existence of local conduit karst within this catchment could have an effect on the flow estimation [18].

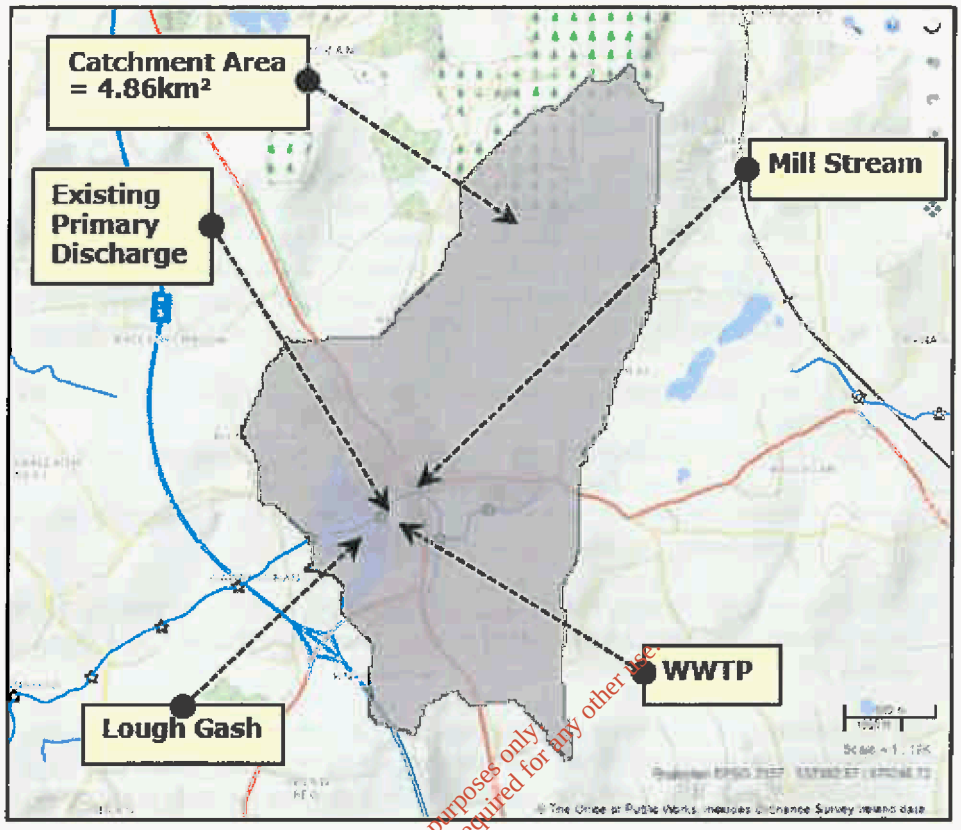

Figure 2.2: Map depicting Lough Gash catchment area [15]

2.3 Tier 3 Environmental Risk Assessment

The receiving waters of the primary discharge from the WWTP have been subject to a Tier 3 Environmental Risk Assessment [19]. The report concluded that a monitoring programme should be instigated to fill information gaps. However, there were no significant adverse impacts reported on either groundwaters or surface waters.

2.3.1 Appropriate Assessment

Appropriate Ecological Assessment Screening was undertaken as part of the discharge licence application. The NPWS were consulted as part of the process as Lough Gash is a turlough designated as an SAC. The assessment concluded that were no discernible impacts on the turlough, surface waters or groundwater and that the improvement in the treatment plant (increase in capacity to 5000 PE and treatment for phosphorus reduction) would reduce the risk of potential impacts. The proposed upgrade has since been completed (2010)

2.4 Alternative Discharge Locations

There are no reported impacts on the environment [19] as a result of the existing treatment plant at Lough Gash. The Tier 3 risk assessment recommended that a monitoring programme and further data be collected. Until this monitoring is complete, it is recommended that the current treatment and discharge is continued.

However in the event that the monitoring programme indicates that the present situation is unacceptable we have considered and assessed a number of alternatives

for the treatment and discharge of the effluent generated at the WWTP. These alternative discharge locations are summarised and considered below.

2.4.1 Lough Gash (Turlough)

Lough Gash is a receptor of the existing receiving water from the Mill Stream. The worst-case scenario occurs during the summer months when the Turlough can dry up and the Millstream flows across the turlough and discharges directly down the swallow hole draining the turlough. The groundwater vulnerability has an 'Extreme' rating indicating that a karst environment exists. Regional hydrogeology mapping (Appendix A - GSI) indicates that Lough Gash has aquifer classifications as follows:

1. Regionally important aquifer – karstified (conduit) aquifer; to the northern region
2. Locally important aquifer – bedrock which is generally moderately productive; through the central portion of the Turlough
3. Locally important aquifer – bedrock which is moderately productive only in locale zones; to the south of the Turlough.

The closest groundwater well with an accuracy within 500m to 1000m is located approximately 0.9km southeast of Lough Gash. Lough Gash is a designated SAC and pNHA site.

It is concluded that the existing discharge will have the same effect as a direct discharge to Lough Gash. As the Mill Stream is reported to flow all year (no flow data available) there will be some dilution before discharge to groundwater. In the winter months when the Turlough is full the flow will bypass the swallow hole and discharge from the Turlough via the manmade channel of the Treannahow Stream and disappear again down another swallow hole in the Treannahow Stream.

2.4.2 Lough Gash Outlet Connecting a Man-Made Channel to the Treannahow Stream

The Treannahow Stream is connected to Lough Gash via a man-made stream. Lough Gash discharges to this man-made stream (outlet location ITM: E0538956, N 0667793). However during a site visit on 13th November 2014 the flow was observed to be flowing down a swallow hole at a point immediately upstream of a culvert (ITM: E: 0538814, N: 0667705) approximately 0.17km downstream of the Lough Gash outlet (see Figure 2.3).

The groundwater vulnerability rating is "rock at or near surface or karst". The closest groundwater well is located approximately 0.8km south southwest of the man-made channel outlet with a well accuracy within 100m.

Discharging to this location would have the advantage that the discharge bypasses the SAC but still goes to groundwater a short distance after the proposed discharge point. The dye tests suggest that the stream will re-emerge as a spring further down the channel.

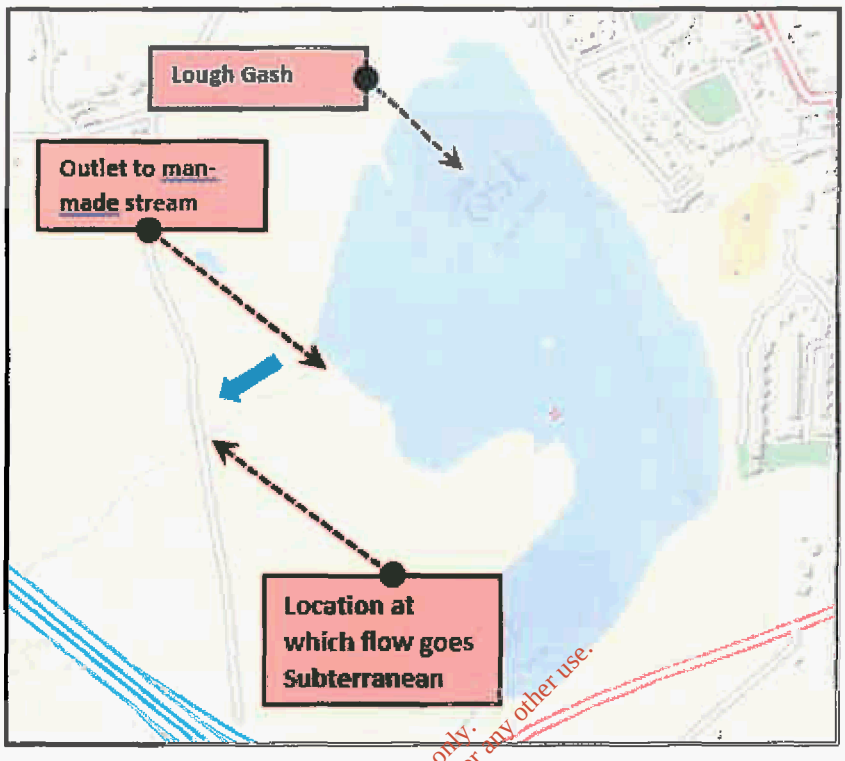

Figure 2.3: Location where the flow in the man-made channel connecting the Turlough to the Treannahow Stream goes subterranean [1]

2.4.3 Lough Gash WWTP to Location on the Treannahow Stream Where Certainty of Flow Exists

As mentioned above the flow in man-made channel connecting Lough Gash to the Treannahow Stream goes subterranean (Figure 2.4) and the hydrogeology assessment considers that the flow re-emerges in the form of a spring approximately 1km downstream of the Lough Gash outlet. The Treannahow Stream subsequently discharges to the Fergus Estuary (ITM: E536528 N665901) approximately 3km downstream of the spring where the subterranean flow re-surfaces. It would be prudent to consider discharging any treated effluent to a sufficient location downstream of the spring to ensure adequate mixing and dilution. This will bypass the Turlough (SAC) ensure that the flow is to surface water.

A report by Dr Catherine Coxon of Trinity College Dublin completed a karst hydrogeological assessment of Lough Gash Turlough in May 1999 as part of the N18/N19 Ballycasey to Dromoland Road Improvement Scheme is consistent with this view.

This option would require a pipeline with an estimated length of 2.1 km.

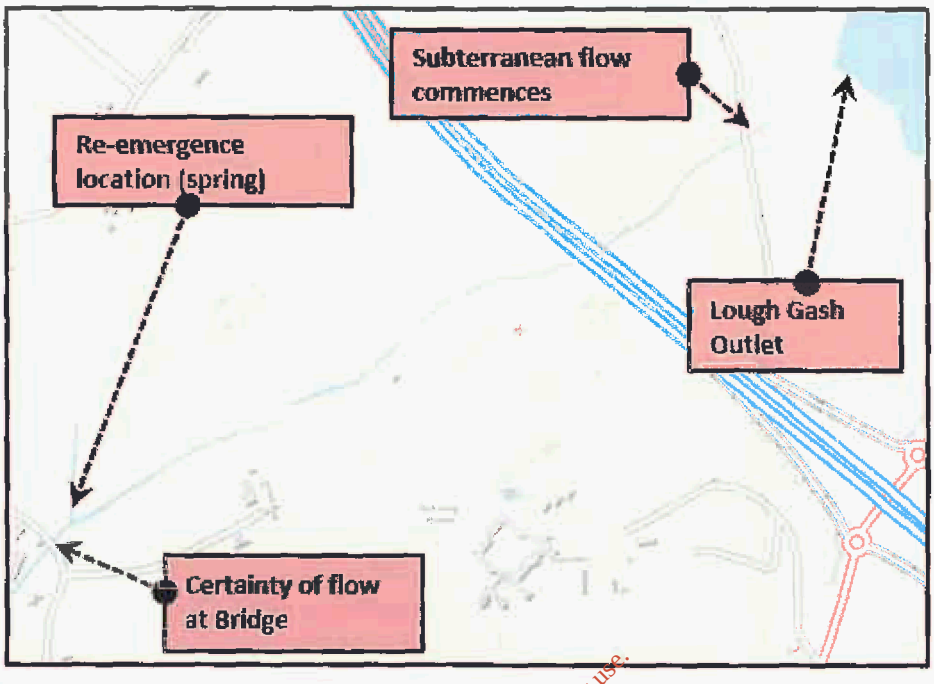

Figure 2.4: Map indicating re-emergence location of the subterranean stream [1]

The groundwater vulnerability is classified as "rock at or near surface or karst (extreme)". The nearest groundwater well is located approximately 0.7km southeast of the spring

The Flood Studies Update (FSU) web portal [15] contains an interactive application, which enabled the catchment area of the alternative receiving water location to be determined (see Appendix B for FSU report). A catchment area of 7.09km^2 for Lough Gash was calculated (Figure 2.5). The 50-percentile flow rate for this catchment is 0.116 m^3/s, which was obtained from flow duration curves for ungauged catchments (see Appendix B for full EPA report [18]). However, the existence of local conduit karst within this catchment could have an effect on the flow estimation [18].

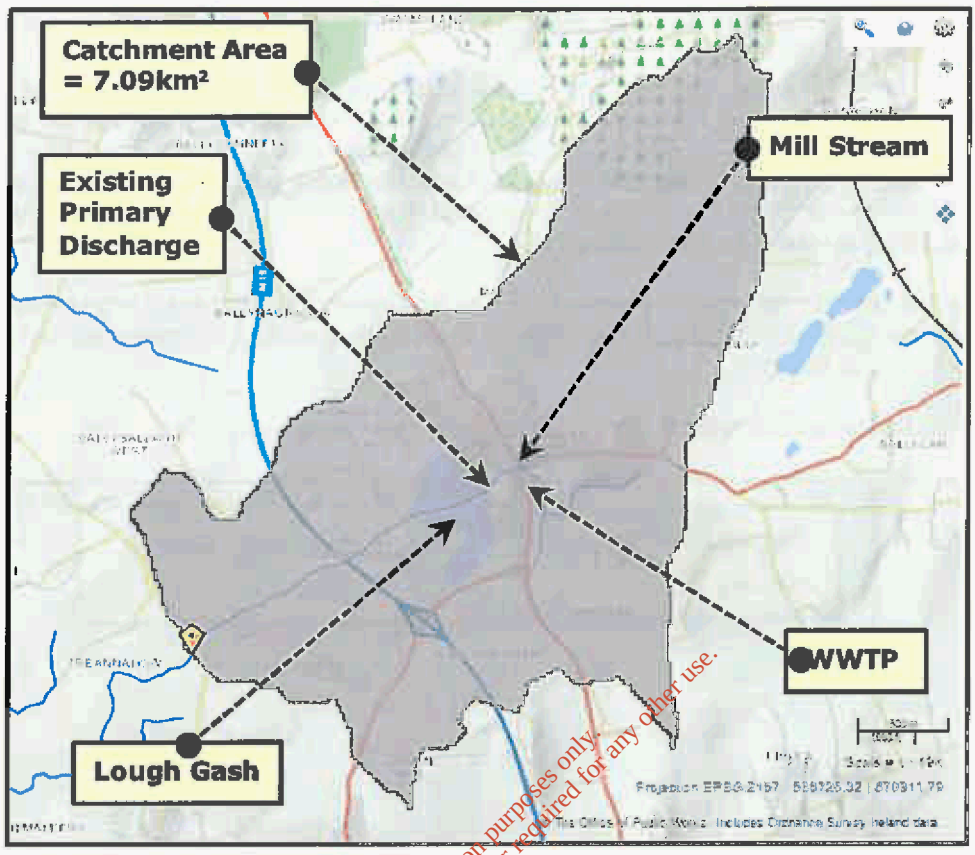

Figure 2.5: Catchment Map for the Treannahow Stream at the Alternative Primary Discharge Location [15]

2.4.4 Fergus Estuary

The Fergus Estuary is another option regarding alternative receiving water. The River Fergus discharges into the estuary with an average flow of 35 m^3/s [21]. The entire estuarine habitat (including the River Shannon Estuary) is a designated SAC, pNHA and SPA site. The estuary contains extensive areas of intertidal mudflats with peripheral reed beds, swamps, salt and wet marsh habitats.

Discharge to the estuary will ensure maximum dilution despite discharging to an SAC. The concerns regarding groundwater contamination will be avoided. However, there will be a considerable length of pipeline required to bring the discharge from the treatment works to this point.

This option would require a pipeline with an estimated length of 6.2 km.

2.4.5 Ballynacragga Stream

The Ballynacragga Stream is an alternative surface water option, which forms in the townland of Ballynacragga approximately 1km northwest of Lough Gash and discharges 2.2km downstream (approx.) to the Fergus Estuary.

Undifferentiated Visean limestones dominate the regional geology of the route of the Ballynacragga Stream. The groundwater vulnerability ranges from extreme to rock at or near surface or karst. Observation of the aquifer classification mapping indicates that the stream is in a regionally important aquifer – karstified (conduit). The closest

groundwater well is located approximately 2.4km to the northeast with a well accuracy of 1km.
The Ballynacragga Stream has a catchment area of 3.91km^2 (see Figure 2.6), calculated using the Flood Studies Update (FSU) web portal [15]. The 50-percentile flow rate for this catchment is 0.062 m^3/s, which was obtained from flow duration curves for ungauged catchments (see Appendix B for full FSU and EPA reports [15, 18]). However, the existence of local conduit karst within this catchment could have an effect on the flow estimation [18].

There are no recorded swallow holes in this area. Discharge to this stream would bypass Lough Gash SAC and discharge to surface waters and ultimately discharge to the Fergus Estuary.

This option would require a pipeline with an estimated length of 3.3 km.

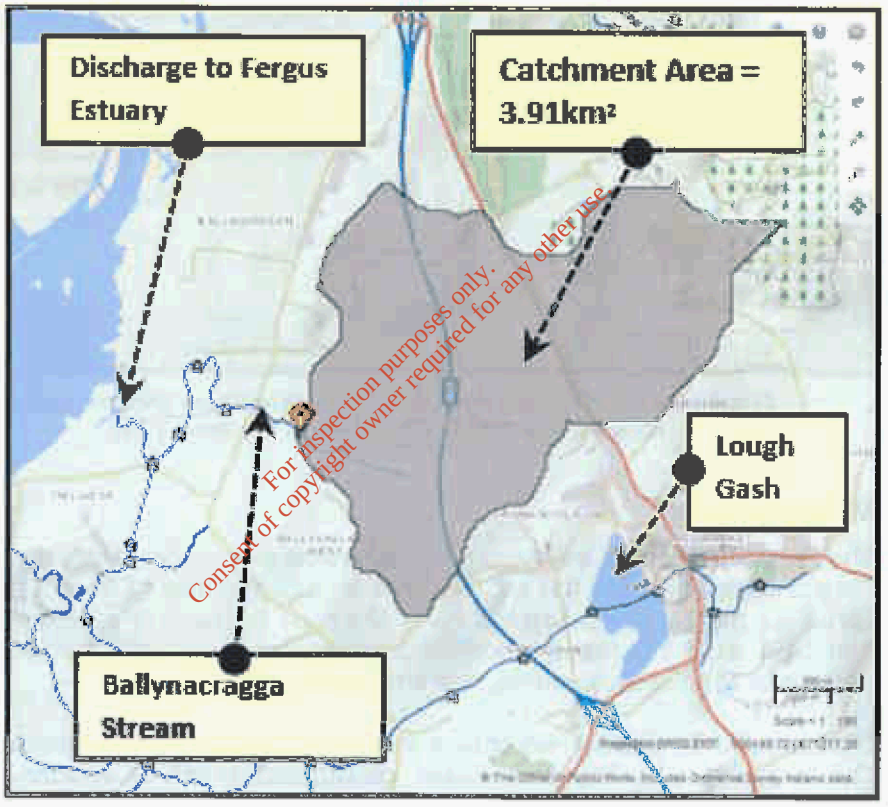

Figure 2.6: Map of Ballynacragga Stream Catchment [15]

2.4.6 Discharge to Groundwater via a Soil/Sand Polishing Filter

If a polishing filter is to be used to, percolate the treated effluent to ground then this can be achieved at best a rate of 60 litres/m^2. For a design PE Of 5000, this would require an area of almost 1.9 hectares. Regardless of site characteristics, this is not practical in our opinion. Such a filter has to be perfectly level and experience has shown this to be very difficult to achieve. In practice, the use of large percolation areas for small municipal treatment plants has proved to be problematic with individual experiences showing problems such as water logging and spill over at sides that are marginally lower than others are. For this reason, alone we would not recommend that the percolation option is viable.

2.4.7 Conclusion

This assessment evaluated six alternative options as discussed above regarding the primary discharge from the WWTP. The following options are not considered viable and are not considered any further.

1. Lough Gash
2. Lough Gash Man-Made Channel Outlet
3. Discharge to Groundwater via a Soil/Sand Polishing Filter

The alternative options to be considered further are:

1. Fergus Estuary
2. Treannahow Stream (discharges to the Fergus Estuary)
3. Ballynacragga Stream (discharges to the Fergus Estuary)

SECTION 3 – WATER QUALITY AND EFFLUENT STANDARDS

3.1 Introduction

The Water Framework Directive (WFD) and the Urban Waste Water Treatment Directive (UWWTD) are the primary references when setting effluent standards. The common primary objective of both directives is to ensure the protection of all waters from pollutants.

3.2 EPA Licence Application

Clare County Council submitted a Waste Water Discharge Authorisation application in 2008; however, the EPA has not issued a licence to date. The Newmarket-on-Fergus WWTP is understood to provide advanced secondary treatment for waste water from a population equivalent of 5,000. The WWTP should be capable of producing the following effluent requirements based on the treatment capabilities of the plant.

Table 3.1: Wastewater Discharge Requirements [22]

Parameters	Concentrations	Minimum Percentage of Reduction
Biochemical Oxygen Demand (BOD5 at 20° C) without nitrification (2)	25 mg/l O_2	70 - 90
Chemical oxygen demand (COD)	125 mg/l O2	75
Total suspended solids	35 mg/l	90
Total Phosphorus*	2 mg/l	80
Total Nitrogen*	15 mg/l	70 - 80

**** 10,000 to 100,000 p.e***

3.3 Water Quality

3.3.1 Introduction

EPA ecologists survey and assess approximately one third of Ireland's principal rivers and their associated more important tributaries annually, which complies with the Water Framework Directive (WFD) Monitoring Programme. The results of the most current biological surveys are available as interactive maps on the EPA website [18]. Once EPA biologists conduct surveys, these maps are updated accordingly.

The Water Framework Directive Ireland website [17] contains the Water Maps mapping information system, which supports the River Basin Management Plan documentation in relation to Ireland's River Basin Districts. This information identifies the status, risks, objectives and measures of a waterbody (defined in Table 2.1).

The water quality status, risk objectives and measures for the existing and alternative receiving waters are summarised in Table 3.2 and presented visually in the form of extracts from the WFD water maps (Appendix C).

Table 3.2: Water Framework Directive Status, Risk, Objectives and measures for the Treannahow Stream Catchment and the Fergus Estuary [17]

Criteria	Surface Water & Turlough Options	Fergus Estuary
Status	High	Moderate
Risk	1a – At risk of not achieving Good Status	2b – Strongly expected to achieve Good Status
Objectives	Protect	Restore - 2015
Measures	**Applicable Directives:** • Habitats Directive • Major Accidents and Emergencies Directive • Environmental Impact Assessment Directive • Sewage Sludge Directive • Urban Waste Water Treatment Directive • Plant Protection Products Directive • Nitrates Directive • Integrated Pollution Prevention Control Directive **Other Stipulated Measures:** • Cost recovery for water use • Promotion of efficient and sustainable water use • Protection of drinking water sources • Control of abstraction and impoundment • Control of point source discharges • Control of diffuse source discharges • Control of priority substances • Controls on physical modifications to surface waters • Controls on other activities impacting on water status • Prevention or reduction of the impact of accidental pollution incident **WSIP:** • Agglomerations with treatment plants requiring capital works • Agglomerations with treatment plants requiring improved operational performance **Miscellaneous:** • On-site waste water treatment systems • Forestry guidelines and regulations • Chanelisation investigations • Protect high quality waters	**Applicable Directives:** • Birds Directive • Habitats Directive • Major Accidents and Emergencies Directive • Environmental Impact Assessment Directive • Sewage Sludge Directive • Urban Waste Water Treatment Directive • Plant Protection Products Directive • Nitrates Directive • Integrated Pollution Prevention Control Directive **Other Stipulated Measures:** • Control of point source discharges • Control of diffuse source discharges • Control of priority substances • Controls on physical modifications to surface waters • Controls on other activities impacting on water status • Prevention or reduction of the impact of accidental pollution incident **WSIP:** • Agglomerations with treatment plants requiring capital works • Agglomerations with treatment plants requiring improved operational performance **Miscellaneous:** • On-site waste water treatment systems • IPPC licences requiring review

3.4 Alternative Options – Treatment Standards

This section briefly describes some alternative treatment options (advanced secondary, disinfection, tertiary and near surface water quality) and their associated wastewater discharge requirements.

3.4.1 Fergus Estuary

Secondary treatment standard is appropriate for discharging treated effluent directly to the Fergus Estuary assuming that no disinfection is required. The nearest live Bivalve Mollusc (shellfish) classified production area is located in the Shannon Estuary adjacent to Askeaton, Co. Limerick, approximately 13 km downstream of the Fergus Estuary.

Similarly there are also no local bathing waters identified and so disinfection requirement for this reason either.

On this basis and for the purposes of this assessment, it is presumed that the existing discharge standard would be appropriate for this location.

3.4.2 Treannahow and Ballynacragga Streams

The EPA hydrometric data website [18] estimates the different percentile flows for the Treannahow and Ballynacragga Streams as follows:

- The Treannahow stream has a 50%ile flow of 116 l/s and a 95%ile flow of between 145 and 92 l/s, which suggests a potential figure of 118.5 l/s.
- The Ballynacragga stream has a 50%ile flow of 62 l/s and a 95%ile flow of between 77 and 49 l/s, which suggests a potential figure of 63 l/s.

A 5,000 PE effluent discharge, which assuming a flowrate of 225 l/hd/day, would result in an average flow of 13 l/s and a peak flow of 39 l/s, would be too large to permit an effluent standard of 25/35 BOD/SS. It is probable that a 10/10 BOD/SS standard with nutrient reduction would be suitable for the Trennahow stream, subject to more detailed assessment of the background water quality. However it is unlikely that such a standard would be appropriate for the Ballynacragga stream and a 5/5 BOD/SS or better, being near surface water quality, will be necessary to permit a discharge.

In addition it should be noted that the local karst environment creates a significant doubt over the reliability of these figures, particularly the Trennahow stream. As a consequence while a tertiary treatment process, such as filtration may be considered appropriate for these discharges the possibility exists that a higher near surface water quality will be required.

The term near surface water quality is being used to reflect difficulties with the generally preferred parameters used for the assessment of waste water effluents, as treatment standards become more onerous.

The following particular comments are pertinent to the parameters typically used for waste water effluents.

- ***BOD_5 & Suspended Solids***

The selection of a standard for these parameters is typically limited to 5/5 (BOD/SS) primarily due to the difficulties associated with the measurement of the parameters and potential sampling errors. Standard Methods for the Examination of Water and Waste Water advises that the limit of detection for BOD_5 (Method 5210B) is 2 mg/l

and also raises concerns regarding the standard deviation error in measuring suspended solids (Method 2540D), which would be a factor at these low levels.

BOD5 and Suspended Solids have traditionally been recognised as the main parameters for assessing treated effluents. However it is difficult to obtain performance guarantees below the 5/5 level due to concerns about sampling errors at low levels. The standard selected can thus be considered to be more reflective of the reliability of the sampling and measurement process for these parameters rather than the performance of the process.

Parameters such as turbidity may in the future become more commonplace for use with high quality effluents, but at this juncture the use of BOD/SS requires the selection of standards which can be guaranteed from a performance perspective, without being subject to the potential errors inherent in the parameters.

- ***Nitrogen and Phosphorous***

The standards for nitrogen and phosphorous are assessed to consider the tendancy of the receiving water towards eutrophication. Eutrophication in a water body is controlled by the amount of nutrients present particularly nitrogen, N, and phosphorous, P. The primary concern in this instance is the impact on the Fergus Estuary, which is currently classified by the EPA as unpolluted. Standards of 10mg/l of total nitrogen and 1 mg/l of total phosphorous are assumed to be appropriate pending more detailed water quality assessments.

The effluent standards that are estimated as applying are detailed in tables 3.3 and 3.4 below, depending upon whether a tertiary standard is acceptable, or whether a higher standard is required.

Table 3.3: Tertiary treatment discharge standards

Parameters	Concentrations
Biochemical Oxygen Demand (BOD5 at 20° C)	10 mg/l O_2
Total suspended solids	10 mg/l
Total Phosphorus*	1 mg/l
Total Nitrogen*	10 mg/l

Table 3.4: Near surface water quality discharge standards

Parameters	Concentrations
Biochemical Oxygen Demand (BOD5 at 20° C)	5 mg/l O_2
Total suspended solids	5 mg/l
Total Phosphorus*	1mg/l
Total Nitrogen*	10 mg/l

3.4.3 Mill Stream / Lough Gash

There are no reported impacts on the environment as a result of the existing treatment plant at Lough Gash, however the Tier 3 risk assessment recommended a monitoring programme and that further data be collected. In the event that an impact is established, then a discharge to the Mill stream can be expected to be required to achieve, either a tertiary standard or higher, similar to the standards discussed earlier and shown in tables 3.3 and 3.4 above.

3.5 Impact Mitigation (Secondary Discharge)

An impact from the existing discharges into the Mill Stream and Lough Gash, being established by further monitoring of water quality, will also possibly require further mitigation of the impact of the secondary discharge.

The existing discharge is mitigated by the following processes:

- Screening
- Flow Balancing
- Sedimentation / Baffling of Overflow

Further mitigation that might additionally be required to protect water quality would include:

- Additonal Flow Balancing
- Natural Wastewater Treatment System

SECTION 4 – COST ESTIMATION

4.1 Comparison of Options

In the event that there is found to be an impact on the existing discharge environment and the mitigation of that impact requires an alternative discharge location, or a higher treatment standard, then additional infrastructure will be required.

An initial estimation of the capital costs involved in the provision of this infrastructure is as follows:

• Provision of additional tertiary treatment system	€500,000
• Provision of natural wetland system (excluding land)	€1,500,000
• Provision of membrane bioreactor	€3,000,000
• Provision of 2.1km pipeline to Trennahow stream	€720,000
• Provision of 3.3km pipeline to Ballynacragga stream	€960,000
• Provision of 6.2km pipeline to Fergus Estuary	€1,650,000

All figures are nett excluding VAT.

Pipeline costs assume a requirement for pumping of final effluent and include an estimate of €250,000 for provision of a pipeline under the M18 motorway.

Additionally it should be noted that a detailed assessment, including site investigations, of the potential alternative solutions would be required to fully assess the feasibility and develop budgets for any of these options.

SECTION 5 – CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion & Recommendation

The Tier 3 hydrogeological assessment of the impact of the existing waste water discharge has not found any negative impact, but recommends further data gathering.

In the absence of any negative impact the existing discharge arrangement should be retained.

In the event that a negative impact is subsequently discovered then the following options, listed in order of preference, should be examined in further detail.

1. Provision of a higher level of treatment at the existing location, comprising tertiary filtration, while retaining the existing discharge location. The capital cost for this option will be in the order of €500,000, nett excluding VAT.

2. Provision of a higher level of treatment at the existing location, comprising tertiary filtration, with a subsequent discharge to the Trennahow stream. The capital cost for this option will be in the order of €970,000, nett excluding VAT.

3. Provision of a higher level of treatment at the existing location, with a discharge to the existing location, such alternative treatment options to be considered comprise

    a. Membrane Bioreactor
    b. Natural Waste Water System

    These options may ultimately prove not to be economically viable.

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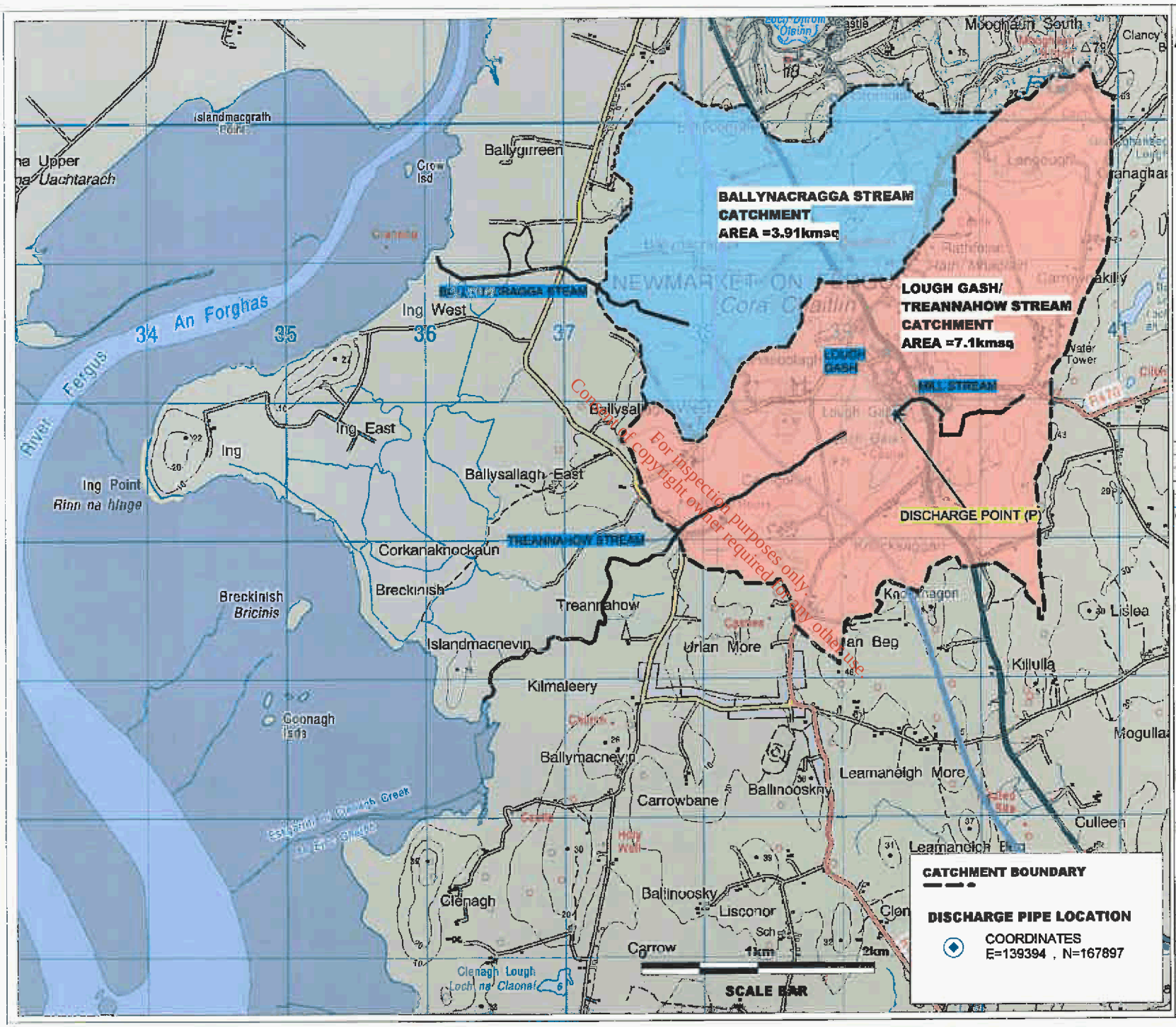
APPENDIX A – SITE LOCATION MAPPING



NOTES

Figured dimensions only to be taken from this drawing
All dimensions to be checked on site.

Ordnance Survey Ireland
Licence No. EN0003014

All maps are referenced to
IRISH NATIONAL GRID (I.N.G)

Rev:	Description:	Drawn:	Ch'kd:	Date:
A	INITIAL ISSUE	UF	DF	NOV'14

Client: Irish Water
Colvill House
24-26 Talbot Street
Dublin 1
Tel.: 1890 278 278
Intl.: +353-1-707 2828
Email: info@water.ie
Web: www.water.ie

UISCE ÉIREANN IRISH WATER

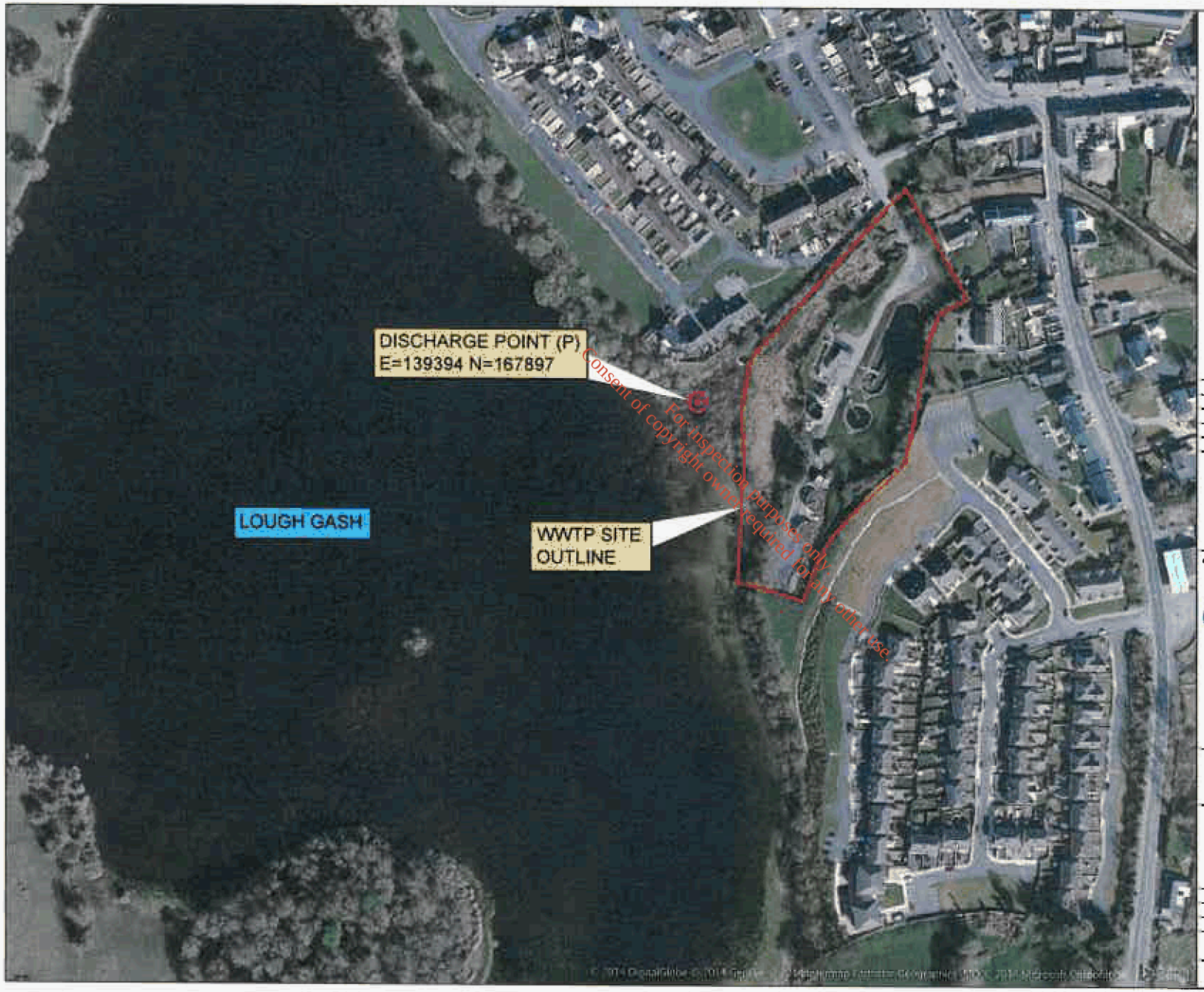
Client Representative:

BARRY & PARTNERS
consulting engineers
Classon House, Dundrum Business Park, Dundrum Road, Dublin 14 Ireland
tel +353 1 485 1400
web www.jbbarry.ie
email info@jbbarry.ie

Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

Drawing Title: Location Overview & Surface Water Catchments

Drawn By:	FN	Date:	NOV.2014
Checked By:	DF	Date:	NOV.2014
Approved By:	GB	Date:	NOV.2014
Scales:	N.T.S		
Drawing No.	Figure 1	Revision:	A



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Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

Drawing Title: Waste Water Treatment Plant Location

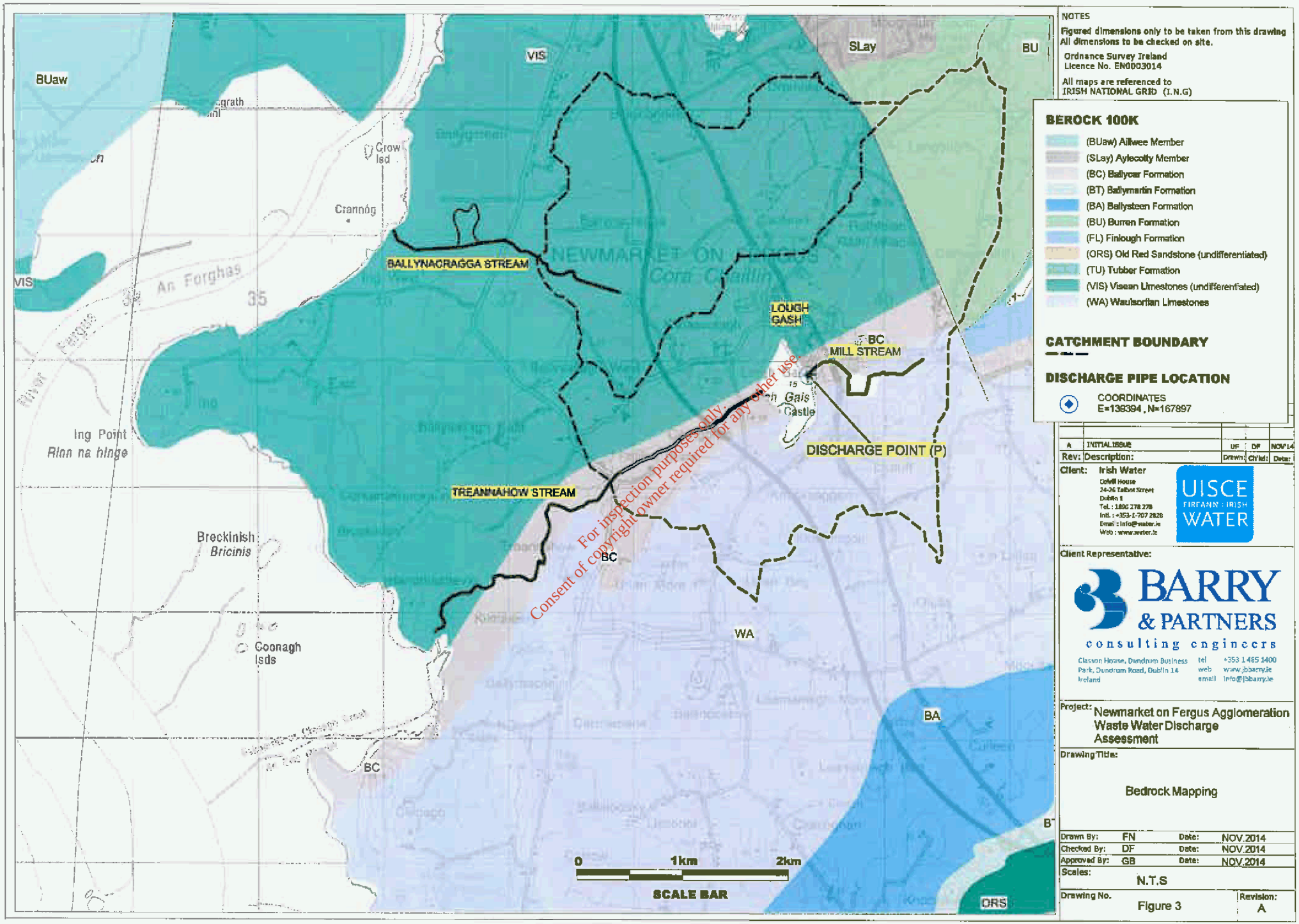
Drawn by :	UF	Date :	NOV.2014
Checked by :	DF	Date :	NOV.2014
Approved by :	GB	Date :	NOV.2014

Scale : 1:2000 @A3

Drawing No. : FIGURE 2

Revision A

APPENDIX B – IDENTIFICATION OF EXISTING AND ALTERNATIVE RECEIVING WATERS



NOTES

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All dimensions to be checked on site.

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All maps are referenced to
IRISH NATIONAL GRID (I.N.G)

BEROCK 100K

- (BUaw) Ailwee Member
- (SLay) Aylecotty Member
- (BC) Ballycar Formation
- (BT) Ballymartin Formation
- (BA) Ballysteen Formation
- (BU) Burren Formation
- (FL) Finlough Formation
- (ORS) Old Red Sandstone (undifferentiated)
- (TU) Tubber Formation
- (VIS) Visean Limestones (undifferentiated)
- (WA) Waulsortian Limestones

CATCHMENT BOUNDARY

DISCHARGE PIPE LOCATION

COORDINATES
E=139394 , N=167897

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email info@jbarry.ie

Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

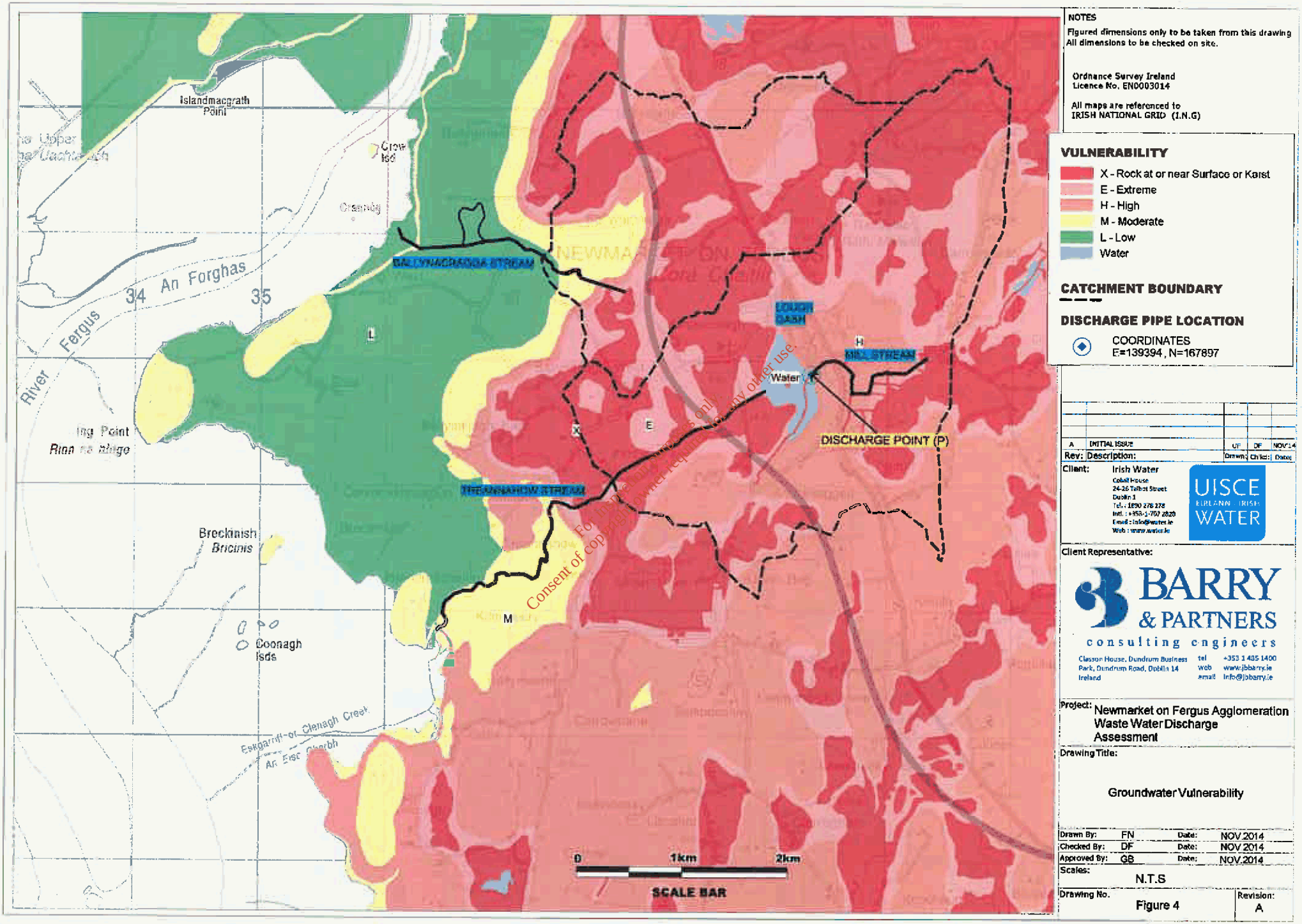
Drawing Title: Bedrock Mapping

Drawn By:	FN	Date:	NOV.2014
Checked By:	DF	Date:	NOV.2014
Approved By:	GB	Date:	NOV.2014

Scales: N.T.S

Drawing No.: Figure 3

Revision: A



NOTES

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All maps are referenced to
IRISH NATIONAL GRID (I.N.G)

VULNERABILITY

- X - Rock at or near Surface or Karst
- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water

CATCHMENT BOUNDARY

DISCHARGE PIPE LOCATION

COORDINATES
E=139394 , N=167897

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Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

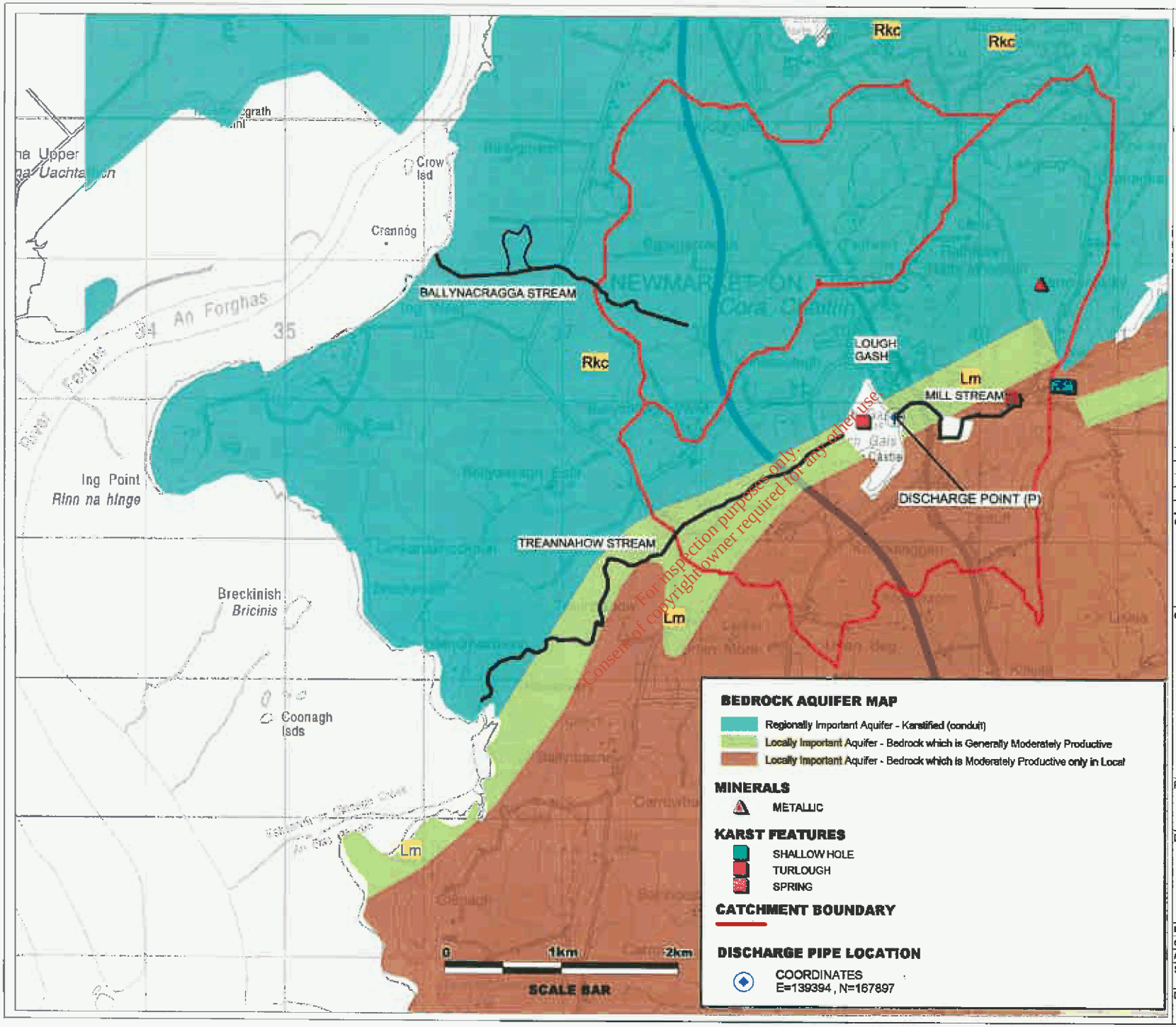
Drawing Title: Groundwater Vulnerability

Drawn By:	FN	Date:	NOV 2014
Checked By:	DF	Date:	NOV 2014
Approved By:	GB	Date:	NOV 2014

Scales: N.T.S

Drawing No. Figure 4

Revision: A



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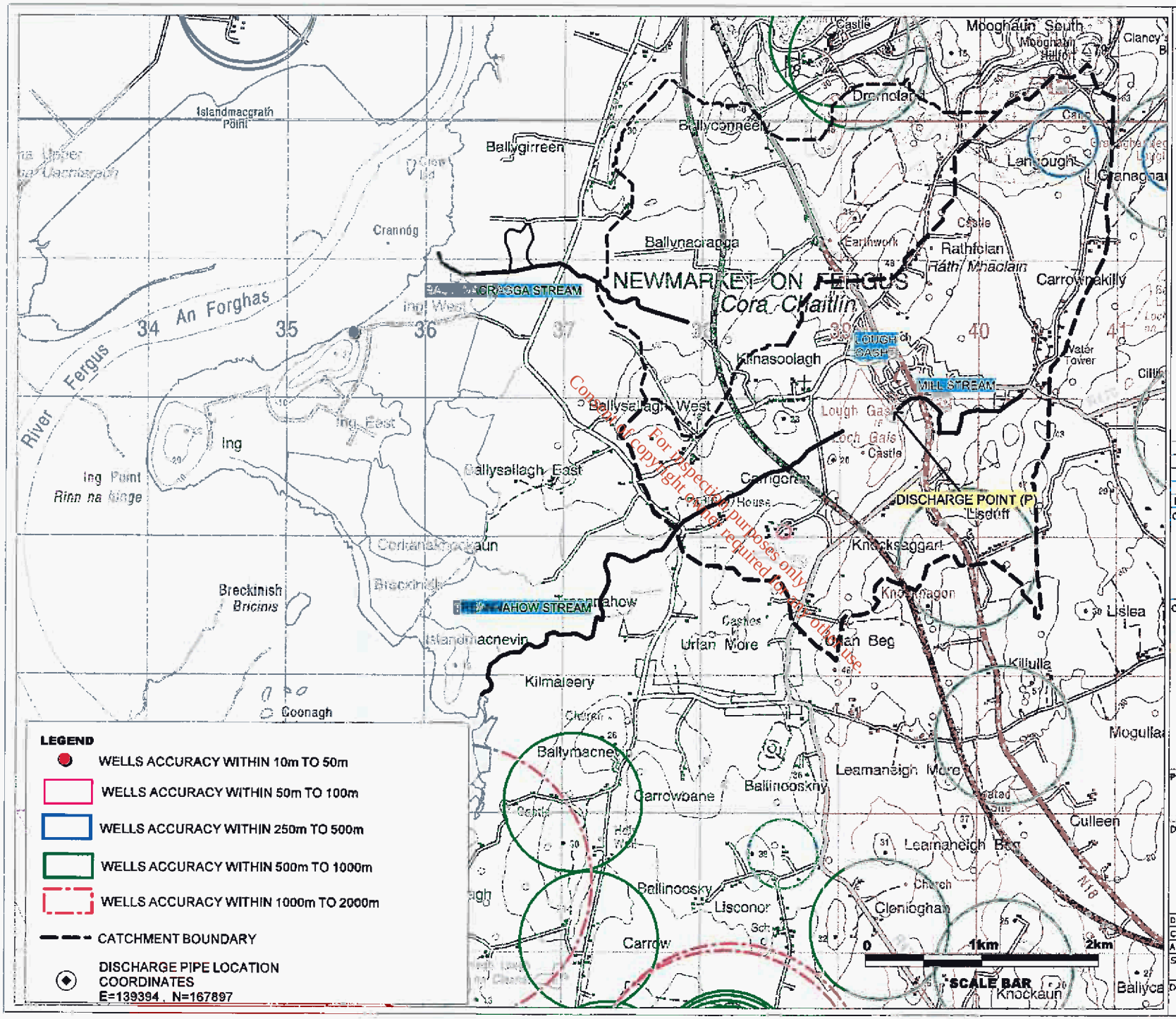
email info@jbbarry.ie

Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

Drawing Title: Aquifer Classification & Karst Features

Drawn By:	FN	Date:	NOV.2014
Checked By:	DF	Date:	NOV.2014
Approved By:	GB	Date:	NOV.2014
Scales:	N.T.S		
Drawing No.	Figure 5	Revision:	A



LEGEND

- WELLS ACCURACY WITHIN 10m TO 50m
- WELLS ACCURACY WITHIN 50m TO 100m
- WELLS ACCURACY WITHIN 250m TO 500m
- WELLS ACCURACY WITHIN 500m TO 1000m
- WELLS ACCURACY WITHIN 1000m TO 2000m
- CATCHMENT BOUNDARY
- DISCHARGE PIPE LOCATION COORDINATES E=139394 , N=167897

NOTES

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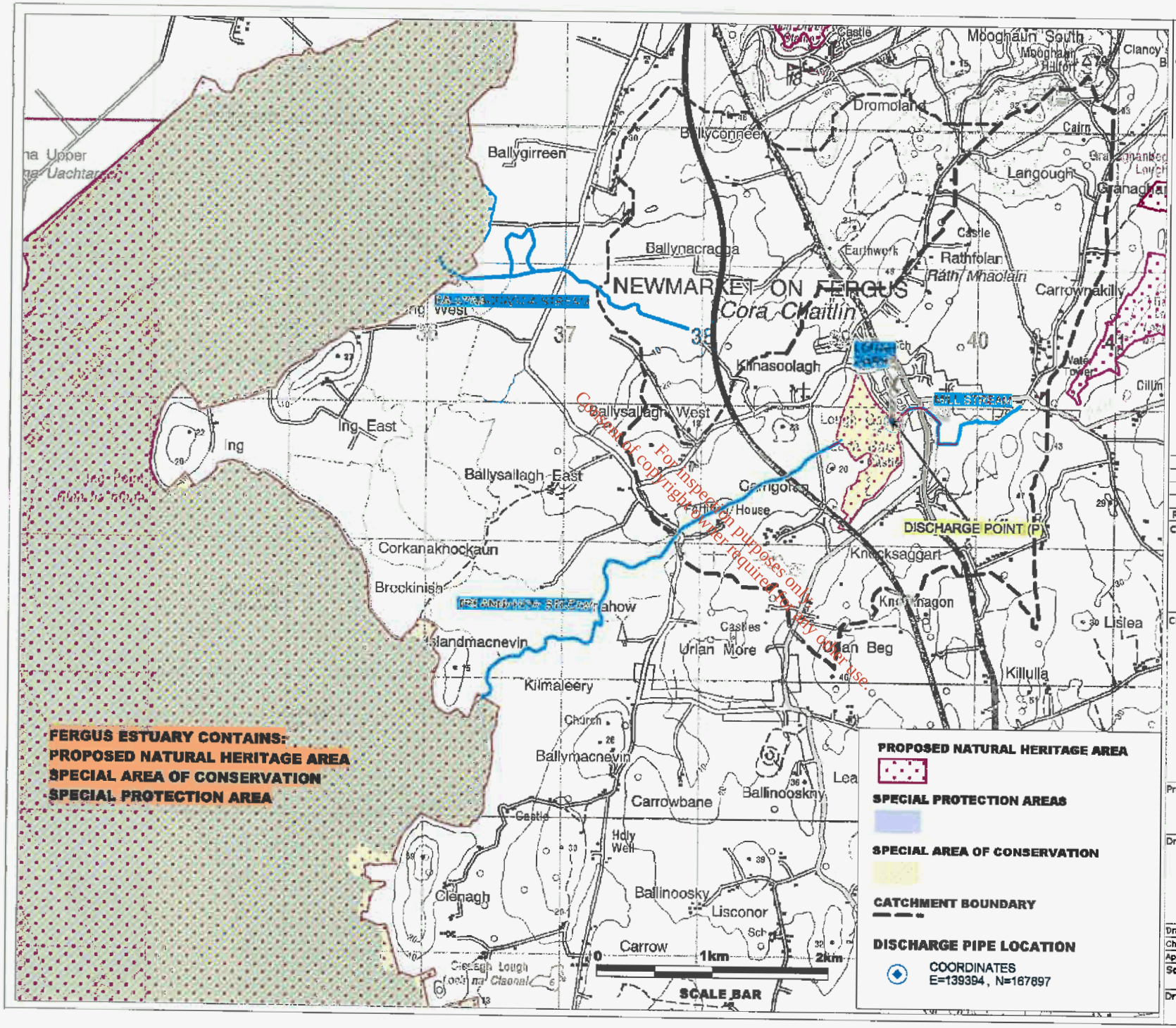
Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

Drawing Title: Groundwater Wells

Drawn By:	FN	Date:	NOV.2014
Checked By:	DF	Date:	NOV.2014
Approved By:	GB	Date:	NOV.2014
Scales:	N.T.S		
Drawing No.	Figure 6	Revision:	A



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Licence No. EN0003014

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email info@jbbarry.ie

Project: Newmarket on Fergus Agglomeration Waste Water Discharge Assessment

Drawing Title: Environmental Designations

Drawn By:	FN	Date:	NOV.2014
Checked By:	DF	Date:	NOV.2014
Approved By:	GB	Date:	NOV.2014
Scales:	N.T.S		
Drawing No.	Figure 7	Revision:	A

APPENDIX C – FSU CATCHMENT & EPA FLOW DURATION CURVE REPORTS

Flood Estimation Report #1257 (Lough Gash Catchment Analysis)

OPW
The Office of Public Works
Oifig na nOibreacha Poibli

Generated 21-11-2014 07:42

Subject site

Attributes

Name	Unit	Value
Coordinate [X]		538960.696060481
Coordinate [Y]		667794.594859828
Distance	km	402.920070577083
Station Number		27_273_1
Location		
Water Body		
Catchment		
Hydrometric Area		
Organisation		
FSU Rating Classification		
Drainage works	year	
Contributing Catchment Area	km^2	4.863
Center Northing	m	168430
Center Easting	m	139780
Northing	m	167753
Easting	m	138997
A-Max series gap in years	year	
A-Max series number of years	year	
A-Max series number of usable years	year	
A-Max series end year	year	
A-Max series start year	year	
FARL		0.802
ALLUV		0
PEAT		0
FOREST		0.0837
PASTURE		0.7215
S1085	m/km	0.60856
MSL	km	1.715
DRAIND	km/km^2	0.423
ALTBAR		30.5
NETLEN	km	2.055
T4		
T3		

SAAPE	mm	551.62
T2		
ARTDRAIN2		0
ARTDRAIN		0
TAYSLO		0.757259
STMFRQ		5
BFISOIL		0.755532524
SAAR	mm	1046.76
RWSEG_CD		27_273
TOP_RWSEG		
Bankfull		
HGF	m^3/s	
MAF	m^3/s	
FAI		0.1096
FLATWET		0.6
URBEXT		0.1441
HGF/QMED		

Map

Audit Trail Report #1257 (Lough Gash Catchment Analysis)

User ID:	dfallon@jbbarry.ie
Name:	Fallon, David
Company:	J. B. Barry and Partners Limited
Address:	
Report date & time:	21-11-2014 07:42
Start of Calculation:	21-11-2014 08:40

Decisions made by the user:

Decision	User comment	System information	Date

Flood Estimation Report #1255 (Treannahow Stream Catchment Analysis)

Generated 20-11-2014 18:50

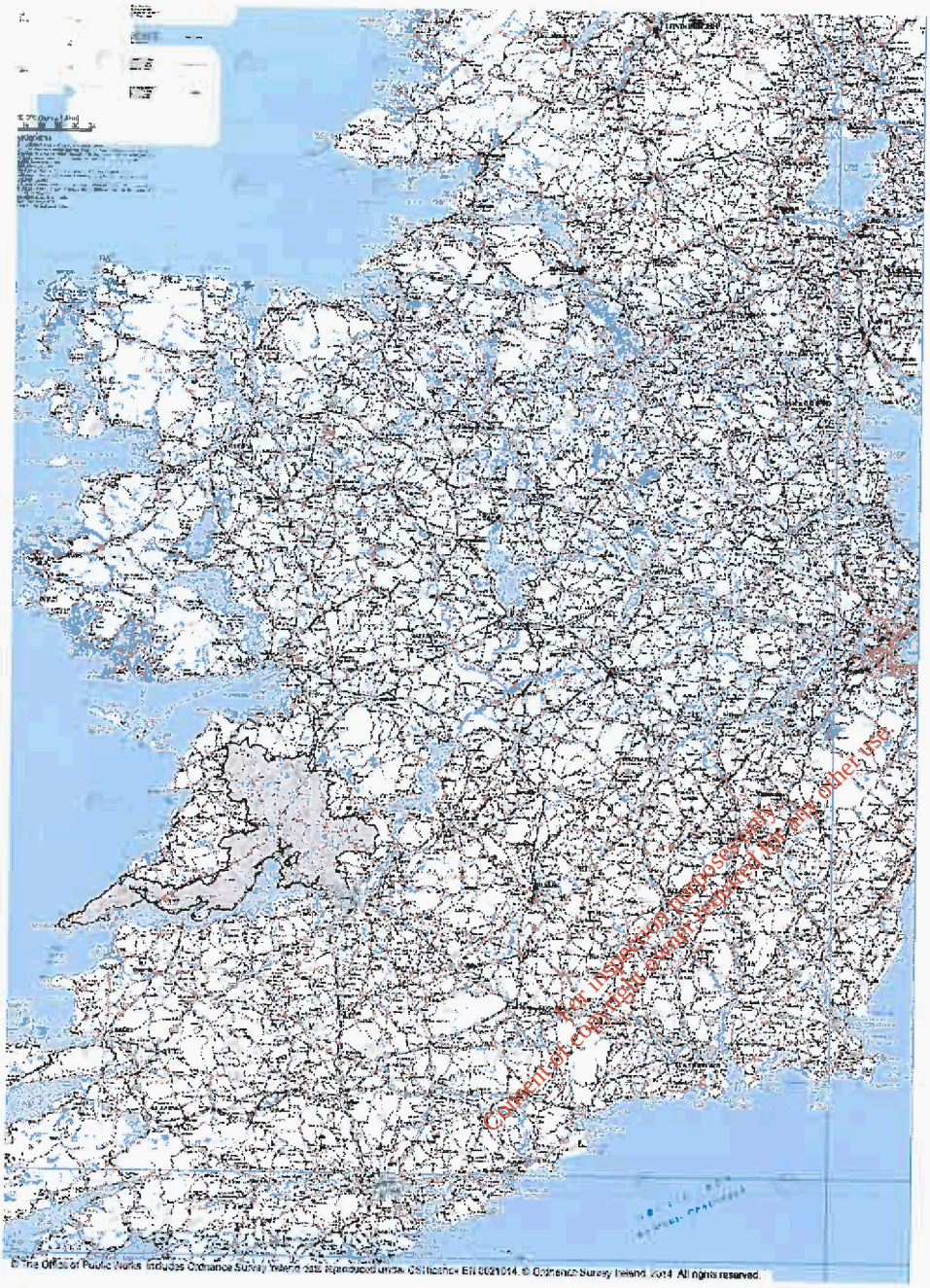
Subject site

Attributes

Name	Unit	Value
Coordinate [X]		537726.954999704
Coordinate [Y]		667008.772374556
Distance	km	5.2709960122519
Station Number		27_273_4
Location		
Water Body		
Catchment		
Hydrometric Area		
Organisation		
FSU Rating Classification		
Drainage works	year	
Contributing Catchment Area	km^2	7.091
Center Northing	m	168260
Center Easting	m	139190
Northing	m	166967
Easting	m	137763
A-Max series gap in years	year	
A-Max series number of years	year	
A-Max series number of usable years	year	
A-Max series end year	year	
A-Max series start year	year	
FARL		0.859
ALLUV		0
PEAT		0
FOREST		0.0753
PASTURE		0.7659
S1085	m/km	4.47155
MSL	km	3.216
DRAIND	km/km^2	0.502
ALTBAR		27.5
NETLEN	km	3.557
T4		

T3		
SAAPE	mm	551.64
T2		
ARTDRAIN2		0
ARTDRAIN		0
TAYSLO		0.663552
STMFRQ		5
BFISOIL		0.709300251
SAAR	mm	1047.58
RWSEG_CD		27_273
TOP_RWSEG		
Bankfull		
HGF	m^3/s	
MAF	m^3/s	
FAI		0.1174
FLATWET		0.6
URBEXT		0.0988
HGF/QMED		

Map



Amax Series Chart

Could not generate Amax chart, no Amax data available

QMED Estimates

QMED Estimates are not available for this report because module 2 was not finished.

Pooling Group

The pooling group is not available for this report because the group was not accepted.

Audit Trail Report #1255 (Treannahow Stream Catchment Analysis)

OPW
The Office of Public Works
Oifig na nOibreacha Poiblí

User ID:	dfallon@jbbarry.ie
Name:	Fallon, David
Company:	J. B. Barry and Partners Limited
Address:	
Report date & time:	20-11-2014 18:50
Start of Calculation:	20-11-2014 19:24

Decisions made by the user:

Decision	User comment	System information	Date

Flood Estimation Report #1256 (Ballynacragga Catchment Analysis)

OPW
The Office of Public Works
Oifig na nOibreacha Poibli

Generated 21-11-2014 07:51

Subject site

Attributes

Name	Unit	Value
Coordinate [X]		537230.075934003
Coordinate [Y]		668847.375921658
Distance	km	13.3438436354757
Station Number		27_784_1
Location		
Water Body		
Catchment		
Hydrometric Area		
Organisation		
FSU Rating Classification		
Drainage works	year	
Contributing Catchment Area	km^2	3.906
Center Northing	m	169010
Center Easting	m	138680
Northing	m	168806
Easting	m	137266
A-Max series gap in years	year	
A-Max series number of years	year	
A-Max series number of usable years	year	
A-Max series end year	year	
A-Max series start year	year	
FARL		1
ALLUV		0
PEAT		0
FOREST		0.0455
PASTURE		0.8797
S1085	m/km	2.4836
MSL	km	0.761
DRAIND	km/km^2	0.195
ALTBAR		21.7
NETLEN	km	0.761
T4		
T3		

SAAPE	mm	551.29
T2		
ARTDRAIN2		1
ARTDRAIN		0
TAYSLO		0.28123
STMFRQ		1
BFISOIL		0.662464691
SAAR	mm	1076.32
RWSEG_CD		27_784
TOP_RWSEG		
Bankfull		
HGF	m^3/s	
MAF	m^3/s	
FAI		0.0438
FLATWET		0.6
URBEXT		0.0173
HGF/QMED		

Map

Audit Trail Report #1256 (Ballynacragga Catchment Analysis)

OPW
The Office of Public Works
Oifig na nOibreacha Poiblí

User ID:	dfallon@jbbarry.ie
Name:	Fallon, David
Company:	J. B. Barry and Partners Limited
Address:	
Report date & time:	21-11-2014 07:51
Start of Calculation:	20-11-2014 19:53

Decisions made by the user:

Decision	User comment	System information	Date

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BOHERAROAN(27_273)
XY Location	138967,167724 (ING)

River Segment Map

Disclaimer
The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

Environmental Protection Agency

Disclaimer

The source of hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

The user should familiarise himself/herself with the catchment being studied and confirm that the ungauged site is in a natural catchment where flows conditions are suitable for the use of the model.

It is strongly recommended that the user examine the catchment descriptors contained in the report produced and confirm that the percentages of the various constituent elements are comparable to a natural catchment.

If the flow in a catchment is not entirely natural, the estimation of flows using the model in these catchments could be affected due to:

- existence of local conduit karst within the catchment;
- the selected location itself is on local conduit karst;
- regulation of the river flow on the river channel (e.g. power station, sluice gates etc)
- impacts of abstractions upstream of the selected location or the impact of the discharge associated with the abstraction into the same/different catchment;
- estimates of flow being sought at locations effected by storage effects at, or near, lake outfalls;
- lack of similar catchments with observed flows, ie where catchment descriptors lie outside the range of available gauging station catchments (e.g. the catchment area is under 5 km²);
- any other special circumstances that may affect river flows.

Expert judgement will be required to ensure that the estimate of flow is not unduly affected by any of these influences.

Please note that the model does not provide estimates of flood peaks and, specifically, should not be used for that purpose.

The EPA has also prepared estimates of DWF and long term 95 percentile flows which are also presented on the EPA web site. These data are presented at http://www.epa.ie/whatwedo/monitoring/water/hydrometrics/data/

The data produced by the model for specific stations should be compared to the data contained in this file of DWF and long term 95percentile flows.

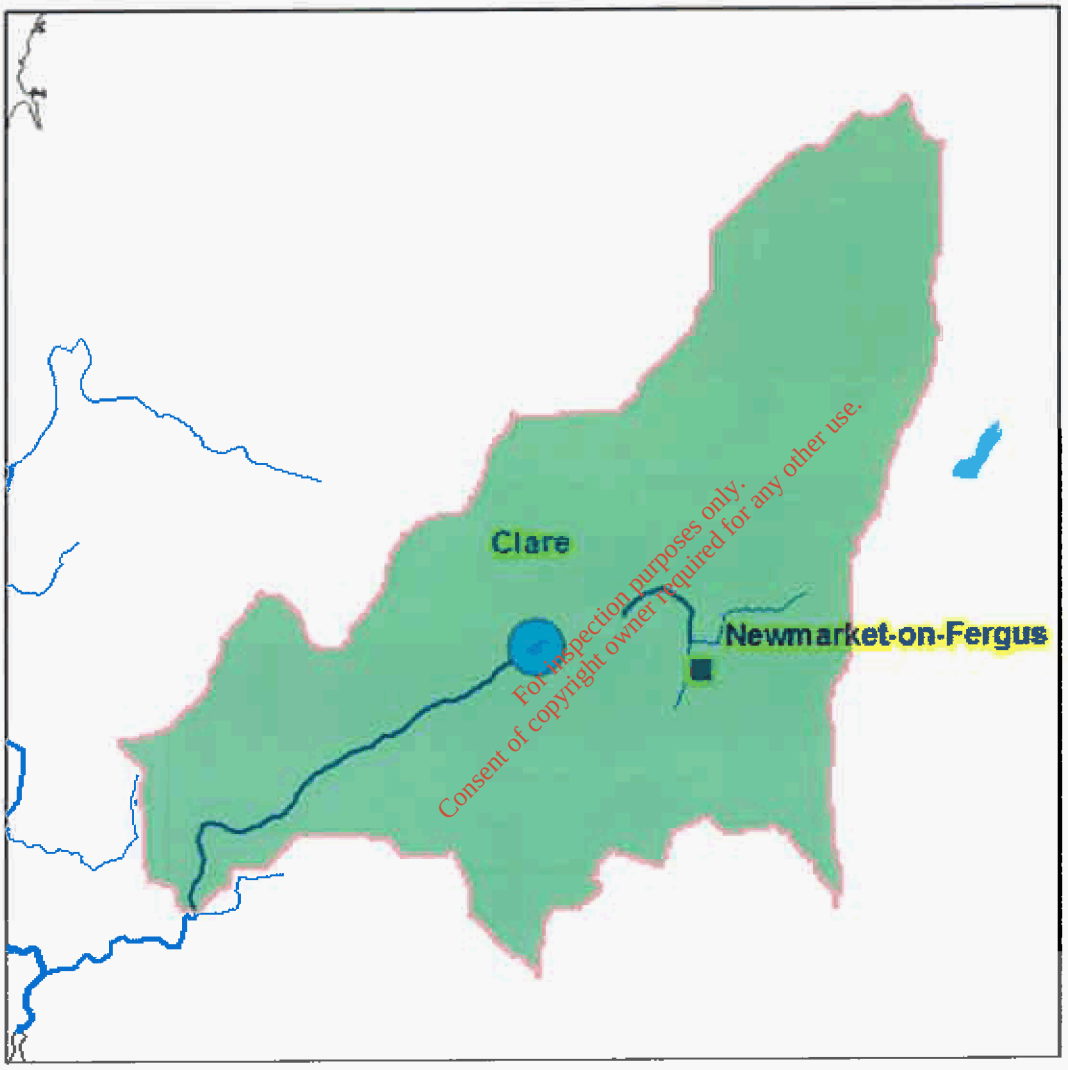
Disclaimer
The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BOHERAROAN(27_273)
XY Location	138967,167724 (ING)

Nested Catchment Map



Disclaimer
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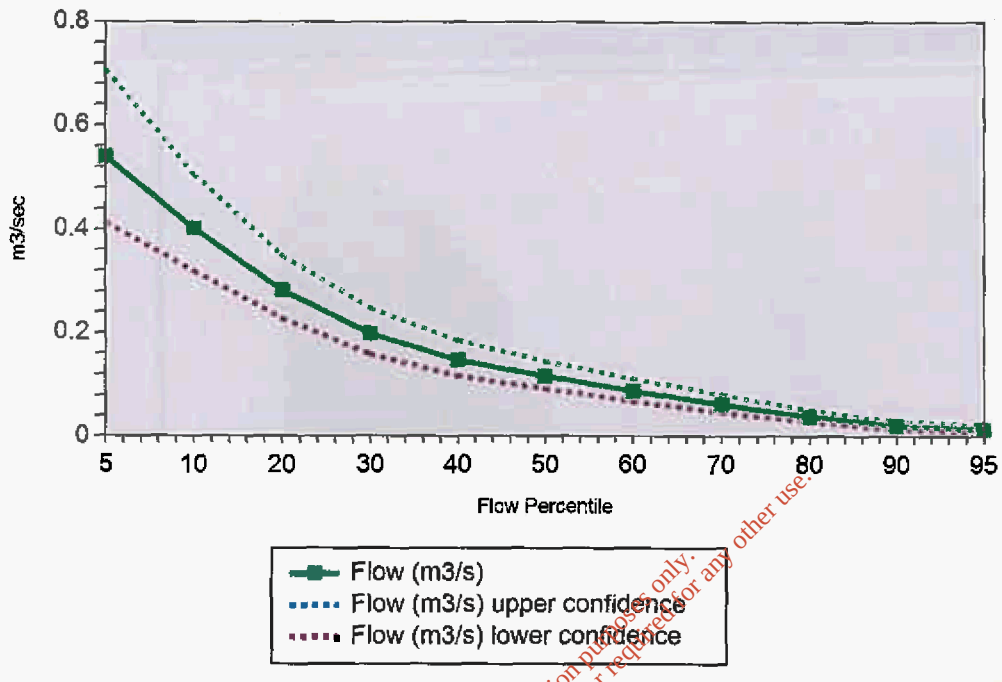
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (Flow in m3/sec)



%ile	flow(m3/sec)	upper 95% confidence limit m3/sec	lower 95% confidence limit m3/sec
5	0.54	0.707	0.413
10	0.401	0.506	0.319
20	0.282	0.349	0.228
30	0.198	0.247	0.159
40	0.147	0.185	0.117
50	0.116	0.145	0.092
60	0.088	0.112	0.069
70	0.062	0.081	0.047
80	0.038	0.051	0.029
90	0.021	0.029	0.015
95	0.014	0.022	0.01

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Catchment Descriptors		
General		
Descriptor	Unit	Value
Area	sq km	7.7
Average Annual Rainfall (61-90)	mm/yr	1012
Stream Length	km	4.5
Drainage Density	Channel length (km)/catchment area (sqkm)	0.6
Slope	Percent Slope	3.1
FARL	Index (range 0:1)	0.9

Soil	
Code	% of Catchment
Poorly Drained	7.8
Well Drained	77.9
Alluvmin	0
Peat	5.9
Water	2.5
Made	5.9

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Subsoil Permeability		
Code	Explanation	% of Catchment
H	High	0
M	Moderate	47.2
L	Low	3.3
ML	Moderate/Low	0
NA	No Subsoil/Bare Rock	47

Aquifer		
Code	Explanation	% of Catchment
LG_RG	LG:Locally important sand-gravel aquifer RG: Regionally important sand-gravel aquifer	0
LL	Locally important aquifer which is moderately productive only in local zones	28.9
LM_RF	LM: Locally important aquifer which is generally moderately productive RF: Regionally important fissured bedrock aquifer	16.2
PU_PL	PU: Poor aquifer which is generally unproductive PL: Poor aquifer which is generally unproductive except for local zones	0
RKC_RK	Regionally important karstified aquifer dominated by conduit flow	51.7
RKD_LK	Regionally important karstified aquifer dominated by diffuse flow	0

Stations in Pooling group			
%ile Flow	Station 1	Station 2	Station 3
5	36029	26018	13003
10	36029	26018	13003
20	36029	26018	13003
30	36029	06014	25030
40	25030	36029	06014
50	26021	07002	26012
60	26021	07002	26012
70	26021	07002	26012
80	26021	26012	27002
90	26021	26012	27002
95	26021	26012	27002

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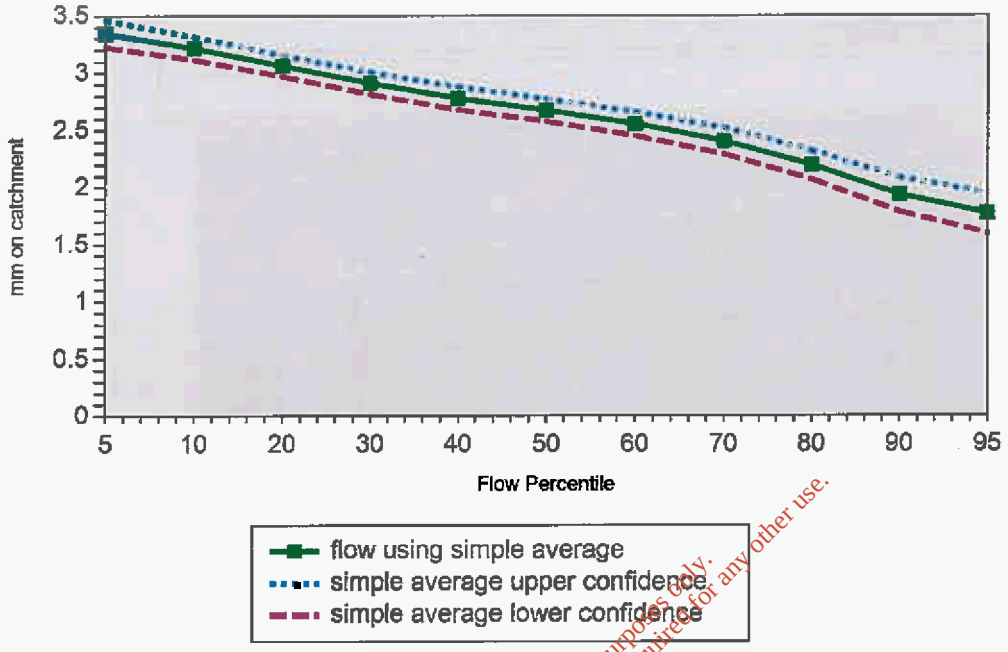
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (mm on catchment)



Log Flow (mm on catchment)			
%ile	mm	upper 95% confidence limit	lower 95% confidence limit
5	3.345	3.462	3.228
10	3.216	3.316	3.116
20	3.063	3.155	2.971
30	2.91	3.006	2.814
40	2.78	2.879	2.681
50	2.676	2.774	2.578
60	2.556	2.661	2.451
70	2.406	2.522	2.29
80	2.195	2.321	2.069
90	1.934	2.084	1.784
95	1.772	1.948	1.596

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BOHERAROAN(27_273)
XY Location	137837,167069 (ING)

River Segment Map

Disclaimer
The source hydrometric data used to estimate the flow duration curve ordinates for ungauged catchments was obtained from (1) water level data and (2) the rating curve(s) generated for each hydrometric station. The Environmental Protection Agency and the Office of Public Works used these data, respectively, to calculate daily mean flows. The daily mean flows were then used by the Environmental Protection Agency to prepare flow duration curves for each station. Neither body accepts any liability for the subsequent handling of the data.

Environmental Protection Agency

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The user should familiarise himself/herself with the catchment being studied and confirm that the ungauged site is in a natural catchment where flows conditions are suitable for the use of the model.

It is strongly recommended that the user examine the catchment descriptors contained in the report produced and confirm that the percentages of the various constituent elements are comparable to a natural catchment.

If the flow in a catchment is not entirely natural, the estimation of flows using the model in these catchments could be affected due to:

- existence of local conduit karst within the catchment;
- the selected location itself is on local conduit karst;
- regulation of the river flow on the river channel (e.g. power station, sluice gates etc)
- impacts of abstractions upstream of the selected location or the impact of the discharge associated with the abstraction into the same/different catchment;
- estimates of flow being sought at locations effected by storage effects at, or near, lake outfalls;
- lack of similar catchments with observed flows, ie where catchment descriptors lie outside the range of available gauging station catchments (e.g. the catchment area is under 5 km²);
- any other special circumstances that may affect river flows.

Expert judgement will be required to ensure that the estimate of flow is not unduly affected by any of these influences.

Please note that the model does not provide estimates of flood peaks and, specifically, should not be used for that purpose.

The EPA has also prepared estimates of DWF and long term 95 percentile flows which are also presented on the EPA web site. These data are presented at http://www.epa.ie/whatwedo/monitoring/water/hydrometrics/data/

The data produced by the model for specific stations should be compared to the data contained in this file of DWF and long term 95percentile flows.

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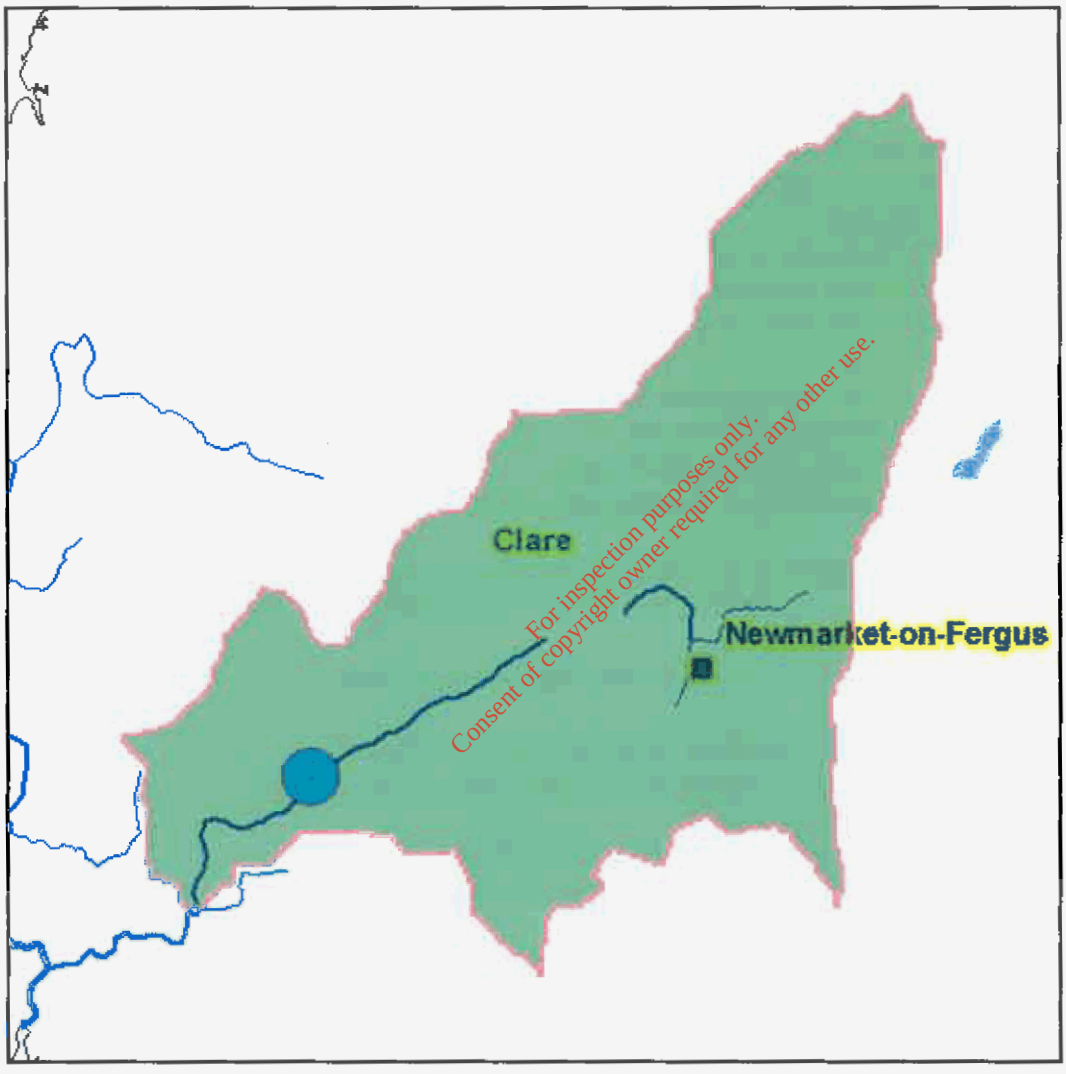
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BOHERAROAN(27_273)
XY Location	137837,167069 (ING)

Nested Catchment Map



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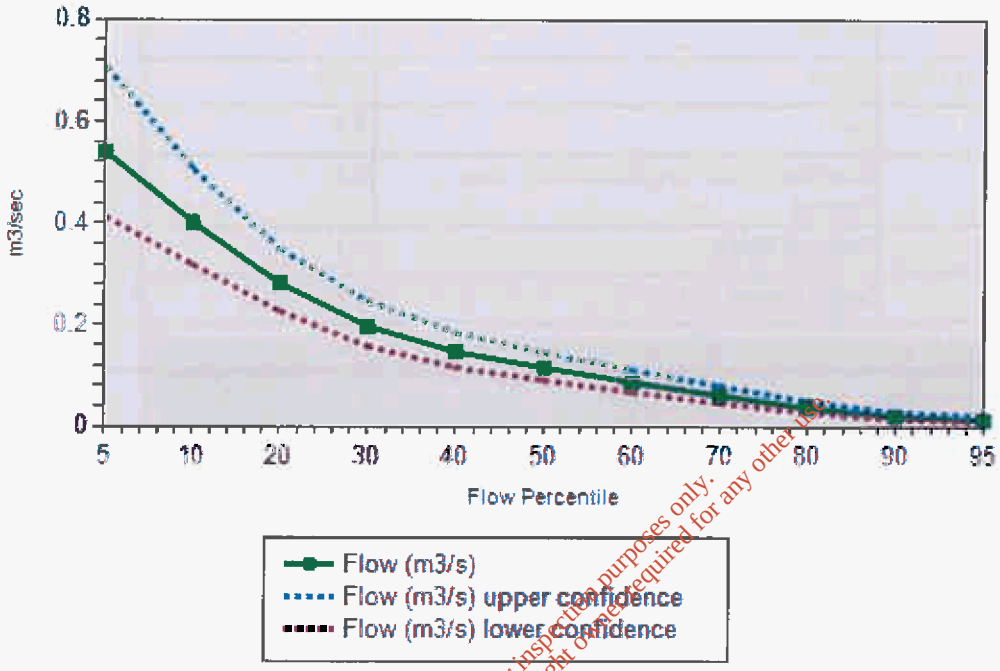
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (Flow in m3/sec)



%ile	flow(m3/sec)	upper 95% confidence limit m3/sec	lower 95% confidence limit m3/sec
5	0.54	0.707	0.413
10	0.401	0.506	0.319
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70	0.062	0.081	0.047
80	0.038	0.051	0.029
90	0.021	0.029	0.015
95	0.014	0.022	0.01

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Catchment Descriptors		
General		
Descriptor	Unit	Value
Area	sq km	7.7
Average Annual Rainfall (61-90)	mm/yr	1012
Stream Length	km	4.5
Drainage Density	Channel length (km)/catchment area (sqkm)	0.6
Slope	Percent Slope	3.1
FARL	Index (range 0:1)	0.9

Soil	
Code	% of Catchment
Poorly Drained	7.8
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Alluvmin	0
Peat	5.9
Water	2.5
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Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Subsoil Permeability		
Code	Explanation	% of Catchment
H	High	0
M	Moderate	47.2
L	Low	3.3
ML	Moderate/Low	0
NA	No Subsoil/Bare Rock	47

Aquifer		
Code	Explanation	% of Catchment
LG_RG	LG:Locally important sand-gravel aquifer RG: Regionally important sand-gravel aquifer	0
LL	Locally important aquifer which is moderately productive only in local zones	28.9
LM_RF	LM: Locally important aquifer which is generally moderately productive RF: Regionally important fissured bedrock aquifer	16.2
PU_PL	PU: Poor aquifer which is generally unproductive PL: Poor aquifer which is generally unproductive except for local zones	0
RKC_RK	Regionally important karstified aquifer dominated by conduit flow	51.7
RKD_LK	Regionally important karstified aquifer dominated by diffuse flow	0

Stations in Pooling group			
%ile Flow	Station 1	Station 2	Station 3
5	36029	26018	13003
10	36029	26018	13003
20	36029	26018	13003
30	36029	06014	25030
40	25030	36029	06014
50	26021	07002	26012
60	26021	07002	26012
70	26021	07002	26012
80	26021	26012	27002

90	26021	**26012**	27002
95	**26021**	26012	27002

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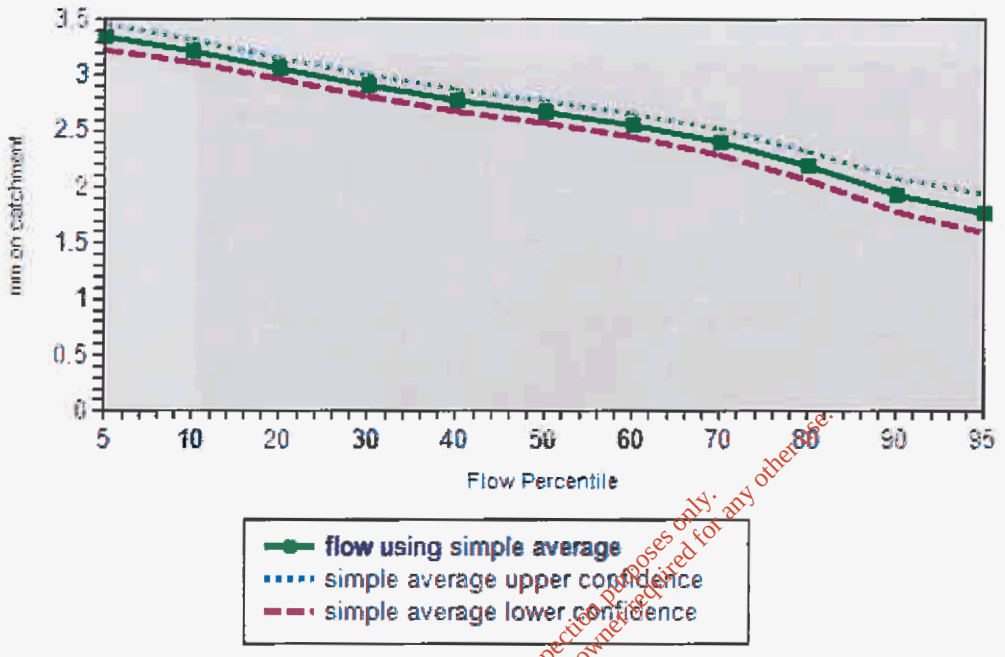
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (mm on catchment)



Log Flow (mm on catchment)			
%ile	mm	upper 95% confidence limit	lower 95% confidence limit
5	3.345	3.462	3.228
10	3.216	3.316	3.116
20	3.063	3.155	2.971
30	2.91	3.006	2.814
40	2.78	2.879	2.681
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60	2.556	2.661	2.451
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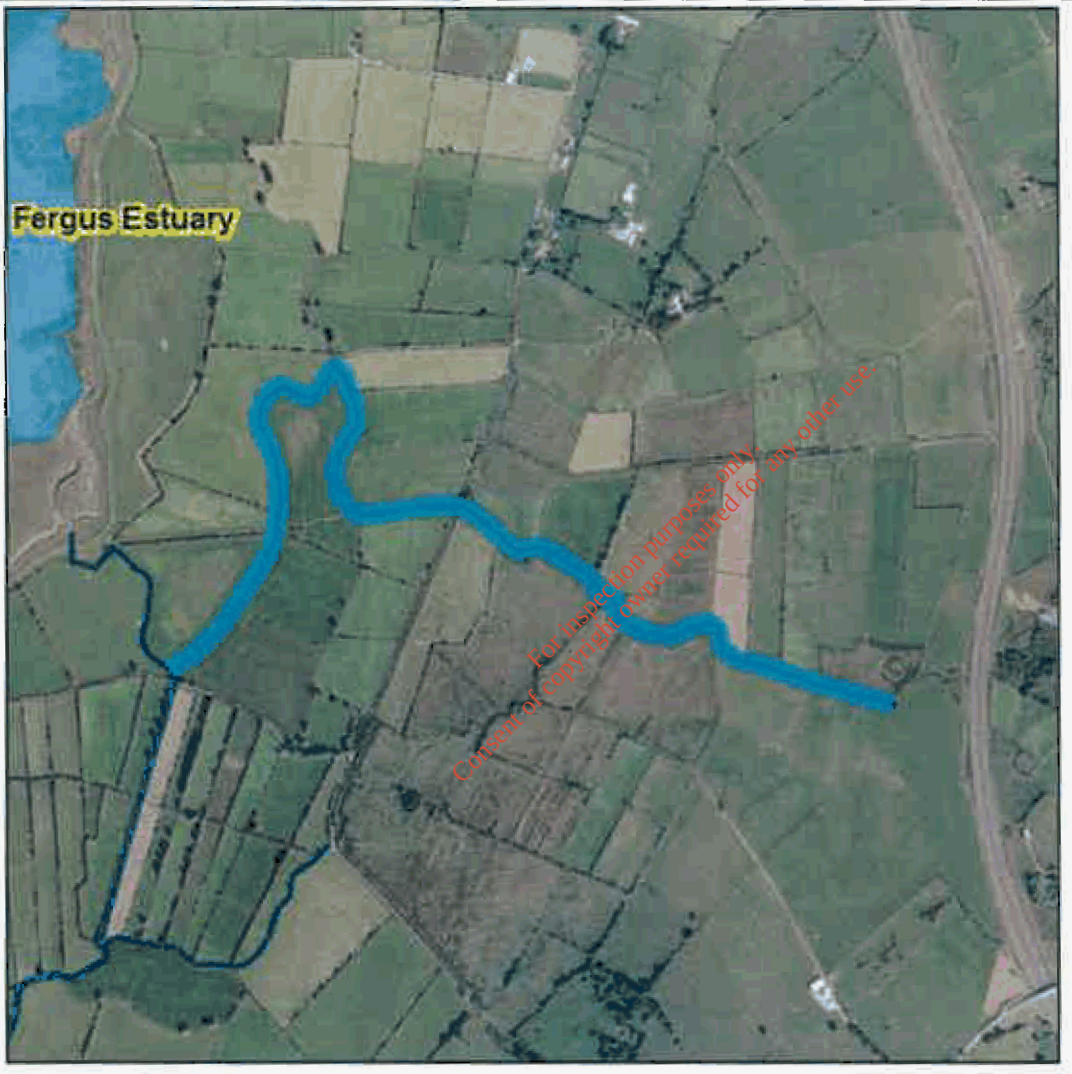
80	2.195	2.321	2.069
90	1.934	2.084	1.784
95	1.772	1.948	1.596

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BALLYGIRREEN(27_784)
XY Location	137229,168840 (ING)

River Segment Map



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Environmental Protection Agency

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- lack of similar catchments with observed flows, ie where catchment descriptors lie outside the range of available gauging station catchments (e.g. the catchment area is under 5 km²);
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The data produced by the model for specific stations should be compared to the data contained in this file of DWF and long term 95percentile flows.

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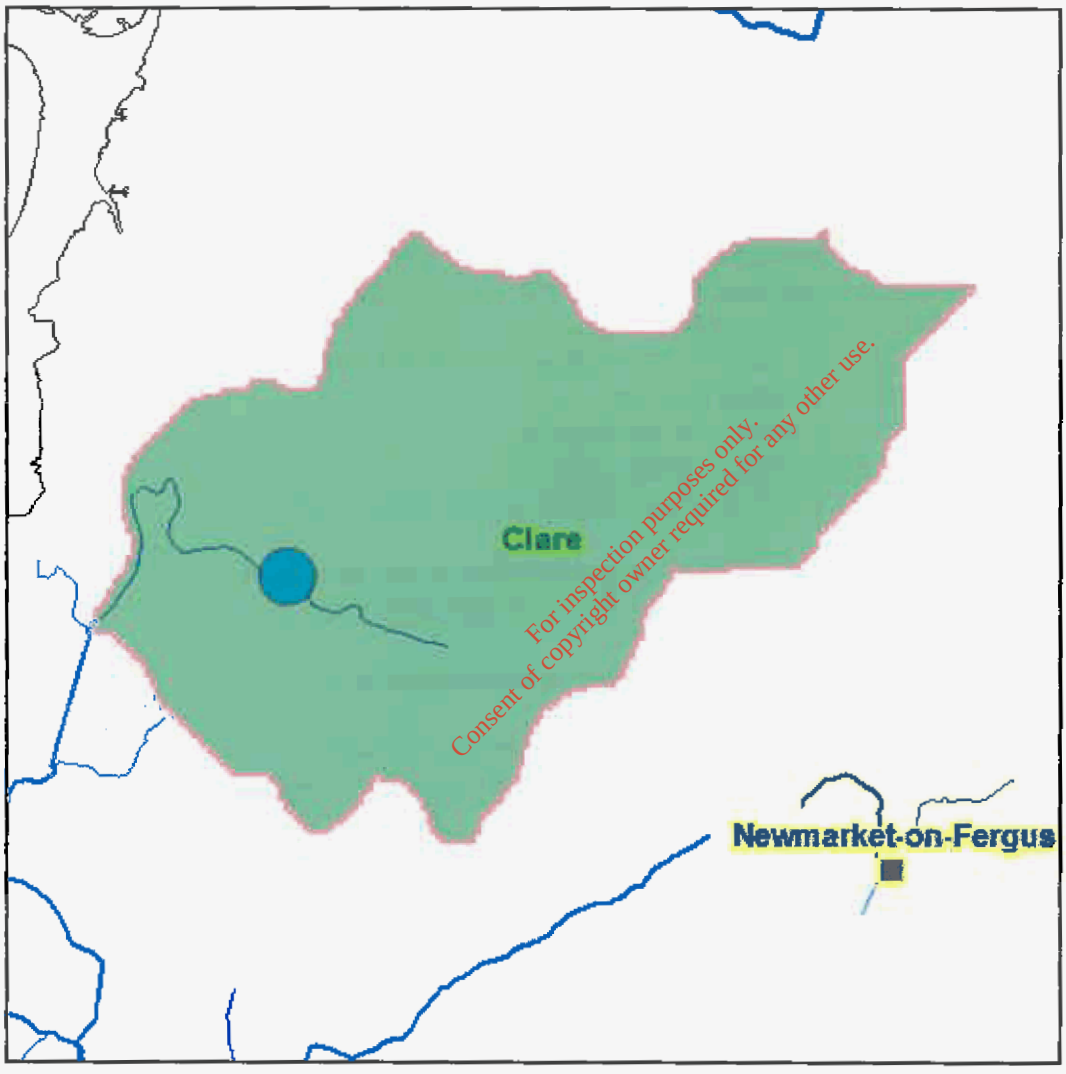
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

River Name	BALLYGIRREEN(27_784)
XY Location	137229,168840 (ING)

Nested Catchment Map



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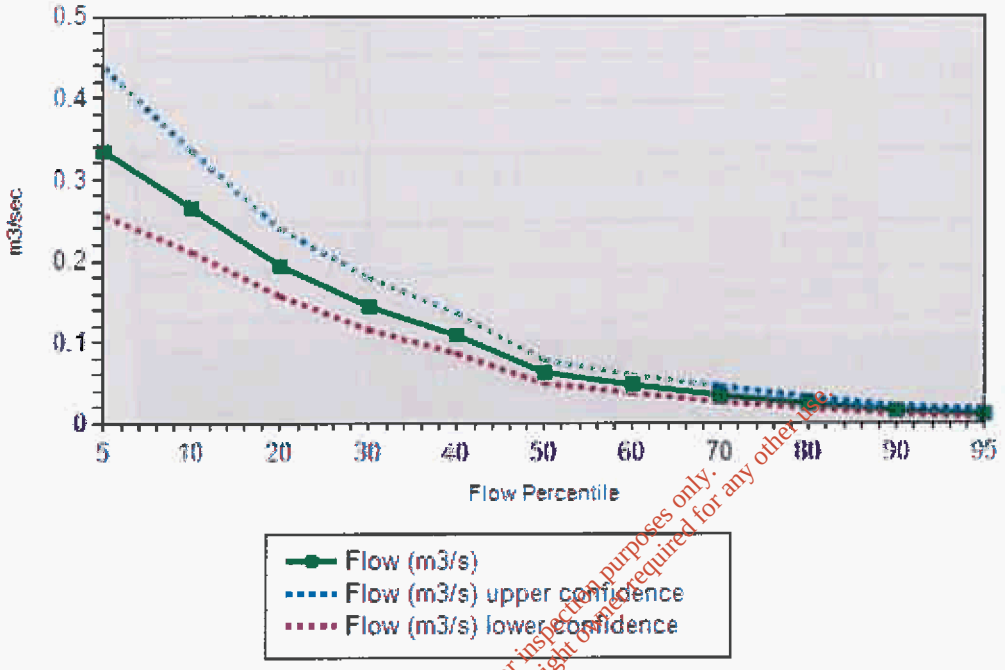
Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (Flow in m3/sec)



Site	flow(m3/sec)	upper 95% confidence limit m3/sec	lower 95% confidence limit m3/sec
5	0.335	0.438	0.256
10	0.265	0.334	0.211
20	0.194	0.239	0.157
30	0.144	0.179	0.116
40	0.108	0.135	0.086
50	0.062	0.077	0.049
60	0.047	0.059	0.037
70	0.034	0.045	0.026
80	0.024	0.032	0.018
90	0.015	0.021	0.011
95	0.011	0.017	0.007

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Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Catchment Descriptors		
General		
Descriptor	Unit	Value
Area	sq km	5.3
Average Annual Rainfall (61-90)	mm/yr	1022
Stream Length	km	2.5
Drainage Density	Channel length (km)/catchment area (sqkm)	0.5
Slope	Percent Slope	2.9
FARL	Index (range 0:1)	1

Soil	
Code	% of Catchment
Poorly Drained	38.3
Well Drained	61.7
Alluvmin	0
Peat	0
Water	0
Made	0

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Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Subsoil Permeability		
Code	Explanation	% of Catchment
H	High	0
M	Moderate	23.7
L	Low	30.3
ML	Moderate/Low	0
NA	No Subsoil/Bare Rock	46

Aquifer		
Code	Explanation	% of Catchment
LG_RG	LG:Locally important sand-gravel aquifer RG: Regionally important sand-gravel aquifer	0
LL	Locally important aquifer which is moderately productive only in local zones	0
LM_RF	LM: Locally important aquifer which is generally moderately productive RF: Regionally important fissured bedrock aquifer	0
PU_PL	PU: Poor aquifer which is generally unproductive PL: Poor aquifer which is generally unproductive except for local zones	0
RKC_RK	Regionally important karstified aquifer dominated by conduit flow	100
RKD_LK	Regionally important karstified aquifer dominated by diffuse flow	0

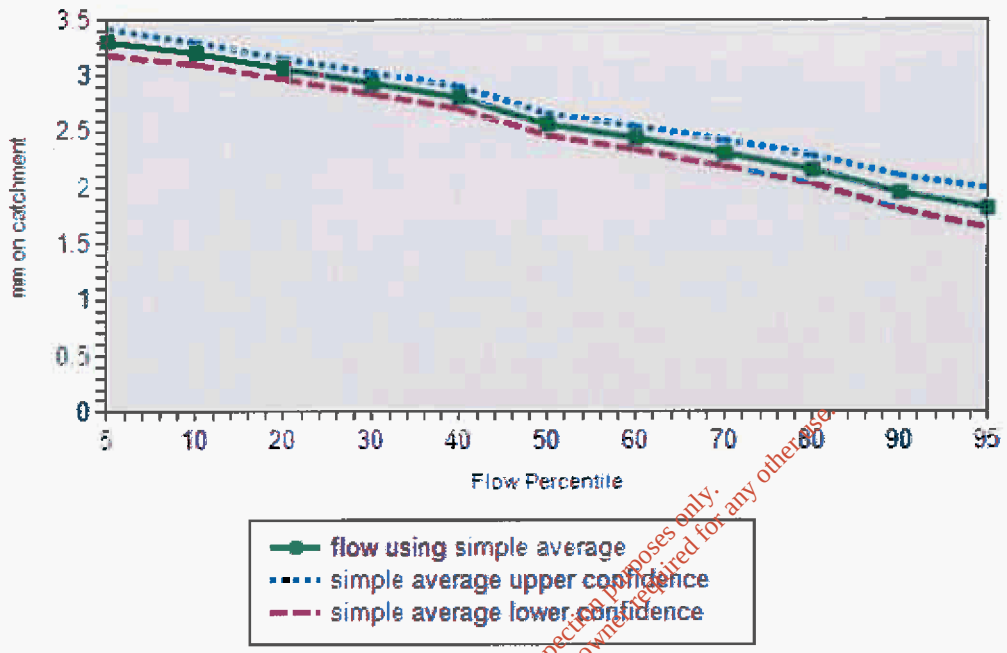
Stations in Pooling group			
%ile Flow	Station 1	Station 2	Station 3
5	26018	30002	13003
10	26018	30002	13003
20	26018	30002	13003
30	26018	30002	13003
40	26018	30002	13003
50	13003	15010	30002
60	13003	15010	30002
70	13003	15010	30002
80	13003	15010	30002

90	13003	15010	30002
95	13003	15010	30002

Environmental Protection Agency

Estimation of Flow Duration Curve for Ungauged Catchment

Flow Duration Curve (mm on catchment)

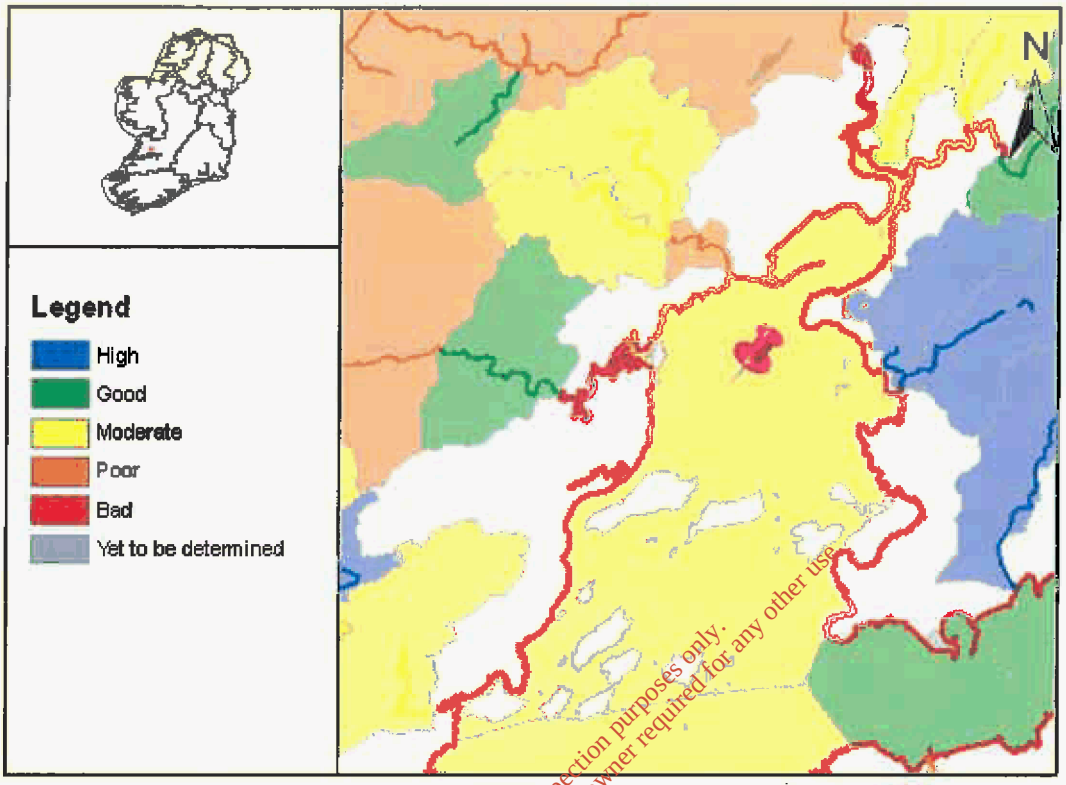


Log Flow (mm on catchment)			
%ile	mm	upper 95% confidence limit	lower 95% confidence limit
5	3.303	3.42	3.186
10	3.202	3.302	3.102
20	3.065	3.157	2.973
30	2.937	3.033	2.841
40	2.81	2.909	2.711
50	2.569	2.667	2.471
60	2.448	2.553	2.343
70	2.312	2.428	2.196
80	2.165	2.291	2.039
90	1.96	2.11	1.81
95	1.82	1.996	1.644

APPENDIX D – WFD WATER QUALITY

water matters
'Your Plan'

Full Report for Waterbody Fergus Estuary



River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 17/11/2014

water matters
Our Plan

Summary Information:

Water Management Unit:	N/A
WaterBody Category:	Transitional Waterbody
WaterBody Name:	Fergus Estuary
WaterBody Code:	IE_SH_060_1100
Overall Status:	Moderate
Overall Objective:	Restore 2015
Overall Risk:	Not At Risk
Heavily Modified:	No

shannon river basin district

Report data based upon final RBMP, 2009-2015.

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 17/11/2014

water matters
'Our Plan'

Status Report

Water Management Unit:	N/A
WaterBody Category:	Transitional Waterbody
WaterBody Name:	Fergus Estuary
WaterBody Code:	IE_SH_060_1100
Overall Status Result:	Moderate
Heavily Modified:	No

shannon river basin district

	Status Element Description	Result
	Status information	
DIN	Dissolved Inorganic Nitrogen status	Good
MRP	Molybdate Reactive Phosphorus status	High
DO	Dissolved oxygen as per cent saturation status	Moderate
BOD	Biochemical Oxygen Demand (5-days) status	High
PHY	Macroalgae - phytobiomass status	High
OPP	Macroalgae - opportunistic algae status	N/A
RSL	Macroalgae - reduced species list status	N/A
ANG	Angiosperms - Seagrass and Saltmarsh status	N/A
BIN	Benthic Invertebrates status	N/A
FIS	Fish status	Good
HYD	Hydrology status	N/A
MOR	Morphology status	Good
SP	Specific Pollutant Status	N/A
PAS	Overall protected area status	At least good
ES	Ecological Status	Moderate
CS	Chemical Status	N/A
SWS	Surface Water Status	N/A
EXT	Extrapolated status	N/A
DON	Donor water bodies	N/A

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water matters
'Our Plan'

Risk Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Fergus Estuary

WaterBody Code: IE_SH_060_1100

Overall Risk Result: Not At Risk

Heavily Modified: No

shannon river basin district

	Risk Test Description	Risk
	Hydrology	
THY1	Water balance - Abstraction	Not At Risk
	Marine Direct Impacts	
TMDI1	Dangerous Substances	N/A
TMDI2	OSPAR	N/A
TMDI3	UWWT Regs Designations	N/A
TMDIO	Marine Direct Impacts Overall - Worst Case	N/A
	Morphological Risk Sources	
TM1	Channelisation	N/A
TM2	Deposition	N/A
TM3	Coastal Defences	N/A
TM4	Impoundments	N/A
TM5a	Built Structures - Port Tonnage	N/A
TM5b	Built Structures - Industrial Intakes	N/A
TM6	Intensive Landuse	N/A
TMO	Morphology Overall - Worst Case	N/A
TMO	Overall (MIMAS) Morphological Risk - Worst Case (2008)	N/A
	Overall Risk	
RA	Transitional Overall - Worst CaseOverall (MIMAS) Morphological Risk - Worst Case (2008)	Not At Risk
	Point / MDI Worst Case	
TPOL	Worst case of Point Overall and MDI OverallOverall (MIMAS) Morphological Risk - Worst Case (2008)	Not At Risk
	Point Risk Sources	
TP1	WWTPs (2008)	Not At Risk
TP2	CSOs	Not At Risk
TP3	IPPCs (2008)	Not At Risk

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TP4	Section 4s (2008)	Not At Risk
TP5	WTPs/Mines/Quarries/Landfills	N/A
TPO	Overall Risk from Point Sources - Worst Case (2008)	Not At Risk

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document library, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

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water matters
'Our Plan'

Objectives Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Fergus Estuary

WaterBody Code: IE_SH_060_1100

Overall Objective: Restore 2015

Heavily Modified: No

shannon river basin district

	Objectives Description	Result
	Extended timescale information	
E1	Extended timescales due to time requirements to upgrade WWTP discharges	No Status
E2	Extended timescales due to delayed recovery of chemical pollution and chemical status failures	No Status
E3	Extended timescales due to winter dissolved nitrogen exceedances	No Status
E4	Extended timescales due to time requirements for status recovery	No Status
E5	Extended timescales from Northern Ireland Environment Agency	No Status
E0V	Overall extended timescale - combination of all extended timescales fields	No Status
	Objectives information	
OB1	Prevent deterioration objective	No Status
OB2	Restore at least good status objective	No Status
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	Restore 2015
OBO	Overall objectives	Restore 2015

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

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water matters
'Our Plan'

Measures Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Fergus Estuary

WaterBody Code: IE_SH_060_1100

Heavily Modified: No

shannon river basin district

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	18
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	Yes
HAB	Directive - Habitats Directive	Yes
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	Yes
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
TP1	WSIP - Agglomerations with treatment plants requiring capital works	Yes
TP2	WSIP - Agglomerations with treatment plants requiring further investigation prior to capital works	Yes
TP3	WSIP - Agglomerations requiring the implementation of actions identified in Shellfish PRPs	No
TP4	WSIP - Agglomerations with treatment plants requiring improved operational performance	No
TP5	WSIP - Agglomerations requiring investigation of CSOs	No
TP6	WSIP - Agglomerations where exisitng treatment capacity is currently adequate but predicted loadings would result in overloading	No
OTS	On-site waste water treatment systems	Yes
SHE	Shellfish Pollution Reduction Plan	No
IPR	IPPC licences requiring review	Yes
WPR	Water Pollution Act licences requiring review	No
HQW	Protect high quality waters	No

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Measures

Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

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n/a - not assessed

Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 status classes: High, Good, Moderate, Poor, Bad. However, not all waterbodies have been monitored, and in such cases the status of a similar nearby waterbody has been used (extrapolated) to assign status. If this has been done the first line of the status report shows the code of the waterbody used to extrapolate.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).