Licensing Notice - Unsolicited Correspondence - 1 for Kilfenora Licence (A0079-01)

Licence: Kilfenora (A0079-01)

Status Reason: Closed

Issued On: 03/11/2014

Action Type: Licensing Notice

Status History Action: Unsolicited Correspondence

Dear Sirs, The Reg 25(c0(ii) Outstanding Info Due by 3 Oct 2014 is identified as CLOSED but there is no uploaded response associated with this notice. I attach herewith the Irish Water response IW-ER-LT0089 to the Reg 25(c)(ii) notice as Unsolicited Correspondence. Yours faithfully, Ken Conroy Irish Water

Associated Documents

- IW-ER-LT0089_kilfenora_ RFI Response Final.pdf

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IW-ER-LT0089
3rd November 2014

RE: Kilfenora Certificate of Authorisation Application A0079- 01

Dear Patrick Byrne

In response to the Regulation 25(c)(ii) request for further information notice please see below relevant response information.

Provide an update on the programme of improvements for Kilfenora waste water works, including details of any proposed WWTP upgrades and/or proposed changes to the waste water discharge.

Kilfenora is included on Irish Waters Capital Investment Programme 2014-2016. Therefore it is anticipated that works will commence within this timeframe. Ryan Hanley Consulting Engineers on behalf of Irish Water recently carried out a design review of the proposed wastewater treatment plant based on the revised population estimates and current legislation and guidelines. The report entitled '*Kilfenora Sewerage Scheme – Assessment of Discharge, October 2014*', included in Appendix 1, sets out proposals for the final effluent standards and an indirect discharge to groundwater which will provide for compliance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. 9 of 2010).

Review and update, as appropriate, the screening (Stage 1) for Appropriate Assessment and the (Stage 2) Appropriate Assessment submitted as part of the further information received by the Agency on the 14th November 2011

Please see attached the Appropriate Assessment (Stage 2- Natura Impact Statement) for Kilfenora.

Best Regards,

Gerry Galvin
Chief Technical Advisor

Appendix 1

Kilfenora Sewerage Scheme – Assessment of Discharge

KILFENORA SEWERAGE SCHEME
CO. CLARE

PHOTO: AERATION TANK AT KILFENORA WWTP

ASSESSMENT OF DISCHARGE
OCTOBER 2014

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Client	Irish Water
Project No.	3021
Project Title	Kilfenora Sewerage Scheme
Report Title	Assessment of Discharge

Rev.	Status	Author(s)	Reviewed By	Approved By	Issue Date
00	Draft for Internal Review	Conor Warner	Paddy Scally		
01	Final	Conor Warner	Paddy Scally	Michael Joyce	31/10/2014

Table of Contents

1. Introduction & Background to Project

Further to the Kilfenora Sewerage Scheme Preliminary Report produced for Clare County Council in August 2007, Ryan Hanley was commissioned by Irish Water to undertake the following as part of the application for a discharge certificate for the Kilfenora Sewerage Scheme:

- Summarise the current WWTP operations, influent and effluent quality and the recommendations set out in the Kilfenora Sewerage Scheme Preliminary Report;
- Review EPA guidance on discharge to groundwater and the Natura Impact Statement and Tier 3 Assessment reports prepared for Kilfenora Sewerage Scheme;
- Undertake an options review for discharge of treated effluent to surface water and groundwater near Kilfenora WWTP, including recommending outfall locations and cost estimates to assess the economic feasibility (both construction and operational costs) of the options considered;
- For the option of discharging indirectly to groundwater, assess suitable location and sizing of percolation areas;
- Further to the options review, recommend any additional studies required;
- Identify WWTP storm-water overflow discharge options including a review of current stormwater facilities;
- Review the required effluent standards for the discharge location;
- Recommend the proposed discharge location and standards (both for treated effluent and storm water overflow) for Kilfenora WWTP, specify the required infrastructure for the proposal and summarise the costs.

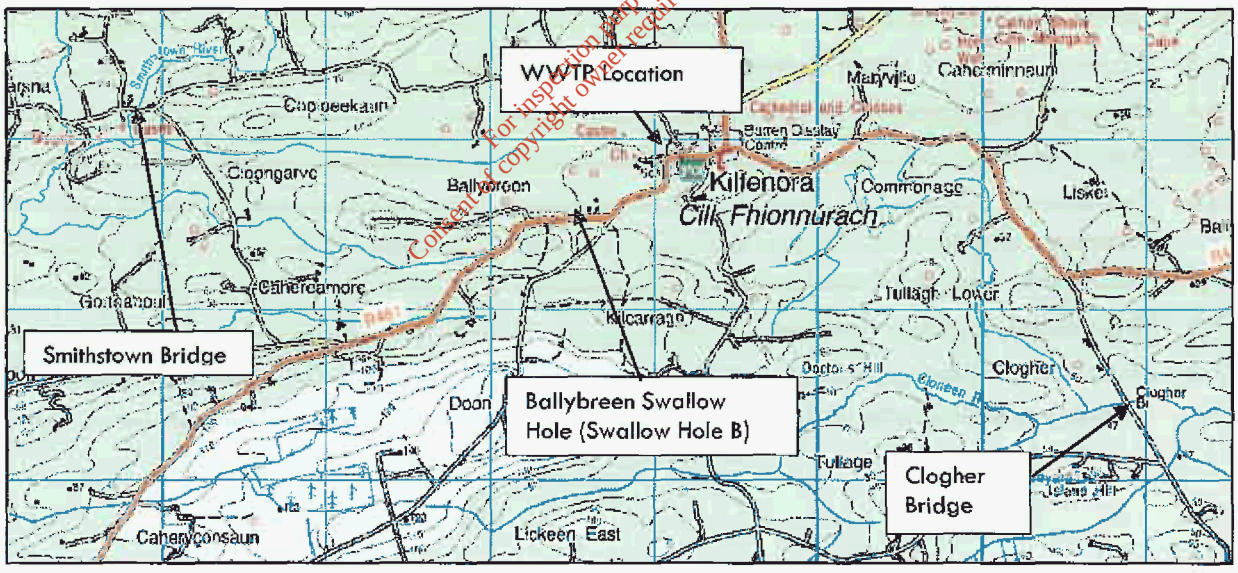


Figure 1: Study Area at Kilfenora.

In 2009, Clare County Council applied to the Environmental Protection Agency (EPA) for a discharge certificate for the Kilfenora WWTP in accordance with the Regulations for a wastewater agglomeration less than 500PE. This application process is now be managed by Irish Water. It is expected that this licence will set emission limit values relating to legislation.

2. Kilfenora WWTP

2.1. Location and Current Population

The existing Kilfenora WWTP is located to the north west of the village centre at Irish Grid co-ordinates E118020, N193970 and ground levels ranging 52.5mOD to 55.75mOD with an overall site area of 0.46ha. The WWTP site is accessed via a track-way from the Kilshanny Road.

The Kilfenora DED census figures for 2006 and 2012 were 409 and 459 persons respectively; it should be noted, however, that the sewerage scheme does not serve the full extents of the DED with the remainder serviced presumably by septic tanks.

Based on information supplied by Irish Water, the current PE within the agglomeration boundary (including a number of properties currently on septic tanks) is 414 PE. Irish Water projects that this will increase to 431 PE by 2020. *(This PE will be finalised at detailed design stage).*

2.2. Existing Treatment Works and Sewerage Network

The Kilfenora WWTP, which was built in 1974, is an activated sludge extended aeration plant comprising a screening chamber, storm water tank (installed c2006), storm overflow, balancing tank, inlet flow measurement, aeration tank, settlement tank, treated effluent pumping station, sludge drying beds and control building (Note: the existing settlement tank comprises 6.7m square, 4m deep hopper with a peripheral overflow weir. A system of perforated slabs spans the surface area of the tank circa 0.4m below the water level). A drawing showing the existing WWTP layout is included in Appendix 1.1.

The influent to the WWTP is wastewater from residential, commercial and institutional properties with a *significant quantity of storm water. The WWTP has an estimated maximum treatment capacity of 350 PE* (Kilfenora Sewerage Scheme Preliminary Report). Sludge arising from the WWTP process is dried in sludge beds at the site when possible and ultimately is removed by tanker to Lisdoonvarna WWTP for further processing.

The existing collection network (refer to Appendix 1.1 for a layout drawing of the existing network) is a combined sewer system with pipe sizes ranging from 150mm to 225mm diameter which discharge to a 300mm diameter pipe at the inlet to the WWTP. The inlet chamber has three outlet pipes, (1) a 150mm diameter pipe direct to the balancing tank, (2) twin 150mm diameter pipes to the storm tank, and (3) a high level overflow pipe which discharges directly to a swallow hole (Swallow Hole A) adjacent to the entrance of the WWTP site.

Flows from the storm tank (volume 200m^3) are returned by pumping to the balancing tank via twin 50mm rising mains. The invert of the storm tank inlet pipes (2) are set lower than that of the high level overflow (3). The high level storm overflow is reported to be operational during wet weather, indicating that either the storm tank and associated overflow does not have sufficient capacity or the hydraulic load at the plant is excessive.

The treated effluent from the settlement tank discharges to a pumping station for forwarding to receiving waters i.e. Ballybreen Swallow Hole (Swallow Hole B).

The influent and effluent quality records were made available by Clare County Council / Irish Water for 2013 and are summarised below:

Summary of Final Effluent Quality from Kilfenora WWTP 2013				
	Flow m^3/day	BOD mg/l	COD mg/l	Suspended Solids (mg/l)
Average	132	6	29	8
Maximum	252	20	101	16
Urban Wastewater Directive Limits	N/A	25	125	35
Actual Loading Reduction Percentage	N/A	96%	88%	86%

Note: the above data was supplied by Clare County Council. A detailed review of the 2013 records concluded that the average and maximum daily flows going forward for treatment was 146m^3/day and 570m^3/day respectively. The influent flows are measured downstream of the balancing tank i.e. flows allowed forward to the aeration tank. The total flow arriving at the inlet works is not recorded.

A review of the 2013 influent flows, inlet works surcharging and storm water overflow events at the plant are included in Section 5.

It is noted from anecdotal evidence on site that parts of the low lying areas of the existing WWTP site were subject to groundwater flooding during November 2009. The November 2009 flood is estimated regionally to have been of the order of a 1 in 100 year event.

2.3. Receiving Waters Overview

The Kilfenora WWTP lies within the upper reaches of the River Fergus catchment in a karst region where there is a close interaction between surface water and groundwater. The WWTP lies close to the watershed between the Fergus and Dealagh River catchments. The WWTP site is located immediately adjacent to areas of outcropping limestone bedrock and bedrock was reported to have been encountered at shallow depths during construction works on the storm water tank. The Dealagh River catchment, in general, lies within a poorly productive aquifer.

There are two discharges from the WWTP (treated effluent and stormwater overflow) that discharge to separate locations. The effluent from the WWTP is pumped via a 340m long 75mm diameter rising main and discharges into a gravity sewer (450m long 150mm diameter) which in turn drains to a stream that outfalls to Ballybreen swallow hole (Swallow Hole B). In terms of stormwater overflow, the high level overflow from the inlet works discharges via a 225mm diameter sewer to a second swallow hole (Swallow Hole A) located adjacent to the WWTP access gate. (See Figure 1)

European Community Groundwater Regulations (see Section 3) define a direct discharge as:

> "A discharge of pollutants into groundwater without percolation throughout the soil or subsoil. As a consequence direct discharges can therefore also occur where the input bypasses the unsaturated zone via natural or artificial open conduits."

Therefore both of the existing discharge regimes from the WWTP are classed as 'Direct Discharge to Groundwater'.

Hydrogeological studies have been undertaken for the Ballybreen Swallow Hole by David Drew (TCD) (2003 & 2012) and by Geosyntec (2014), the latter of which was for a Tier 3 assessment associated with the Irish

Water application to the EPA for a discharge certificate (See Section 4). The studies concluded that conduit flow exists between Ballybreen Swallow Hole and large springs in the River Fergus valley to the south east of Kilfenora near Kilnaboy and that dispersed flow exists (probably radiating from the main conduit flow) to the east of Kilfenora in the Lisket to Leamaneh area. The River Fergus ultimately discharges to the Fergus Estuary at Clarecastle near Ennis. The studies also concluded that at times of high groundwater levels that connectivity exists between Ballybreen Swallow hole and seasonal flood plain lands located to the west of Kilfenora at Cloongarve and Ballybreen. These seasonal flood plain lands historically were subject to drainage works via a channel (Cloongarve Open Drain) to the Smithstown River downstream of Smithstown Bridge. Smithstown River in turn drains to the Dealagh River which ultimately discharges to the Inagh River Estuary at Lahinch. (See Figure in Appendix 1.2 for general hydrology in the Kilfenora Area.)

A more detailed review of the receiving waters is examined in Section 6.

2.4. Preliminary Report Recommendations

The Kilfenora WWTP Preliminary Report recommended that the existing treatment works be augmented to continue operating as an extended aeration process and to increase the overall treatment capacity to 700 PE for design year 2031 involving the construction of the following:

- Aeration tank (8m internal diameter with 2.15m liquid depth) giving a combined aeration volume of 211m^3
- Settlement tank (6m internal diameter and overall volume of 56.0m^3)
- Tertiary treatment tank filtering system
- New sludge pumping station
- Sludge thickening tank
- Phosphorus Removal (Ferric Sulphate dosing system)
- Upgraded final effluent pumping station
- Upgraded inlet works with (new screens already installed), grit removal, automatic sampling, magnetic flow meter and improved storm over flow system. Odour treatment facilities to be included at the inlet works.

The Preliminary Report recommended effluent standards are:

BOD_5	maximum 10mg/l O_2	70-90% removal rate
Suspended Solids	maximum 10mg/l	90% removal rate
COD	maximum 125mg/l	75% removal rate
Total Phosphorus	maximum 2mg/l	80% removal rate
Total Nitrogen	maximum 15mg/l	70-80% removal rate

The option of disinfectant UV treatment was reviewed in the Preliminary Report and it was concluded that given the small volume of discharge and the very small resulting pollutant load that the expenditure on UV treatment would not be justified.

In terms of discharge of treated effluent, the Preliminary Report recommended, further to a review of a surface water discharge options, the following:

- to continue discharging treated effluent to groundwater via a proposed 200m^2 percolation area adjacent to Ballybreen Swallow Hole; and

- to continue using the high level overflow adjacent to the plant (discharging to swallow hole A)

It is noted that since the preparation of the Preliminary Report, Irish Water has undertaken a review of the Kilfenora agglomeration and recommended that, for the purposes of this study, the design PE should be assumed to be **450 PE** (the PE is to be finalised at detailed design stage).

Photo 1: Existing Settlement Tank

3. Current Legislation

3.1. EPA Guidance for Groundwater Discharge

3.1.1 Introduction

Discharge to groundwater licenses are granted under the following legislation:

- Local Government (Water Pollution) Acts 1977 to 1990 – Section 4 Licence;
- Environmental Protection Agency Acts, 1992 to 2011 – IPPC Licence;
- Waste Management Acts, 1996 to 2011 – Waste Licence, Waste Facility Permit or Certificate of Authorisation; and
- Waste Water Discharge (Authorisation) Regulations 2007 and 2010 (S.I. No 684 of 2007 as amended by S.I. No. 231 of 2010) – Waste Water Discharge Licence or Certificate of Authorisation.

The EPA has produced two guidance documents relating to discharge to groundwater as follows:

- Guidance on the Authorisation of Discharges to Groundwater, (EPA December 2011)
- Guidance on the Authorisation of Direct Discharges to Groundwater, (EPA January 2014)

The December 2011 guidance focused on the technical assessment of indirect discharges to groundwater via percolation systems, while the January 2014 document deals with direct discharge to groundwater.

The pertinent legislation relating to discharge in Kilfenora is discussed hereunder.

3.1.2 Guidance on the Authorisation of Discharges to Groundwater, (EPA December 2011)

The Guidance on the Authorisation of Discharges to Groundwater, (EPA December 2011) document provides guidance on the technical assessments that are needed to authorise discharges to groundwater, as a means of satisfying the requirements of the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) (Groundwater Regulations).

Under Regulation 4 of the Groundwater Regulations, a duty is placed on public authorities to promote compliance with the requirements of the regulations and to take all reasonable steps including, where necessary, the implementation of programmes of measures, to:

(a) prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater;

(b) protect, enhance and restore all bodies of groundwater and ensure a balance between abstraction and recharge of groundwater with the aim of achieving good groundwater quantitative status and good groundwater chemical status by not later than 22 December 2015;

(c) reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater;

(d) achieve compliance with any standards and objectives established for a groundwater dependent protected area included in the register of protected areas established under Regulation 8 of the 2003 Regulations [S.I. No. 722 of 2003] by not later than 22 December 2015, unless otherwise specified in the Community legislation under which the individual protected areas have been established."

Regulation 7 of the Groundwater Regulations further states that "Point source discharges and diffuse sources liable to cause groundwater pollution shall be controlled so as to prevent or limit the input of pollutants into groundwater".

The document provides a technical assessment methodology for examining the Source-Pathway-Receptor (SPR) relationships. Three tiers of assessment are defined as follows:

- Tier 1 Assessment - Low-risk activities. Effluent from on-site waste water treatment systems (OSWTSs) of less than 5 m^3/d. Assessment procedures set out in the EPA Code of Practice for OSWTSs for single houses. The proposed percolation site assessment must demonstrate sufficient infiltration capacity and adequate attenuation potential.

- Tier 2 Assessment - Moderate-risk activities. Domestic wastewater effluent from OSWTSs of between 5 m^3/d and 20m^3/d with integrated constructed wetlands and trade effluent where risk screening indicates a moderate risk of impact to the receptor. In addition to assessing the proposed percolation site assessment for sufficient infiltration capacity and adequate attenuation potential, the potential impact on groundwater quality is to be calculated. The assessment requires detailed site investigation works for characterisation of subsoils and monitoring wells for monitoring groundwater levels and sampling. A Tier 2 assessment is to be carried out by a suitably qualified hydrogeologist.

- Tier 3 Assessment - Higher-risk activities. Cover activities including domestic wastewater effluent of greater than 20m^3/d with integrated constructed wetlands, any proposed activity that is screened as carrying a high risk of impact on the receptor, activities where Tier 1 and Tier 2 assessments indicate significant scientific uncertainty. A Tier 3 assessment requires more technical assessment of the substrata and groundwater regime than Tier 2. A Tier 3 assessment is to be carried out by a suitably qualified hydrogeologist.

The methodology for the initial risk screening procedure is presented below in Figure 1. Based on the above criteria, the requirement for a Tier 3 Assessment for Kilfenora Sewerage Scheme was identified and subsequently Irish Water commissioned Geosyntec to undertake a Tier 3 assessment for Kilfenora Sewerage Scheme in association with the Natura Impact Statement prepared by Ryan Hanley.

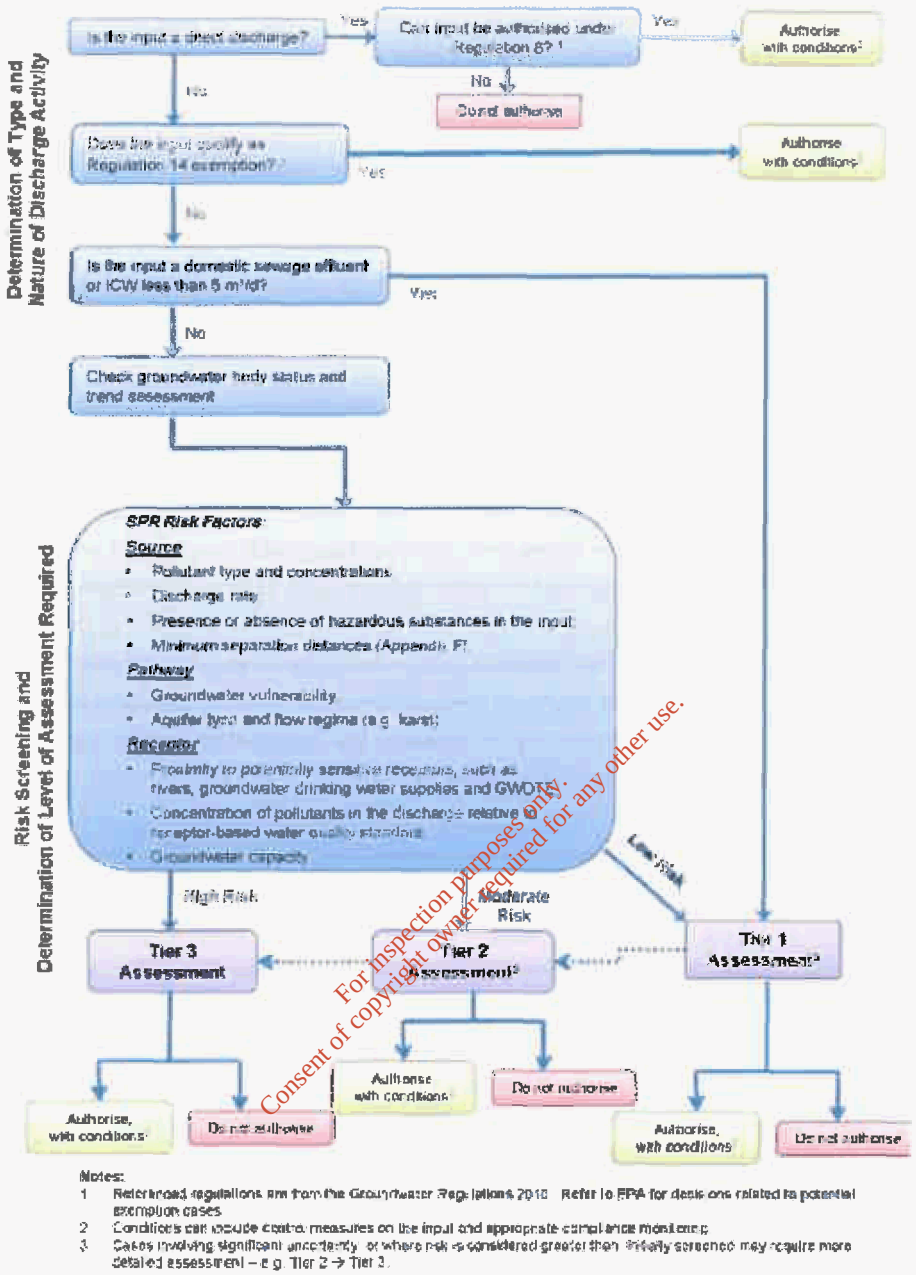


Figure 1: Risk Screening of New Inputs (Guidance on the Authorisation of Discharges to Groundwater, (EPA December 2011)

3.1.2 Guidance on the Authorisation of Direct Discharges to Groundwater, (EPA January 2014)

The Groundwater Regulations define a direct discharge as a "discharge of pollutants into groundwater without percolation throughout the soil or subsoil". As a consequence, direct discharges can therefore also occur where the input bypasses the unsaturated zone via natural or artificial open conduits.

The Guidance on the Authorisation of Direct Discharges to Groundwater (EPA January 2014) document includes a review of The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) regarding direct discharge and sets out the exemptions that may be permitted. The guidance document also describes the various direct discharge pathways to groundwater in karst areas.

The Groundwater Regulations stipulate the groundwater quality objectives that must be achieved; and the measures considered necessary to achieve the objectives, as defined by the Water Framework Directive (2000/60/EC) (WFD) and the Groundwater Directive (2006/118/EC) (GWD).

Under Regulation 8 of the Groundwater Regulations, as well as Article 11.3(j) of the European Commission Water Framework Directive (2000/60/EC), direct discharges to groundwater are prohibited. However, certain types of direct discharges may be permissible subject to a requirement of prior authorisation (in this case by the EPA) "provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made". It should be noted that Regulation 8 does not make specific reference to direct discharges of wastewater effluents.

Under Regulation 14 of the Groundwater Regulations, certain direct and indirect discharges to groundwater may be granted exemptions from measures to prevent or limit the input of pollutants into groundwater, under conditions (technical rules) established by the EPA, but only "where the Agency is satisfied that adequate monitoring of the bodies of groundwater concerned, in accordance with point 2.4.2 of Annex V to Directive 2000/60/EC [i.e. Water Framework Directive], or other appropriate monitoring, is being carried out."

The EPA may, according to Regulation 14, "direct a public authority to provide information in relation to the location and nature of inputs of pollutants, and any other information, which it considers necessary. The relevant public authority, shall take the steps necessary to provide the information requested by the Agency. The information shall be provided to the Agency in a timely manner".

Categories and examples of possible exempted inputs under Regulation 14 are presented as follows:

(a) Inputs permitted by Regulation 8, generally associated with mining exploration and civil engineer works. (Note: does not include for direct discharge from Wastewater Treatment Plants.)

(b) Inputs considered to be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater. Examples include:
   i. Discharge of highly treated effluent;
   ii. Discharge of 5 m^3/d or less of water with no discernible hazardous substances or significant concentrations of non-hazardous substances;
   iii. Discharges where the concentration in the effluent is so small that it does not result in a quantifiable/detectable concentration in groundwater, after mixing/dilution.

(c) Inputs that are the consequences of accidents or exceptional circumstances of natural cause that could not reasonably have been foreseen, avoided or mitigated.

(d) Inputs that are the result of artificial recharge or augmentation of bodies of groundwater authorised in accordance with Article 11(3)(f) of Directive 2000/60/EC.

(e) Inputs considered incapable, for technical reasons, of being prevented or limited without using:
   i. measures that would increase risks to human health or to the quality of the environment as a whole, or,
   ii. disproportionately costly measures to remove quantities of pollutants from or otherwise control their percolation in, contaminated ground or subsoil.

(f) Inputs that are the result of interventions in surface waters for the purposes, amongst others, of mitigating the effects of floods and droughts, and for the management of waters and waterways.

Figure 2 presents a flow chart, taken from Guidance on the Authorisation of Direct Discharges to Groundwater, (EPA January 2014), of the authorisation assessment process for direct discharge of domestic-type wastewater effluent.

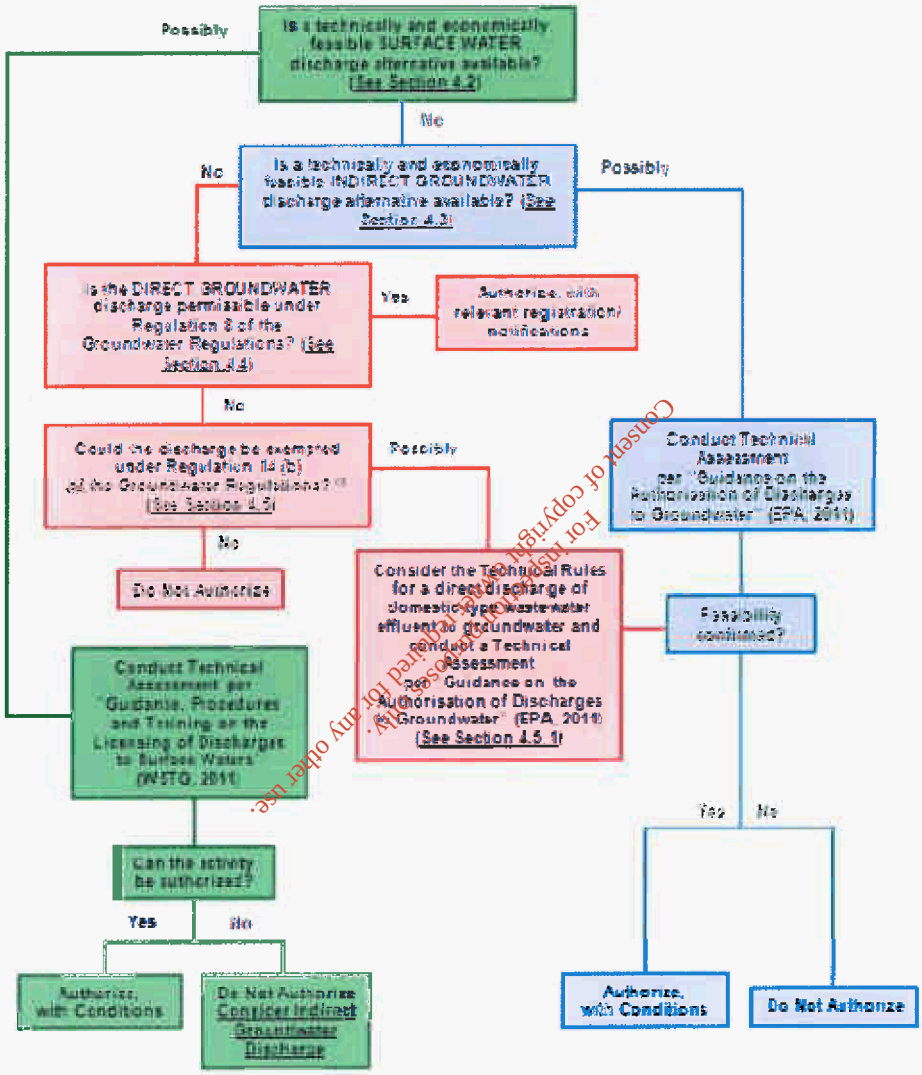


Figure 2: Assessment process when considering authorisation of direct discharges of domestic-type wastewater effluent

In line with the process set out in Figure 2 (and the project brief), the following discharge assessment has been undertaken as part of this report:

(1) Surface water discharge and indirect discharge to groundwater options have been reviewed for Kilfenora WWTP based on environmental, technical and economic parameters. (See Section 6 and 7). (Note: In accordance with EC regulations, continued direct discharge is not recommended);

(2) The necessary infrastructure for the most viable proposal for both discharge options has been scoped (high-level) in order to undertake a technical and economic analysis;

(3) Discharge standards for treated effluent have been reviewed (further to the Tier 3 assessment and consultation with relevant stakeholders);
(4) A Recommended Discharge Strategy has been proposed.

3.2. Regulations applicable to Surface Water Discharge

3.2.1 Introduction

As part of this study, the option of discharging treated effluent to surface water has been reviewed (See Section 6) (in this case for both the Smithstown River and River Fergus). The regulations applicable to surface water discharge in these potential receiving waters are discussed in Appendix 2.

Photo 2: Smithstown Bridge (looking upstream)

4. Tier Three Assessment

4.1. Geosyntec Tier Three Assessment

Geosyntec Consultants Ltd. was commissioned as part of the NIS process associated with the application for a discharge certificate for Kilfenora WWTP to undertake a Tier 3 Assessment for the site in accordance with the Guidance on the Authorisation of Discharges to Groundwater (EPA December 2011).

Geosyntec concluded and recommended the following:

- The current discharge of treated effluent to the stream at Ballybreen Swallow Hole is a direct discharge to groundwater. The current direct discharge to Ballybreen swallow hole does not comply with the requirements specified in EPA (2011;2014) and the Groundwater Regulations underpinning this guidance for the authorisation of 'direct discharges to groundwater' as the current discharge does not fall within any of the permissible or exempted pollutant inputs defined by Regulations 8 & 14 of the Groundwater Regulations (S. I. No. 9 or 2010);
- Further to review of the hydrogeological tracer studies undertaken by David Drew (TCD) (2001, 2012), it was identified that significant conduit flow exists from Ballybreen Swallow Hole to the springs in the Fergus River Valley to the south east of Kilfenora and a lateral diffuse connection to wells exists to the east around Lisket and Leamaneh. Sampling was undertaken for the Leamaneh private group water scheme on five occasions in April and May 2012 and pathogenic bacteria was detected in the pre-treated water on each occasion when analysed (however none was detected after treatment);
- The main contaminants of potential concern from the discharge at Ballybreen Swallow Hole are considered to be microbial pathogens, nitrogen and phosphorus compounds;
- The tracer studies have confirmed that there are direct connections from the discharge at the Ballybreen swallow hole to both the private water supply wells in the study area and the River Fergus i.e. viable S-P-R linkages are present. As such, there is currently a potentially significant risk to human health receptors from the discharge at Ballybreen in the event that abstracted water from impacted wells is ingested without adequate treatment. This issue and the requirement to prevent or limit direct discharges of potentially hazardous substances to groundwater (under the Groundwater Regulations) has resulted in the conclusion that improvements in the degree of treatment provided by the WWTP is required in order to mitigate this risk. (It is understood that households using borehole wells identified (in the April 2012 tracer study) as being at risk and others potentially at risk of contamination from the Kilfenora WWTP discharge were provided with a mains water connection by Clare County Council);
- Whilst monitoring of these abstraction wells did provide evidence of impacts to groundwater quality, a material impact on the water quality in the River Fergus was not evident at Poplar Bridge, i.e. this stretch has good water quality status with no exceedances of the environmental quality standards for surface water in 2013. This is likely to be due to the significant degree of dilution afforded by other inputs to the river;
- Compliance monitoring of the treated effluent discharge to groundwater is required;
- An UV disinfectant system will need to be considered as part of this design to ensure final discharges do not include microbial pathogens;
- The Tier 3 Assessment should be revisited following the upgrade of the WWTP.

Geosyntec also specified the Potential Final Effluent Design Parameters for Kilfenora WWTP as set out below:

Parameter	Emission Limit Value	Source of Emission Limit Value
BOD (mg/l)	25	Urban Waste Water Treatment Directive (91/271/EEC)
COD (mg/l)	125	
Suspended Solids (mg/l)	35	
Molybdate Reactive Phosphorus –MRP (µg/l P)	-	No human health criteria for phosphorous compounds
Nitrate (mg/l NO_3)	37.5	Groundwater Threshold Value (GVT) intended for human consumption
Ammonium (µg/l N)	175	GVT intended for human consumption / Drinking Water Standards (SI 278 of 2007)
Nitrite (µg/l NO_2)	375	Groundwater Threshold Value (GVT) intended for human consumption
E. Coli (counts/100ml)	<1	Drinking Water Standards (SI 278 of 2007)
Enterococci (counts/100ml)	<1	
Clostridium Perfringens (counts/100ml)	<1	

5. WWTP Influent Assessment

5.1. Existing Scenario

A review of the WWTP records for the year 2013 was undertaken to assess the flow rates discharging to Ballybreen Swallow Hole, the frequency of surcharging / hydraulic overloading of the plant inlet works and spillage of storm water via the high level overflow to groundwater at Kilfenora WWTP. Table 6 summarises the monthly average and maximum influent flows, the number of days when the inlet works was surcharged / hydraulically overloaded (i.e. the storm water tank was filling or was full) and the number of days when spill events to the emergency overflow occurred (i.e. discharge to Swallow Hole A). It is noted that recording of flow at the WWTP is for flow forwarded to treatment only (i.e. there is no flow monitoring of total inflow to the WWTP).

Month	Average, m³/day	Maximum, m³/day	No. Days when Storm Tank is Operational	No. Days Overflow to Swallow Hole A
Jan-13	224.6	472	21	13
Feb-13	166.7	321.6	20	3
Mar-13	77.2	201.8	0	0
Apr-13	172.1	273.7	12	3
May-13	121.0	236.2	7	4
Jun-13	115.2	253.5	6	1
Jul-13	107.7	257.2	2	1
Aug-13	104.9	179.6	3	1
Sep-13	124.2	320.7	1	0
Oct-13	159.6	258.9	11	10
Nov-13	165.6	290.3	24	16
Dec-13	213.5	570.8	17	13
Total	146	570.8	124	65

Note: The influent flows are measured downstream of the balancing tank (by an ultra-sonic sensor and flume) i.e. the flows allowed forward to the aeration tank not the total flow to the inlet works.

Table 6 Kilfenora WWTP Influent quantities (2013)

The average daily volume of treated effluent being pumped to direct discharge at Ballybreen Swallow Hole during 2013 is calculated at 146 m³. This flow rate constitutes a input of greater than 20m³/day of domestic waste water to the groundwater receptor and therefore requires a Tier 3 Assessment. (Note: this assessment has already been carried out by Geosyntec (See Section 4))

5.2. Storm Water Overflows

As part of the Kilfenora WWTP Preliminary Report (August 2007), it was identified that surface water enters the combined sewer system from private roofs, paved areas and generally via the rear of premises. Storm water overflows at the inlet works are diverted to a 200m³ storm water tank via twin 150mm diameter pipes and when influent flows subside (measured by a float switch in the balance tank), the stored storm water is returned by pumping for treatment when water levels in the balancing tank subside. When the capacity of both the inlet to the WWTP and the storm tank are exceeded, the excess influent overflows (untreated) via by a high level weir to a 225mm pipe which discharges to a swallow hole (Swallow Hole A) at the entrance to the WWTP site.

Note:

As part of the Kilfenora Sewerage Scheme Preliminary Report (August 2007) flow and load contract, the overflow duration and quantities at the WWTP were recorded between 24th June 2006 to 15 August 2006. The storm holding tank was not commissioned at that time. During this period, 8 No.

overflow events to groundwater (Swallow hole A) were recorded with the maximum daily overflow recorded at 122.6m³ which occurred over a 17 hour period. It was included in the report that although rainfall does contribute to storm overflow events (via surface water / combined sewer connections), that hydraulic backup of the works due to insufficient capacity and infiltration are significant contributors.

Of the 124 days in 2013 when the storm tank was in operation (filling or was full), the inlet spilled for 65 days via the high level overflow to Swallow Hole A. The total flows entering the inlet works and the volumes of storm water being discharged via the high level overflow are not recorded. As expected, considering that the collection system is combined and infiltration is likely to be prevalent, the highest average and maximum flows occur in winter when the regional water table and rainfall rates are at their highest.

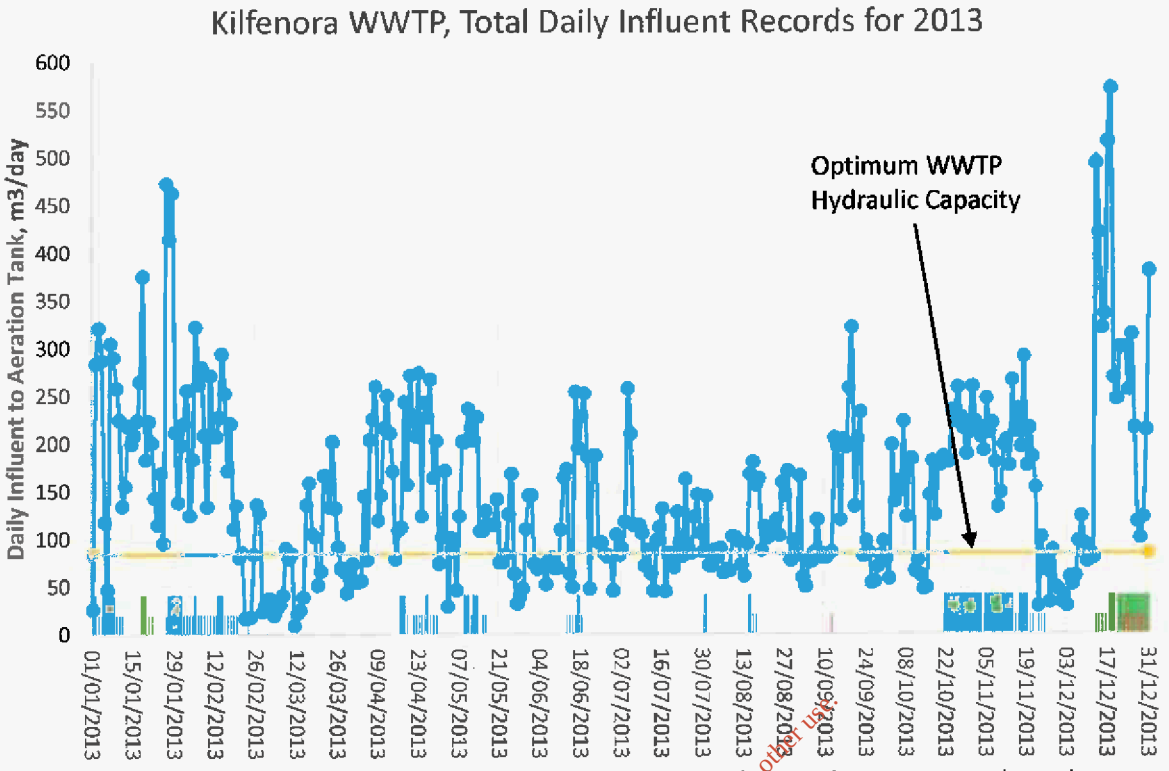
Chart 1 presents the daily total flow recorded at the plant for 2013.

The current forward flow to the plant is controlled by a penstock at the outlet from the balancing tank. The WWTP has an estimated maximum treatment capacity of 350PE (Kilfenora Sewerage Scheme Preliminary Report) and a hydraulic capacity of circa 80m³/day (225 l/hd/d) or 2.7 l/s at 3DWF (Note: 80m³/day is calculated to be approximately the 30%ile influent rate for 2013, i.e. total daily flows exceeded the plant's optimum hydraulic capacity for 70% of the year). Therefore, the WWTP, if operated at its optimum hydraulic capacity, would be restricted to 80m³/day with the remainder being diverted to the storm water tank or spilling via the high level overflow. The Kilfenora WWTP, it can be concluded, is currently hydraulically overloaded.

In the case of Kilfenora WWTP (with a design PE less than 2000) the Formula A and FFT are taken as 6 DWF and 3 DWF and the minimum recommended storm holding tank volume is 2 hours storage for 3 DWF. The existing storm tank (with a volume of 200m³) has a storage capacity of approximately 2 days of the plants hydraulic capacity and 1.4 times the current average daily hydraulic load (146m³/day) going forward for treatment (i.e. not the total WWTP inlet flow). The three day storage volume for the average daily FFT flow is c440m³, or 2.2 times the existing storage. However, storage of such storm water volumes for treatment would be impractical. **Reduction of storm water volumes entering the combined sewer is, therefore, an essential part of the Kilfenora WWTP upgrade works.**

A preliminary estimation of the impermeable area contributing to the combined sewer system, taking that the majority of road runoff has been shown to be drained by a dedicated storm sewer, is estimated at approximately 6,000m² (based on a desk study which assumed that the rear roofs and back yards of the long established properties in the village drain to the combined sewer system). The Seasonal Annual Average Rainfall (SAAR) depth for Kilfenora is 1,450mm/annum (1981-2010 Met Eireann). Using a 100% runoff rate from the impermeable area, the average daily surface water volume flowing to the WWTP via the combined sewer is estimated at c30m³/day. It is clear that the actual daily average non-waste water contribution to the WWTP is significantly higher than 30m³/day which suggests that infiltration is likely to be a significant contributor of non-wastewater hydraulic load at Kilfenora WWTP.

Chart 2 in Appendix 3 presents the total daily rainfall recorded at Shannon Airport for August 2014 relative to the recorded total daily flow forwarded to treatment (FFT) at Kilfenora WWTP. It should be noted that the daily flows at the WWTP are read each morning while the rainfall is measured from midnight to midnight. The lowest FFT flow during this period was approximately 65 m³/day on the 19th August.



Note: Red Line represents days when storm tank was in operation, and Green Line represents days when emergency spillage to Swallow Hole A occurs

Chart 1: Total daily flows, storm tank operations and high level overflow events, 2013

5.3. Groundwater Regulations

The current practice of emergency spillage of storm water overflow to groundwater adjacent to the WWTP site is a direct discharge and, due to its regularity, cannot be deemed to be an exempted pollutant input. In the scenario where storm water hydraulic loading to the plant has been significantly reduced by a combination of flow separation and prevention of infiltration, emergency spillages to groundwater would be expected to occur very rarely and exemption (c) (see below) as set out in the Guidance on the Authorisation of Direct Discharges to Groundwater, (EPA January 2014) may be applicable, as follows:

(c) Inputs that are the consequences of accidents or exceptional circumstances of natural cause that could not reasonably have been foreseen, avoided or mitigated.	This would not apply to inputs that are the result of poor design and/or maintenance practices. Exempted inputs could result from accidental spills or phenomena that are caused by extreme weather events (e.g. flooding) that fall outside normal bounds of prediction. It could also apply to non-hazardous substances arising from the emergency treatment of water for drinking supply (e.g. in response to unforeseen spills).

Therefore, in order to satisfy the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), works are required at Kilfenora WWTP to prevent spillage of untreated storm water overflow to groundwater.

5.4. Storm Water Recommendations

The following works are recommended for the Kilfenora Sewerage Scheme with specific regard to reducing storm water volumes in the influent and prevent emergency overflow spillage to Swallow Hole A.

- A preliminary inspection of the combined sewer collection system (i.e. manhole inspections to observe flows) is to be undertaken during wet weather to identify likely sources of infiltration and surface water inflow.
- Following the above inspection, a more detailed impermeable area study (IAS) may be required for the Kilfenora Sewerage Scheme in line with a flow and load survey at the WWTP.
- A CCTV sewer survey contract is to be carried out for the existing collection system (concentrating on the sections of likely infiltration and surface water inflow), programmed to be carried out during wet weather and when the groundwater level are high (i.e. winter).
- Following the sewer survey it is recommended that a sewer rehabilitation contract is carried out to repair the sections of pipeline and manholes where infiltration exists.
- A drainage separation contract, where practical, is to be carried out involving diversion of roof down pipes and back yard drainage to soak-aways or dedicated surface water sewers and diversion of road drainage to surface water sewers. It may, however, considering the age of some of the buildings and confined backyard areas in Kilfenora village, prove impractical to carry out extensive drainage separation on private property. Preliminary calculations indicate that infiltration is likely to be the primary source of storm water in the combined sewer network.
- Additional storm water storage may be required to prevent storm water overflows to groundwater (at Swallow Hole A). However, it is recommended that the sewer rehabilitation and separation of flow contracts are completed and storm water flow rates monitored before any additional storm water storage is provided.

While treatment and pumping away of the excess storm water from the Kilfenora Sewerage Scheme to surface waters rather than discharging to Swallow Hole A is technically feasible it would likely be economically prohibitive and unsustainable to operate. Therefore, it is recommended that the facility to outfall to Swallow Hole A be retained for emergency spillage in extreme events (in the region of 1 in 5 years or greater).

The recommended option for management of storm water at Kilfenora WWTP is summarised as follows:

- Undertake inspection surveys to identify the likely sources of infiltration and surface water in the collection system.
- Following the surveys reduce infiltration in the collection system and divert runoff to surface water sewers where possible.
- All flows to the inlet works are to pass through the WWTP (i.e. no storm water overflow permissible except in extreme events.)

6. Treated Effluent Discharge Options

6.1. Introduction

As set out in Section 3.1.2, as part of the assessment for the authorisation of direct discharge, options for discharging treated effluent to surface water from Kilfenora WWTP have been reviewed. Based on the findings discussed in Section 5 above, the assessment of options for discharge of treated effluent will proceed on the assumption that that drainage separation and infiltration repair works will be undertaken and that the average flow at the WWTP inlet works will be equivalent to 225l/hd/d. Irish Water has advised that 450PE should be adopted as the design population for Kilfenora Sewerage Scheme for the purposes of this report (PE to be finalised at detailed design stage) - i.e. 101.3m³/day.

6.2. Nearby Sewerage Schemes

A preliminary review was undertaken of other existing wastewater treatment plants in the vicinity of Kilfenora. The following table summarises the location of these WWTP relative to Kilfenora and the maximum elevation along the potential route of a rising main between them.

Option	Location	Maximum elevation along the RM route	WWTP Capacity
W1 – Corofin SS	The most northerly extents of the Corofin Sewerage Scheme is 13.2km by road	circa 75mOD	Corofin WWTP is located on Ennis Road to the east of the village and discharges to the River Fergus. The WWTP has a design of P.E. of 1,725 PE. The average annual PE for 2013 was 710P.E. (AER 2013, D0434-01)
W2- Lisdoonvarna SS	The most easterly extents of the Lisdoonvarna Sewerage Scheme is 6.35km by road	circa 120mOD	Lisdoonvarna WWTP is located at Knockaskeeheen and discharges to the Aille River. The WWTP has a design of P.E. of 5,000 PE of which 2,500PE is currently operational. The average annual PE for 2013 was 1,769 P.E. (AER 2013, D0077-01)

Note: the ground level at the Kilfenora WWTP treatment plant is approximately 54mOD.

Table 7: Nearby existing Wastewater Treatment Plants

Further assessment of the Lisdoonvarna and Corofin WWTP capacities would be required to determine the actual spare capacity available and the works necessary at these plants and within the associated networks to facilitate additional pumped flows from Kilfenora WWTP.

Pumping of untreated sewage in long rising mains (with retention times greater than 8 hours) can lead to septicity with associated odour and hydrogen sulphide gas issues.

Option W1 - Corofin Sewerage Scheme

The option of pumping to Corofin WWTP has been screened out due to the estimated excessive capital cost associated with constructing the rising main and the limited spare capacity at the plant.

Option W2- Lisdoonvarna Sewerage Scheme

The capacity of a 100mm diameter rising main over a distance of 6.35km is calculated at 50m³ while the design PE of 450 PE Kilfenora plant is 101m³ /day (i.e. rising main cleared twice daily during dry weather flow).

While Option W2 would negate the need for upgrade works at the existing Kilfenora WWTP and removes the licencing, monitoring and health issues associated with discharge of treated effluent to groundwater at Ballybreen Swallow Hole, it is probable that such a pumping regime would be technically difficult to operate and would have relative high pumping and maintenance costs (pumping at a high head would be required to transfer sewage from Kilfenora to the Lisdoonvarna network). The capital and operational costs for this option are included in Section 6.5.2 below. Unless no other technically or economically feasible options are available, it is unlikely that this will be the preferred discharge option.

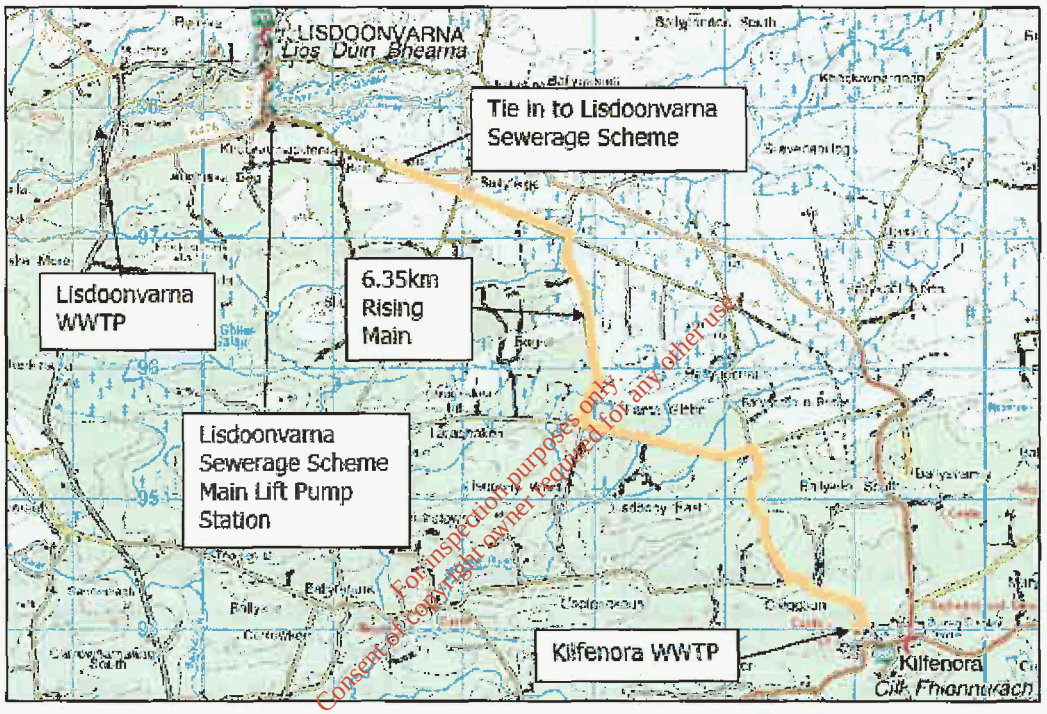


Figure 3. Potential Kilfenora to Lisdoonvarna Rising Main option.

6.3. Discharge to Surface Water Options near Kilfenora

6.3.1 Initial Screening Assessment

Kilfenora is located in a karst region where surface water drainage is predominantly to groundwater by dispersed percolation and direct discharge i.e. via swallow holes, fissures in the bedrock, epikarst etc. and the nearest permanent over ground watercourses are over 3km from the existing WWTP site. Further to a desk study of the hydrology in Kilfenora, a site visit to the nearest potential over ground receiving waters was undertaken on the 12th September 2014. The site visit coincided with a relatively long dry spell (bar one significantly wet day on the 5th September, 38mm) following a relatively dry summer (June 40.5mm, July 35.8mm, August 90mm) which would have been expected to have resulted in reasonably low flow conditions regionally. Chart 3 in Appendix 3 presents the rainfall data from Shannon Airport Weather Station for the 6 week period prior to the site visit.

Six potential surface water body discharge locations were visited as follows:

Ref	Watercourse	Location	Easting	Northing	Comment

S1	Smithstown River	D/S of Smithstown Bridge	114867	194172	Moderate flow observed
S2	Cloongarve Stream	Cloongarve Culvert	115197	193932	Negligible flow observed
S3	Caherminnaun West Cave	Kilfenora Mart	119612	193967	No flow evident (Becomes active in flood conditions only)
S4	Tullagh Stream	Corofin Road	119902	193384	Minimal flow observed
S5	Clooneen River	Clogher Bridge	120880	192456	Minimal flow observed
S6	River Fergus	D/S of Clogher Bridge	121293	192385	Moderate Flow observed

Table 8: Potential Surface Water Discharge Locations

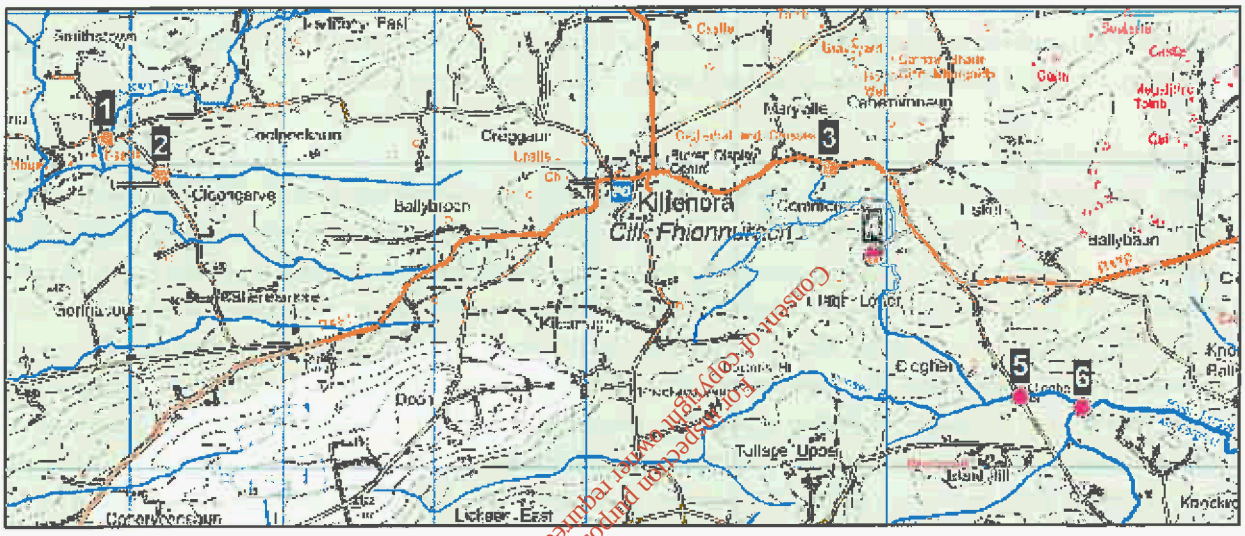


Figure 4: Surface Water Discharge Options

Based on observed flows on the 12th September 2014 alone it is concluded that Sites 2, 3, 4 and 5 would probably have insufficient capacity to assimilate treated effluent from Kilfenora WWTP. It is proposed to further review Site 1 (Smithtown River) and Site 6 (River Fergus) as potential surface water body discharge locations.

6.3.2 Options Review: Ecology and Hydrology

The hydrology of the two potential discharge sites (i.e. Smithstown River at Smithstown Bridge and River Fergus downstream of Clogher Bridge) has been reviewed to identify the receiving waters ecological constraints and to assess, on a preliminary level, if adequate assimilative capacity exists in the watercourses for treated effluent from the Kilfenora WWTP.

Ecological Review

The water-body status and surface water quality, as set out in the Water Framework Directive database, for the Smithstown River and River Fergus at the potential outfall locations are summarised in Table 9.1:

Waterbody	Waterbody Code	Overall Ecological status	Overall Objective	Overall Risk	Surface Water Quality	Salmonid Waters
(Dealagh R.) Smithstown River d/s of	IE_SH_28_555	Good	Protect	2b not at risk	Q4-Good Status Note1	Yes (IFI)

Smithstown Bridge					Note2	
River Fergus d/s of Clogher Bridge	IE_SH_27_181	High	Protect	1A at risk	Q4-Good Status Note3	Yes (IFI)

Note 1: Smithstown Bridge, Note 2: Also Q4 downstream at Aughvackeen Bridge; Note 3: N.W. of Kiltoraght Glebe

Table 9.1: Potential Surface Water Bodies Ecological Status

The Smithstown River discharges to the Deelagh River which in turn outfalls to the Inagh River Estuary near Lahinch. The Inagh River Estuary is a designated special area of conservation (Ref: SAC000036). The River Fergus discharges to the East Burren Complex special area of conservation (Ref: SAC001926) and the Corofin Wetlands special protection area (Ref: SPA004220) at Lough Inchiquin. In the Natura Impact Statement (Ryan Hanley 2014), prepared for the Kilfenora Sewerage Scheme, the likely impacts of the upgrade works on these designated areas have been assessed and mitigations have been recommended.

Hydrological Review

While the potential receiving waters lie in close proximity, their catchment hydrology differ significantly. Smithstown River is located in a poor aquifer, predominantly shale/ sandstone catchment and the Fergus River catchment is, in general, a Regionally Important Aquifer (karstified) limestone catchment with the upper reaches of the Fergus to the south of Kilfenora being located in Poor Aquifers (shale) and Locally Important Aquifer (sandstone). Ballybreen Swallow Hole is located at the interface between the Poor Aquifer and Regionally Important Aquifer (karstified) (i.e. high run-off lands discharging onto karst bedrock formed the swallow hole and underground drainage at Ballybreen). The stream that drains to Ballybreen Swallow Hole has an approximate catchment area of 0.75km² with a steep catchment with very high runoff rates (i.e. WRAP soil type 5) and is likely to run dry during the summer. A minimal flow was noted in the channel upstream of the swallow hole on the 12th September 2014.

Smithstown River rises at Cohy in the hills to the north of Kilfenora and flows in a south westerly direction to join the River Dealagh and in turn the Inagh River before discharging to the sea at Lahinch. Its catchment area at confluence with Cloongarve Stream is 11.3km².

The extents of the Fergus River catchment at Clogher Bridge is difficult to define due to a complex karst drainage system that exists in the region. Three tributaries join close to Clogher Bridge to form the uppermost reaches of the main River Fergus channel, namely Kilfenora (Commonage) Stream, Clooneen Stream and Kilmore North Stream. The direct surface water runoff catchment of the Commonage Stream is less than 4km² while, during flood conditions a large catchment area from the Burren Uplands (which generally drains to the karst underground system that is understood to discharge to the springs downstream of Poulnaboe) overflows into the stream via a series of springs located to the south of Kilfenora Mart. However, as observed in September 2014, following dry periods, the flows in the stream are small. The Commonage Stream drains to the Clooneen Stream upstream of Clogher Bridge. Clooneen and Kilmore North stream catchments are underlain by shale and sandstone bedrock and have estimated catchment areas of 4km² and 13.5km² respectively. A moderate flow was noted in the channel downstream of the confluence of the streams in September 2014.

Low Flow Estimation

The EPA Hydrotool website reports that the 95%ile flow for Smithstown River at the potential outfall location downstream of Smithstown Bridge is 0.035cumec with a catchment area of 15.2km². The catchment on the website is shown to include Ballybreen Stream which has been proven to drain to the Fergus system during

normal conditions and only contributes to the Smithstown River system during flood conditions; therefore, the 95%ile flow is likely to be less than 0.035cumec. Using the Area-SAAR method developed by Mandal-Cunnane (2009), the 95%ile and 50%ile flows at the Smithstown River outfall are estimated at 0.028 cumec and 0.20 cumec respectively.

The EPA Hydrotool website reports that the 95%ile flow at Clogher Bridge (i.e. the Commonage and Clooneen Streams) is 0.15cumec with a catchment area of 62.1km²; however, considering the karstified nature of the catchment the actual 95%ile in the surface channel is likely to be considerably less. The EPA Hydrotool website reports that the 95%ile flow for the Kilmore North Stream upstream of its confluence with Clooneen Stream is 0.015cumec with a catchment area of 13.5km². This estimation appears reasonable based on the observations in September 2014. Based on this data, at the potential outfall location to the River Fergus the 95%ile flow is interpreted as 0.024cumec (24 l/s). Using the Area-SAAR method developed by Mandal-Cunnane (2009), the 95%ile and 50%ile flows at the River Fergus outfall are estimated at 0.052 cumec and 0.38 cumec respectively.

The River Fergus 95%ile flow at Corofin Bridge is reported at 0.317 cumec (EPA Hydronet database) with a catchment area of 166.5km² whilst the OPW river gauge 27003 95%ile flow at the bridge is measured at 0.22 cumec. Figure 5 presents the drainage catchment and Table 9.2 below presents the river catchment characteristics for the potential outfall locations:

Catchment	Area (km²)	Run-off Type*	SAAR**, (mm/annum)	Upstream Main Channel Length (km)	95%ile (cumec)	50%ile (cumec)
Smithstown River downstream of Smithstown bridge	11.3	Moderate to High (Soil Type 3 and 4)	1,500	7.1	0.032	0.20
River Fergus at confluence of Clooneen and Kilmore north Streams	c21.5	High to Very High (Soil Type 4 and 5)	1,400	6.8	Between 0.024 and 0.052 (Ave 0.038)	0.38

Note: The surface area is taken as the apparent area contributing during low flow conditions.
* = IH-126 (Flood Studies Report) Winter Rainfall Acceptance Potential (WRAP) factors
** = Seasonal Annual Average Rainfall (SAAR) (1981 -2010)

Table 9.2: Potential Surface Water Bodies Discharge Locations Catchment Characteristics

Preliminary Assimilative Capacity Assessment

The existing and design future population equivalents (further to Irish Water estimates) for Kilfenora WWTP are 414 PE and 450 PE respectively. Based on 225l/hd/day the DWF for the existing and future plant (excluding storm water) are 93m³/day and 101m³/day. As a preliminary review (and in the absence of background water quality data) the design 3DWF rates are compared to the 95%ile flows in the potential receiving waters in accordance with Memorandum No. 1 Water Quality Guidelines 1978 (See Appendix 2, Section 2.7). The dilution factors are calculated as follows:

Outfall	95%ile Dilution Factor (414PE, Existing)	95%ile Dilution Factor (450 PE, Future)
S1. Smithstown River	9.9	9.1
S6. River Fergus	11.7	10.8

Table 10: Surface Water Bodies Discharge Locations Dilution Factors

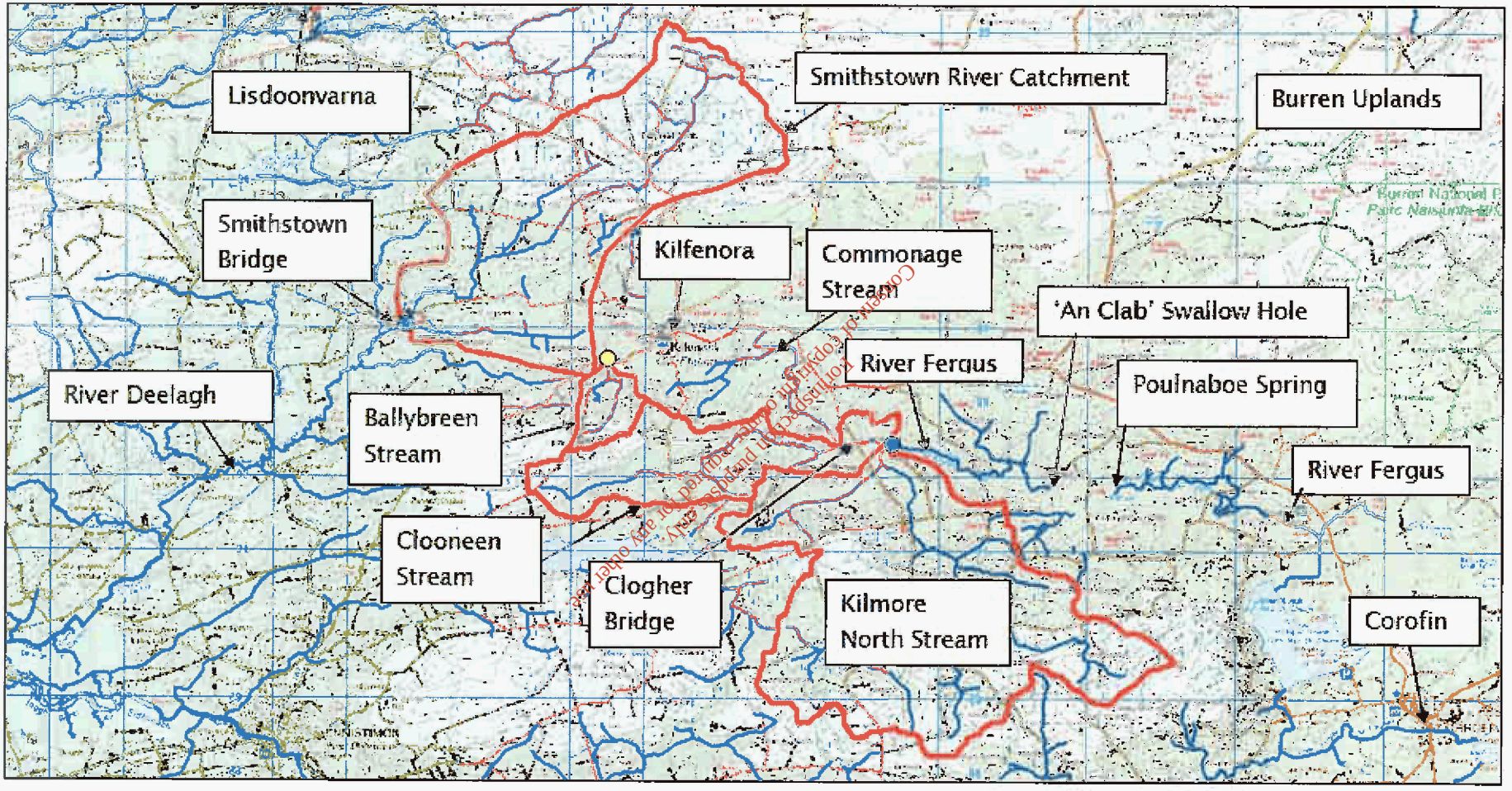


Figure 5: River Catchments at Potential Surface Water Outfall Locations (Blue circles = potential surface water outfalls, yellow circle = existing groundwater outfall)

In all cases the dilution factors between the 3DWF and the river 95%ile flow are greater than 1:8 and therefore it is concluded that, based on this preliminary assessment, the proposed receiving waters are likely to have (in the absence of water quality data) sufficient assimilative capacity. If discharge to surface water were to proceed as further as a potential option, it is recommended that background water quality sampling and low flow measurements be undertaken to allow the actual assimilative capacity of the rivers to be determined.

The tracing studies undertaken by David Drew (TCD) for Ballybreen Swallow Hole have proven connectivity to Poulnaboe (Fergus main channel) in addition to connectivity to borehole supplies downstream of Kilfenora at Lisket and Leamaneh. The following extract from the "Guidance on the Authorisation of Direct Discharges to Groundwater (January 2014)" sets out the definition of the discharging downstream of Clogher Bridge with regard to direct discharge to groundwater:

"In karstified aquifers, where a river may flow above ground only to sink below ground and then re-appear at the surface further downstream, the distinction between groundwater and surface water can sometimes be difficult to determine. In the Groundwater Regulations, a river is defined as "a body of inland water flowing for the most part on the surface of the land but which may flow underground for part of its course". The implication of this definition is that rivers or streams that disappear underground at swallow holes and re-appear further downstream are considered to be rivers in the sections that flow underground. By this definition, it could, therefore, be inferred that the Surface Waters Regulations (2009), as amended (S.I. No. 272 of 2009 and S.I. No. 327 of 2012) would apply to sinking streams/rivers.

However, the nature of water movement in karstified aquifers is complex and is not just confined to movement via conduits, so the question of "which regulations apply" also becomes more complex. Importantly, recent tracer testing in the Burren, County Clare (Drew, 2012) demonstrated that dyes that were injected into an active swallow hole migrated to down-gradient springs rapidly via conduit flow, but also to down-gradient private wells via slower and more "diffuse" pathways, represented by fractures, in the same karstified aquifer. The inference of these results is that the consideration of sinking rivers or streams at swallow holes solely as "river water" does not always accurately depict the true nature of water movement in karstified aquifers. Because of the potential that sinking water can flow diffusely away from conduit systems underground, a river or stream that sinks should be regarded as groundwater unless defensible evidence exists that diffuse dispersion (through fracture systems) is not important for a given site or setting."

The River Fergus outfall, while attenuation and dilution may exist, could be interpreted as being a groundwater discharge. It is likely that tracing of treated effluent discharged to the Fergus at Clogher Bridge could, due to the close interaction between the surface and groundwater in the upper Fergus main channel, prove connectivity to borehole supplies in this area.

Clare County Council have extended the water supply network (supply sourced from Ballymacraven WTW) to all users between Kilfenora and Leamaneh (Leamaneh Private GWS) to remove the existing contamination risk associated with the Ballybreen Swallow Hole outfall. These works, therefore, have likely mitigated the potential drinking water quality issues associated with a surface water discharge to the River Fergus at Clogher Bridge. Inland Fisheries Ireland in their correspondence dated May 2006 expressed their preference that treated effluent would not be discharged to the River Fergus system due to the Salmonid status of the river and to prevent further nutrient enrichment of Lough Inchiquin.

Smithstown River is also classed as a Salmonid river. There are no known water supply abstractions from this watercourse.

Conclusion

Based on ecological issues, assimilative capacity, Inland Fisheries Ireland commentary and groundwater discharge concerns, Option S1 - Smithstown River downstream of Smithstown Bridge would be considered to be the most suitable for treated effluent for Kilfenora WWTP, on the basis of a hydrological and ecological assessment.

6.3.3 Options Review: Infrastructural and Operational Requirements

The potential preliminary routes of the rising main options associated with the Smithstown and Fergus Rivers receiving surface waters outfalls are described below (Figure 6).

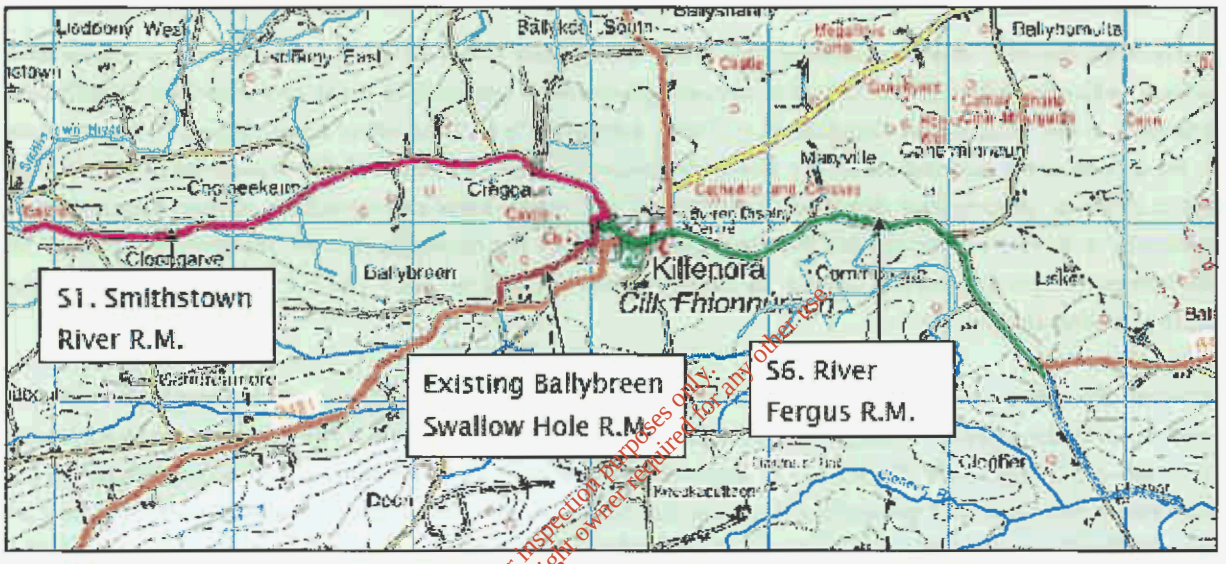


Figure 6: Potential Approximate Routes of Rising Main Options and Existing Rising Main to Ballybreen Swallow Hole

Option S1 - Smithstown River Rising Main

From the WWTP the proposed rising main follows the Kilshanny Road in a north westward and then westward direction for 1.6km before crossing into fields in a south westerly direction towards Cloongarve Stream (1km). The rising main continues along the north bank of the stream as far as the Cloongarve Road (0.6km) and crosses the road and the stream and continues along the south bank of the stream to the proposed outfall location (0.4km), situated approximated 0.23km downstream of Smithstown Bridge. The route avoids the high ground and narrow roads at Coolpeekaun.

Option S6 - River Fergus Rising Main

From the WWTP the rising main crosses lands directly to the Kilshanny road and then southwards to the main street in the village (0.1km). From there the rising main continues eastwards and south eastwards along the R476 to Kennedy's Cross (2.8km) before continuing south eastwards to Clogher Bridge (0.9km). From the bridge the rising main follows the north bank of the Clooneen River to the proposed discharge point 0.5km downstream of the bridge.

Table 11 summarises the Option S1 and S6 rising main routes.

Outfall	Total Length (km)	Length in Road (km)	Length in Field (km)	WWTP level (mOD)	Highest Ground level en route (mOD)
S1. - Smithstown	3.64	1.70	1.94	53	62.8
S6. -Fergus	4.36	3.78	0.58	53	71.6

Table 11: Rising Main Options Comparison

Conclusion

Based on the infrastructure quantities and the likely pumping head requirements Option S1 – would require the least rising main length, requires less work in roads and would involve less pumping head than Option S6.

6.3.4 Discharge to Surface Water Conclusion

The option of discharging treated effluent to the Option S1 - Smithstown River downstream of Smithstown Bridge is likely technically feasible and is the preferred receiving surface water outfall option for the Kilfenora Sewerage Scheme. As part of the screening assessment for discharge to groundwater, this option has been reviewed (See Section 6.5) in comparison to the other preferred viable options, i.e. pumping away to an alternate sewerage scheme and groundwater discharge.

Note: the assimilative capacity of Smithstown River will need to be assessed prior to the appropriateness of these receiving waters being confirmed.

6.4. Discharge to Groundwater Options

Kilfenora lies in the Burren Groundwater Body which is classed as a Regionally Important Aquifer- karstified where conduit flow is prevalent (Note: Kilfenora lies close to the Miltown Malbay GWB which is classed as a poorly productive aquifer). The groundwater vulnerability at the existing WWTP site and Ballybreen Swallow Hole is classed as 'Extreme' i.e. karstified rock at or close to the surface. The existing treated effluent outfall rising main and sewer discharges to a stream located immediately upstream of Ballybreen Swallow hole and is, by definition, a direct discharge to groundwater. Connectivity between the swallow hole and springs and water supply boreholes downstream of Kilfenora during normal conditions and additionally in the Cloongarve Stream during flood conditions has been proven by tracing studies (Drew 2001, 2012). The current discharge (as stated in the Geosyntec Tier 3 Assessment report) is non-compliant with the requirements specified in the EPA guidance and the groundwater regulations underpinning the guidance. Therefore, continued direct discharge to groundwater at Ballybreen Swallow is not a permissible option for Kilfenora WWTP. The main contaminants of potential concern (COPC) regarding discharge to groundwater are considered to be microbial pathogens, nitrogen and phosphorous compounds.

Indirect discharge to groundwater via percolation may be considered a permissible option following COPC reduction / removal. For this option it is recommended that, in addition to a secondary treatment system, the Kilfenora WWTP would include phosphates removal (e.g. Ferric Sulphate dosing upstream of the settlement tank) and a tertiary treatment system followed by UV disinfection prior to discharge via pumping to an engineered percolation area.

Site characterisation and percolation testing have not been undertaken for this assessment as it is accepted, at this stage that, based on the prevailing karst nature of the study area, adequate percolation exists to the regionally important aquifer (karst) in the Kilfenora area. Due to the expected lack of attenuation through the thin overburden and the seasonal high groundwater level in the area it is proposed that a constructed raised

bed percolation system would be used for indirect discharge of treated effluent to the aquifer. Using a hydraulic application rate of 0.8m³/m²/day (as proposed in the Kilfenora Sewerage Scheme PR), an area of 127m² is required for percolation. A network of pipes, will ensure even dispersion of treated effluent. Based on a raised bed height of 1.5m and side slopes of 1 to 2.5, the total plan area (square) would be approximately 400m² or 20m x 20m.

Three options have been identified for indirect discharge of treated effluent to groundwater at Kilfenora, namely:

- Option G1: Construction of tertiary treatment facilities and the percolation area at the existing treatment plant site;
- Option G2: Construction of tertiary treatment facilities at the existing treatment plant site and pumping to a percolation area adjacent to Ballybreen Swallow hole;
- Option G3: Pumping from the WWTP to the tertiary treatment facilities and percolation area located adjacent to Ballybreen Swallow hole.

The elevation of the lands adjacent to Ballybreen Swallow Hole are circa 57mOD and therefore likely to be in Flood Zone C (i.e. low flood risk) (i.e. significantly higher than the Cloongarve turlough flood level observed in November 2009).

Option G1- Tertiary treatment and Percolation discharge at the Existing Site

Coupled with available lands constraints, much of the undeveloped area at the existing WWTP site lies in Flood Zone A or B. Consequently, development of a percolation area at the site may not be deemed appropriate and would require justification under the Planning System and Flood Risk Management Guidelines (OPW, Nov 2009). This option is therefore deemed not appropriate due to flood risk.

Option G2 - Tertiary treatment at the Existing WWTP Site and Percolation discharge adjacent to Ballybreen Swallow Hole

The location for the tertiary treatment works, as proposed in the preliminary report, lies within Flood Zone A and B; however, these works are liable to be deemed justifiable with appropriate mitigation measures put in place. Under this option, the effluent from the tertiary treatment would receive UV disinfection at the existing site before ultimately being pumped to the proposed engineered percolation area adjacent to the Ballybreen Swallow Hole. There are sufficient lands available at this location to accommodate the percolation area.

Option G3 - Tertiary treatment and Percolation discharge adjacent to Ballybreen Swallow Hole

There is adequate available lands adjacent to Ballybreen Swallow Hole to facilitate the development of the tertiary treatment as well as an engineered percolation area. The WWTP pumping operations would require modification whereby the treated effluent from the settlement tank would be pumped (utilising the existing rising main where possible) to the tertiary treatment works adjacent to Ballybreen Swallow Hole. In turn, the effluent from the tertiary treatment would receive UV disinfection before being pumped to the adjacent proposed engineered percolation area.

Alternative sites to those discussed above are likely to be available near Kilfenora where an engineered percolation area could also be situated. However, considering the proven reliable capacity of the karstified bedrock at Ballybreen Swallow Hole, the preferred site for a percolation area is adjacent to the existing outfall.

Conclusion

Option G2 as described above is the recommended groundwater discharge option for further consideration based on the reduced land purchase requirements and the availability of power, access etc. at the existing WWTP site for tertiary treatment. As part of the screening assessment for discharge to groundwater, this option has been reviewed (See Section 6.5) in comparison to the other preferred viable options, i.e. pumping away to an alternate sewerage scheme and discharge to receiving surface waters.

Note: Percolation tests will be required at the lands adjacent to Ballybreen Swallow Hole to confirm their suitability.

6.5. Options Review

6.5.1 Introduction

As part of the screening assessment in accordance with the EPA guidelines to determine if indirect discharge of treated effluent from Kilfenora WWTP to groundwater is permitted, the first two step (as presented in Figure 2 above) require assessments of the following:

- Is a technically and economically feasible surface water discharge alternative available
- If No, is a technically and economically feasible indirect groundwater discharge alternative available

Based on the 'prevent or limit' objective, alternates to treatment of wastewater at Kilfenora were also reviewed.

Table 12 summarises the environmental, engineering (technical) and economic aspects of the discharge options reviewed to allow a recommended discharge proposal, in keeping with the EPA guidance documents, be determined. The options reviewed below are based on the assumption that the existing infiltration and surface water drainage issues associated with the Kilfenora Sewerage Scheme collection system will be resolved (i.e. infiltration and surface water loading to WWTP reduced).

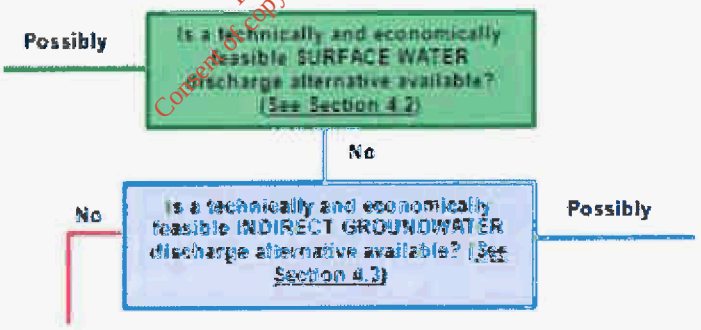


Figure 7: Extract from Figure 2 (first two steps)

6.5.2 Preliminary Cost Estimates

In order to compare the economic aspects of the various discharge options, preliminary capital and operational cost estimates of the different options are presented based on typical rates to allow a cost comparison to be made. The cost estimate does not include for the running cost of the existing or upgraded Kilfenora WWTP treatment plant or the additional operation costs at Lisdoonvarna WWTP as these are taken to be, in general, equivalent. Further to the preliminary report cost estimate of approximately €640,000 for the treatment plant upgrade works, an estimate for a 450PE SBR WWTP system to provide the final effluents standards was calculated at approximately €485,000 (ex. VAT) (including UV) as part of this study.

The following have been considered:

- Option W2 (pump untreated flows to Lisdoonvarna SS) - includes for primary treatment upgrade works & septicity control at Kilfenora WWTP and a telemetry / pump control system. It also includes for a high lift pumping station and 6350m of rising main in roads (estimated at 3000m of 125mm DI pipe (€225/m) and 3350m of 125mm DI PE100 pipe (€150/m)). Includes €100,000 for commissioning works at Lisdoonvarna WWTP to facilitate additional load from Kilfenora. (Note that these are preliminary estimates and could increase depending on the works required at Lisdoonvarna WWTP and on the Lisdoonvarna network).
- Option S1 (pump treated effluent to Smithstown River) - includes for treatment plant upgrade (450PE, secondary and tertiary treatment), effluent pumping station, 1700m of 100mm PE100 rising main in roads (€140/m) and 1940m of 100mm PE100 rising main in fields (€110/m), Outfall structure
- Option G2 (pump treated effluent to Ballybreen Percolation Area) includes for treatment plant upgrade (450PE, secondary and tertiary treatment and UV treatment), percolation area and pump station with land purchase, fencing and works
- For each option €150,000 is included to cover costs of collection system surveys and rehabilitation and flow separation works to reduce the hydraulic load at the WWTP.

The preliminary estimated capital cost (ex. VAT) are summarised below:

Option	Rising Mains	Pumping Stations	WWTP Upgrade	Percolation Area	Land Purchase	Collection System Upgrades	Total
W2	€1,177,500	€200,000	€150,000			€150,000	€1,677,500
S1	€451,400	€60,000	€432,000			€150,000	€1,093,400
G2		€50,000	€463,000	€25,000	€15,000	€150,000	€703,000

Table 12: Preliminary Estimate of Capital Costs

The background to the calculation of the pumping operation costs are included in Appendix 4 while The preliminary estimated operational cost are summarised below:

Option	Daily Cost, €	Annual Cost
W2	€14.73	€5378
S1	€3.96	€1445
G2	€1.80	€657

Note: The above pumping rates are based on infiltration and flow separation contracts been completed for the Kilfenora Sewerage Scheme and design flow for 450PE being 101.25m³/day.

Table 13: Preliminary Estimate Pumping Operational Costs

As storm water overflow discharge to groundwater is not permissible, in the absence of the network upgrade works, all flows will need to be treated and pumped which would require a significant increase in treatment and pumping capacity with associated increase in operation costs. Pumping of storm water is not recommended as part of this assessment and would be considered unsustainable.

Discharge Option	Description	Environmental	Engineering	Economics
W2 - Alternate to treatment of sewage at Kilfenora WWTP	Pump forward primary treated effluent to Lisdoonvarna Sewerage Scheme for secondary treatment and discharge to surface water.	Avoids discharge of treated effluent to ground water and to watercourse of limited assimilative capacity. Potential septicity issues (H_2S and odours).	Existing Lisdoonvarna WWTP has sufficient spare capacity. Involves the construction of 6.35km of 125mm rising main in roads between Kilfenora and Lisdoonvarna with pumping head requirements of in excess of 150m. Septicity control works required. Kilfenora Sludge already treated at Lisdoonvarna. Technically difficult pump operations and maintenance	Estimated Capital Costs is €1,527,500 (Ex VAT) plus €150,000 for collection system surveys, rehab and flow separation works. The annual pumping operational costs are estimated at €5,378. Negates the need to upgrade Kilfenora WWTP. Involves the construction of a large pumping station and probable associated substation.
S1 - Discharge of treatment effluent to surface water	Treat effluent at Kilfenora WWTP to secondary standard and pump treated effluent to Smithstown River for discharge.	Avoids discharge of treated effluent to ground water.	Involves the construction of 3.6km of 100mm rising main in roads and fields with a total pumping head of 44m. Lower treatment standard required than groundwater discharge requirements.	Estimated Capital Costs is €943,400 (Ex VAT) plus €150,000 for collection system surveys, rehab and flow separation works. The annual pumping operational costs are estimated at €1,445 Requires the upgrade of the Kilfenora WWTP as the existing plant is under capacity for 450PE.
G2 - Indirect discharge of treatment effluent to groundwater	Treat effluent at Kilfenora WWTP to tertiary standard and pump treated effluent to Ballybreen for percolation to ground water.	Discharge of treated effluent of a high standard to groundwater by indirect discharge. This discharge method is only permitted where discharge to surface waters is not technically or economically feasible. IFI preference is that discharge to Fergus River avoided.	Involves the construction of a 200m², 1.5m high raised bed percolation area, a tertiary treatment system, UV disinfection system and pumping system. Existing rising main infrastructure can be utilised.	Estimated Capital Costs is €553,000 (Ex VAT) plus €150,000 for collection system surveys, rehab and flow separation works. The annual pumping operational costs are estimated at €657. Requires the upgrade of the Kilfenora WWTP as the existing plant is under capacity for 450PE. Involves purchase of lands adjacent to Ballybreen Swallow hole to accommodate the percolation area.

Table 14: Environmental, Economic and Engineering Aspects Review of Discharge Options

Option W2 (pump to Lisdoonvarna) is a feasible alternative to treatment of wastewater at Kilfenora but involves technically difficult pumping operations and ongoing maintenance and high operational cost. The options negates the need to upgrade the Kilfenora WWTP and Lisdoonvarna has sufficient spare capacity. However, the capital costs are high (i.e. 6.35km of rising main in roads and 1 No. pumping station. There are likely operational issues to be overcome associated with septicity control and blockage in the rising main. While the design PE for Lisdoonvarna Sewerage Scheme is understood to be 5000PE, it will be necessary to assess the scheme's infrastructure capacity to identify if upgrades that would be required (on both the network and WWTP) to facilitate flows from the Kilfenora Sewerage Scheme. Option W2, has the highest estimated capital and pumping operation costs of the three options considered. Irish Water has advised that, based on the cost estimated, this option would not be economically feasible considering the design population equivalent.

Option S1 (discharge to Smithstown River) is technically feasible (pending confirmation of the assimilative capacity of the river). However, Irish Water has advised that, based on the costs estimated, this option would not be economically feasible considering the design population equivalent.

Option G2 (indirect discharge to groundwater at Ballybreen) is technically feasible but requires the purchase of land to accommodate a large engineered percolation area. Taking account of capital and operation costs, this option has the lowest whole-life cost of the three options considered. Irish Water has advised that the costs associated with this option would be economically feasible.

6.6. Conclusion

In accordance with the EPA Guideline screening assessment, indirect discharge to groundwater is permitted only if an alternate technically and economically discharge to surface water is not technically or economically feasible. While Option S1 (pumping to Smithstown River) is technically feasible, it involves a larger capital cost (rising main and pumping station) and pumping costs than Option G2 (indirect discharge to groundwater) and would not be economically feasible considering the design PE for Kilfenora. Therefore the only remaining feasible option, both technically and economically, is deemed to be Option G2, i.e. indirect discharge to groundwater at Ballybreen.

7. Discharge Standards

7.1. Wastewater Treatment Process

A summary of the estimated chemical and pathogenic reductions in effluent consequent to secondary treatment (with or without UV treatment) and following tertiary filtration (with or without UV treatment) is included in Appendix 5.

7.2. Groundwater Discharge Standards

The Tier 3 Hydrogeology Assessment for Kilfenora WWTP Discharge identifies that main contaminants of potential concern (COPC) are considered to be microbial pathogens, nitrogen and phosphorous compounds. It is therefore imperative that any effluent discharge to groundwater from the WWTP would be to a standard which includes for the removal microbial pathogens and significantly reduces nitrogen and phosphorous compounds.

Table 15 summarises the discharge and receiving water standards requirements for the treated effluent from Kilfenora WWTP to Option G2 – Indirect Discharge to Groundwater. Due to the proven close interconnection between groundwater and surface water to the east of Kilfenora in the Fergus catchment it is deemed appropriate that Freshwater Fish and Salmonid Directives are considered for determining the final effluent standards.

<table>
<tr><th>Directive / Regulation</th><th>Requirement</th></tr>
<tr><td>Urban Wastewater Treatment Directive - 91/271/EEC & SI 254 of 2001</td><td>
<table>
<tr><th>Parameters</th><th>Concentration</th><th>Minimum Percentage of Reduction</th></tr>
<tr><td>Biochemical Oxygen Demand (BOD_5 at 20°C) without nitrification</td><td>25 mg/l O_2</td><td>70-90</td></tr>
<tr><td>Chemical Oxygen Demand (COD)</td><td>125 mg/l O_2</td><td>75</td></tr>
<tr><td>Total Suspended Solids</td><td>35 mg/l</td><td>90</td></tr>
</table>
Table 15.1 Final Effluent Parameters-Urban Wastewater Treatment Directive
</td></tr>
<tr><td>Water Framework Directive/ European Communities Environmental Objectives (Surface Waters) Regulations – 2000/60/EC & SI 272 of 2009</td><td>
The overall aim for surface waters is to protect the 'good ecological status' and 'good chemical status' by 2021. The current status should not be allowed to deteriorate [Regulation 28].
<table>
<tr><th>Waterbody</th><th>Smithstown (Dealagh)</th><th>WFD Status</th><th>Good</th></tr>
<tr><th>Parameter</th><th>All flow conditions</th><th>50%ile Flow Concentrations</th><th>95%ile Flow Concentrations</th></tr>
<tr><td colspan="4">Thermal Conditions:</td></tr>
<tr><td>Temperature</td><td>Not greater than a 1.5°C rise in ambient temperature outside the mixing zone</td><td></td><td></td></tr>
<tr><td colspan="4">Oxygenation Conditions:</td></tr>
<tr><td>BOD mg O_2/l</td><td></td><td>≤ 1.5</td><td>≤ 2.6</td></tr>
<tr><td>Dissolved Oxygen Lower limit</td><td></td><td></td><td>>80% saturation</td></tr>
<tr><td>Dissolved Oxygen Upper limit</td><td></td><td></td><td><120% saturation</td></tr>
</table>
</td></tr>
</table>

	Acidification Status

pH	Soft Water 4.5< pH < 9.0 Hard Water 6.0< pH < 9.0		
Nutrient Conditions			
Total Ammonia (NH_3) mg N/l (1)		≤ 0.065	≤ 0.14
Molybdate Reactive Phosphorus (MRP) mg P/l		≤ 0.035	≤ 0.075

Note: (1) = 82.2% of Ammonia is N, Soft = Water hardness ≤ 100 mg/1 CaCO3, Hard = Water hardness > 100 mg/1 CaCO3

Table 15.2 Water Regulations standards

EC (Quality of Salmonid Waters Regulations) 1988 (SI No.293 of 1988).

Freshwater Fish Directive

Parameter	Concentration	Standard
BOD_5	<5.0mg/l O_2	>95% of samples over a period of 12 months where sampling is carried out at least once per month
SS	<25.0mg/l	Average concentration over a period of 12 months
Nitrites	<0.05mg/l NO_2	>95% of samples over a period of 12 months where sampling is carried out at least once per month
Total Ammonium	<1mg/l NH_4 or <0.8mg/l - N	>95% of samples over a period of 12 months where sampling is carried out at least once per month

Table 15.3 Salmonid Water Quality Standards for receiving waters

Freshwater Fish Directive states a limit for BOD_5 of 3mg/l

Local Government (Water Pollution) Act 1977 (Water Quality Standards for Phosphorus) Regulations 1998(SI No. 258 of 1998)

Existing Q Value	Target Q-Value	Target MRP (µg P/l)
5	5	15
4/5	4/5	20
4	**4**	**30**
3/4	4	30
3	3/4	50
2/3	3/4	50
<2	3	70

Table 4 Phosphorus Regulations Target Values for receiving waters

Council Directive 91/676/EEC (The Nitrates Directive) 1991

The River Fergus may be considered a sensitive water for Eutrophication and therefore consideration should be given to the discharge of Total Nitrogen concentrations in the effluent of 15mg/l N'.

Parameter	Concentration	
Total Nitrogen	15	mg/l

Table 15.4 Nitrates Regulations Target Values

Groundwater Threshold Value protective of water intended for human consumption / Drinking Water Standards (SI 278 of 2007)

Parameter	Emission Limit Value
Nitrate (mg/l NO_3)	37.5
Ammonium (µg/l N)	175
Nitrite (µg/l NO_2)	375
E. Coli (counts/100ml)	<1
Enterococci (counts/100ml)	<1
Clostridium Perfringens (counts/100ml)	<1

Inland Fisheries Ireland (letter dated 5th May 2006)	Minimum Discharge Requirements. Preference that there will no to discharge to the Fergus catchment Smithstown River outfall BOD:SS = 10:10 98% phosphorus removal Nitrates reduction

Table 15: Discharge and receiving waters (Groundwater at Ballybreen) standards requirement for treatment effluent from Kilfenora WWTP.

The recommended final effluent standard for Kilfenora WWTP is therefore

Parameter	Final Effluent Standard
BOD	10 mg/l
COD	125 mg/l
SS	10 mg/l
Phosphorus Removal	98% reduction
Total Nitrogen	15 mg/l
E.coli	5 x 10^2 per 100ml or less
Enterococci	1 x 10^2 per 100ml or less

Table 16: Recommended Final Effluent Standards

The final effluent standards proposed for indirect discharge to groundwater at Ballybreen (as set out in Option G2) are achievable using a secondary treatment process with phosphorus removal (e.g. ferric sulphate dosing upstream of the settlement tank) followed by tertiary (sand filtration) treatment system and UV-disinfection prior to discharge to a percolation system. The percolation system, in addition to facilitating dispersion of treated effluent for indirect percolation to groundwater, will provide treatment which will further improve the final effluent standard. Treated effluent quality will be assessed at the outfall from the WWTP.

7.3. Groundwater Discharge Location

It is recommended that, considering the proven reliable drainage capacity of the karstified bedrock at Ballybreen Swallow Hole, the site for the percolation area associated with Option G2 is adjacent to the existing outfall. Based on a raised bed height of 1.5m and side slopes of 1 to 2.5, the total plan area (square) of the percolation area will need to be approximately 400m² or 20m x 20m. The Irish Grid reference of the recommended site for the percolation area is E117470, N193547.

A topographical survey of the lands adjacent to Ballybreen Swallow Hole coupled with percolation testing will need to be undertaken to confirm the suitability of the proposed raised bed percolation area site.

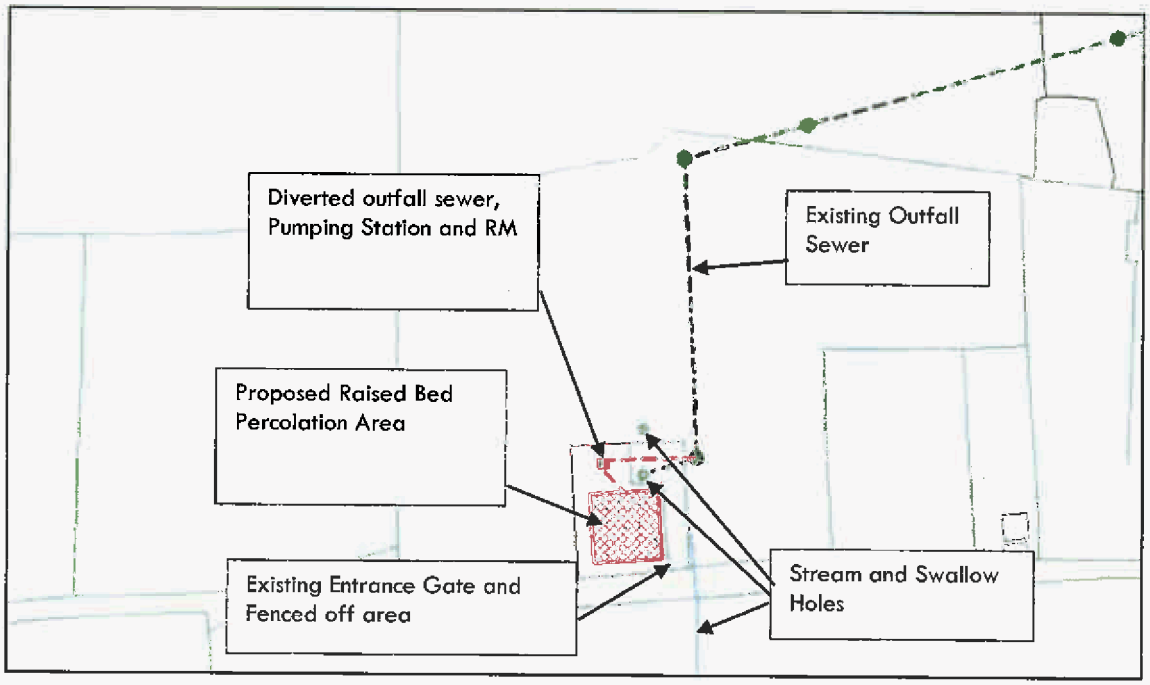


Figure 8: Proposed raised bed percolation area adjacent to Ballybreen Swallow Hole

Photo 3: Site of Proposed Raised Bed Percolation Area and existing fenced off area at Ballybreen Swallow

Photo 4: Site of Proposed Raised Bed Percolation Area and adjacent Ennistymon Road. Note: ESB overhead lines adjacent to the site.

8. Summary and Recommendations

Currently, Kilfenora WWTP discharges treated effluent directly to Ballybreen Swallow Hole and has a high level storm water overflow which discharges to a swallow hole adjacent to the WWTP. In accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010), direct discharges to groundwater are prohibited. Irish Water requested Ryan Hanley to review the appropriate legalisation, assess the discharge options available for the treated effluent and storm water overflow for Kilfenora WWTP and identify the preferred discharge option.

The Kilfenora Sewerage Scheme Preliminary Report (Ryan Hanley, August 2007) recommended the upgrade of the existing treatment plant and to discharge the treated effluent to a percolation area at Ballybreen Swallow Hole. The WWTP has been assessed, as part of this report, to be hydraulically overloaded and it is recommended that upgrade works be carried out at Kilfenora to provide treatment capacity for the design population equivalent of approximately 450 (subject to confirmation at detailed design stage) to produce the recommended final effluent standards (see below).

The first two steps of the screening assessment in accordance with the EPA guidelines to determine if indirect discharge of treated effluent from Kilfenora WWTP to groundwater is permitted, are as follows:

- Is a technically and economically feasible surface water discharge alternative available?
- If No, is a technically and economically feasible indirect groundwater discharge alternative available?

Based on the 'prevent or limit' objective, alternates to treatment of wastewater at Kilfenora were reviewed in addition to alternate discharge locations for treated effluent. In total, the discharge options reviewed are as follows:

- Pump untreated wastewater to a nearby WWTP for treatment;
- Treat wastewater at Kilfenora WWTP to an appropriate standard and pump treated effluent to nearby surface waters; and
- Treat wastewater to an appropriate standard at Kilfenora WWTP and discharge treated effluent indirectly to groundwater.

It is noted that prior to this report, a Natura Impact Statement and a Tier 3 Assessment (in accordance with Guidance on the Authorisation of Discharges to Groundwater, (EPA December 2011)) have been undertaken for the current preliminary report proposal i.e. indirect discharge to groundwater.

For each of the three different discharge options outlined above, different sub-options were considered under each and the three preferred discharge options identified for comparison are as follows:

- Option W2 – Pump untreated effluent to Lisdoonvarna sewerage scheme
- Option S1 – Upgrade Kilfenora WWTP including tertiary treatment and phosphorus removal and pump treated effluent for discharge to Smithstown River
- Option G2 – Upgrade Kilfenora WWTP including tertiary treatment, UV disinfection and phosphorus removal and pump treated effluent for discharge to a raised bed percolation area adjacent to Ballybreen Swallow Hole.

The options were compared based on Environmental, Engineering and Economic parameters and it was identified that, based on the EPA guidance documents requirements and estimated capital cost for the WWTP

and collection system upgrade works and pumping costs, Option G2 is the only technically and economically feasible option.

The final effluent discharge standards are recommended as follows:

Parameter	Final Effluent Standard
BOD	10 mg/l
COD	125 mg/l
SS	10 mg/l
Phosphorus Removal	98% reduction
Total Nitrogen	15 mg/l
E.coli	5 x 10^2 per 100ml or less
Enterococci	1 x 10^2 per 100ml or less

Note: The proposed design PE for the WWTP upgrade is estimated to be 450PE (subject to confirmation at detail design stage).

These treatment standards can be achieved by a secondary treatment process with phosphorus removal (e.g. ferric sulphate dosing upstream of the settlement tank) and a tertiary (sand filtration) treatment system followed by UV disinfection before discharge to a raised bed percolation area.

The recommended site for the percolation area is adjacent to the existing outfall at Ballybreen Swallow Hole. The raised bed height will be 1.5m with side slopes of 1 to 2.5 and a total plan area of 400m² or 20m x 20m. The Irish Grid reference for the recommended percolation area site is E117470, N193547.

A topographical survey of the lands adjacent to Ballybreen Swallow Hole coupled with percolation testing will need to be undertaken to confirm the suitability of the proposed raised bed percolation area site.

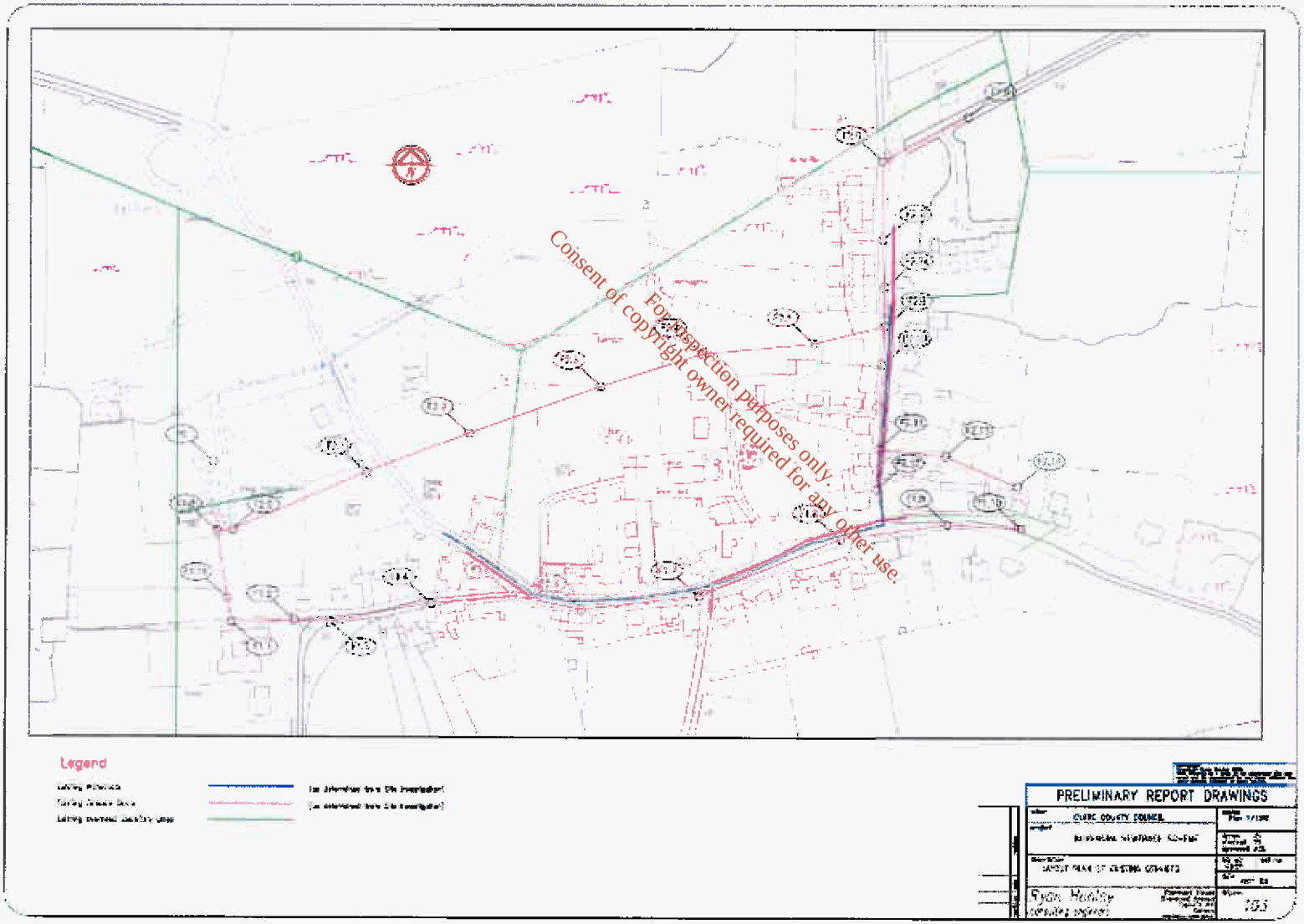
Based on a review of the total daily flows records forwarded for treatment at the WWTP for 2013 and preliminary impermeable area calculations, it was concluded that storm water contribution and infiltration are prevalent in the Kilfenora Sewerage Scheme collection system. The 2013 WWTP records also reported that the high level overflow at the inlet works discharged untreated storm water to Swallow Hole A on 65 days. This is considered to be a direct discharge and in accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) is not exempt and therefore prohibited. The recommended option for storm water at Kilfenora WWTP is to carry out works on the network to reduce the volumes arriving at the plant, provide appropriately sized stormwater handling facilities and treat all flows to the required standard for discharge to the proposed percolation area adjacent to Ballybreen Swallow Hole. The storm water strategy therefore requires both collection system and WWTP upgrade works.

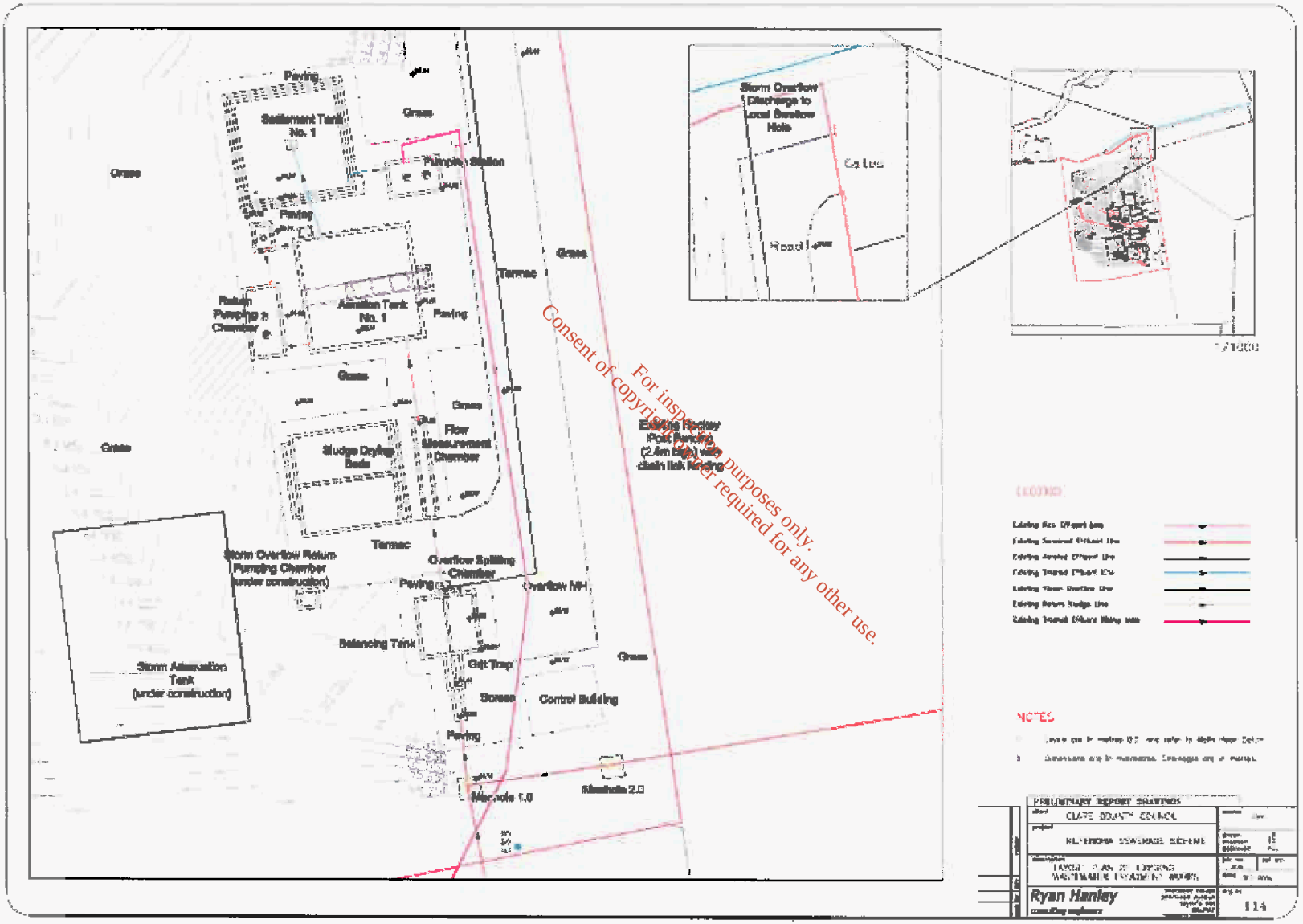
The following studies and surveys are recommended for the Kilfenora Sewerage Scheme:

- Primarily sewer inspection survey followed by a CCTV sewer survey coupled with a flow and load survey programmed to be undertaken when storm water contribution and infiltration are likely to be high i.e. winter, to allow the necessary collection system infiltration repair and flow separation contracts to be designed to reduce the storm water volumes arriving at the plant.
- Flood Risk Assessment for the WWTP site.
- Percolation tests and topographical survey for the lands adjacent to Ballybreen Swallow Hole for a raised bed percolation area (Option G2).

Kilfenora Sewerage Scheme
Assessment of Discharge
Appendices

Appendix 1.1





Appendix 1.2

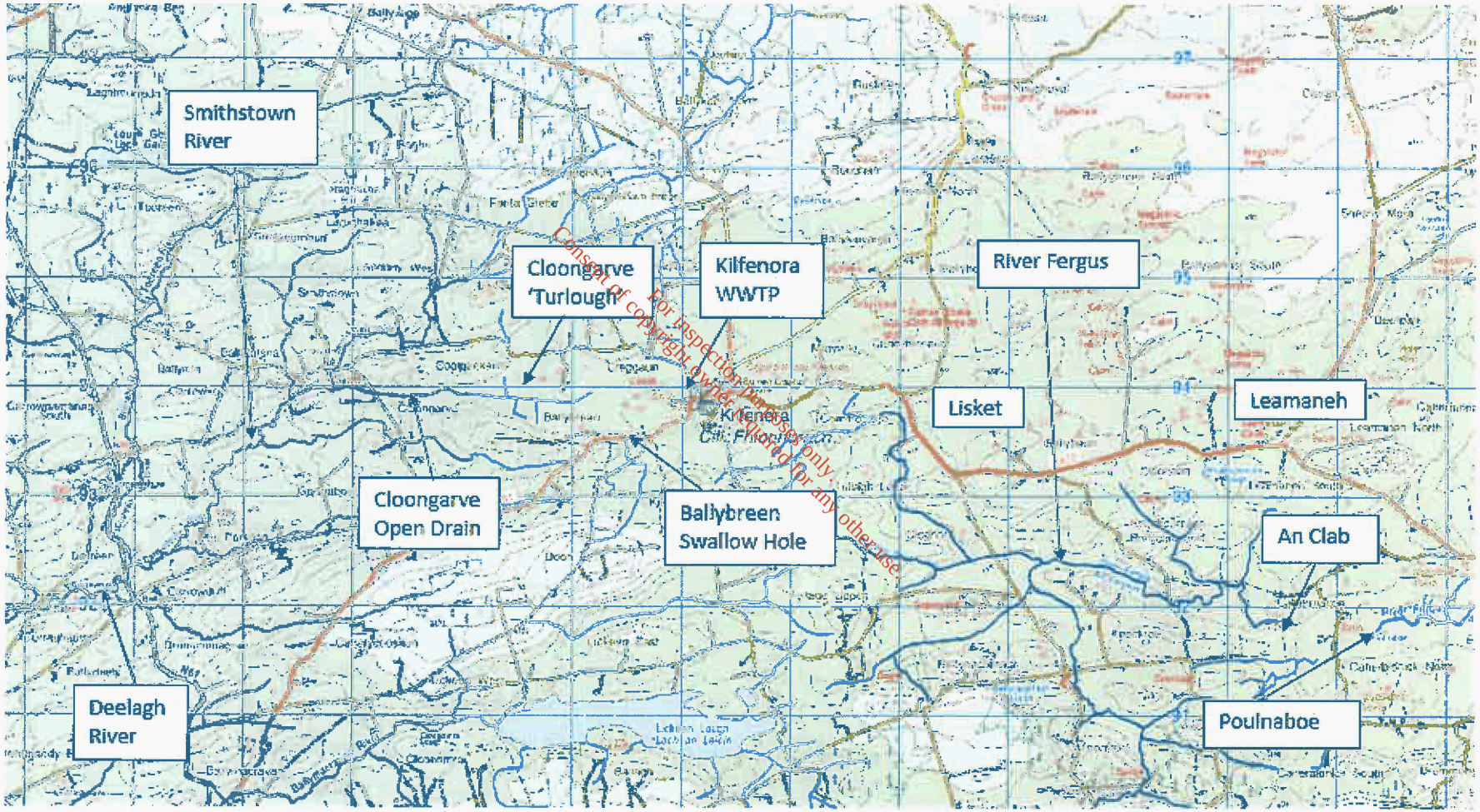


Figure Ap1.2: Hydrology adjacent to Kilfenora

Appendix 2 – Surface Water Discharge Regulations

2.1 Urban Wastewater Treatment Directive - 91/271/EEC & SI 254 of 2001

The Urban Wastewater Treatment Regulations deal with the collection, treatment and discharge of urban water and wastewater from certain industrial sectors. The relevant parameters for final effluent quality laid down by the second schedule of these regulations are as follows;

Parameters	Concentration	Minimum Percentage of Reduction
Biochemical Oxygen Demand (BOD_5 at 20°C) without nitrification	25 mg/l O_2	70-90
Chemical Oxygen Demand (COD)	125 mg/l O_2	75
Total Suspended Solids	35 mg/l	90

Table 1 Final Effluent Parameters [Urban Wastewater Treatment Directive]

Further final effluent parameters relating to nitrogen and phosphorous are given in Part 2 of the Second Schedule. The above final effluent standards, typically, are achievable by the provision of wastewater treatment of adequate capacity, to at least secondary treatment standard.

2.2. Surface Waters Regulations

The Water Framework Directive / European Communities Environmental Objectives (Surface Waters) Regulations – 2000/60/EC & SI 272 of 2009 transposed into Irish law the measures needed to give effect to the environmental objectives of the Water Framework Directive. These regulations give legal status to the criteria and standards to be used to classify surface waters. The standards apply to all surface waters i.e. rivers, lakes, transitional, coastal and artificial water bodies. Agencies involved in authorising discharges to water need environmental quality standards to determine the amount and concentration of a substance that may be allowed in the discharge without causing damage to aquatic biological communities or failure of the environmental objectives of the Water Framework Directive. Based on the River Basin Management Plans and these regulations, the overall aim for surface waters is to protect the 'good ecological status' and 'good chemical status' by 2021.

Regulations 35 to 40 of the regulations lay down the rules for the classification of ecological status. The evaluation of ecological status of a surface water is to be based on the lower of the status values obtained for the biological and physico-chemical quality elements. Regulation 41 lays down the rules for assessing the chemical status of a water body which is to be assigned on the basis of compliance or otherwise with the environmental quality standards established for priority and priority hazardous substances. Priority substances are chemical substances presenting a high risk to the aquatic environment. Thirty three substances or groups of substances are on the first EU priority list.

2.3. Biological Quality Elements

To date, six biological classification systems are included for the purpose of ecological assessment of surface waters as follows;

1. Macroinvertebrates in Irish Rivers
2. Phytobenthos in Irish Lakes
3. Phytoplankton in Irish Lakes
4. Macrophytes in Irish Lakes
5. Phytoplankton in Irish Coastal Waters
6. Elevated Abundance of Opportunistic Macroalgae in Coastal and Transitional Waters

Of the six, only one classification system is relevant (through the close interaction of groundwater with surface waters in a karstic region) to the treated effluent outfall from the Kilfenora WWTP wastewater treatment works i.e. Macroinvertebrates in Irish Rivers.

Council Directive 78/659/EEC 1978 on the quality of fresh waters needing protection in order to support fish life was given effect in Ireland through the EC (Quality of Salmonid Waters Regulations) 1988 (SI No.293 of 1988). As the River Fergus and the Smithstown Rivers are considered as Salmonid waters, the treated effluent should be of a sufficient quality to not impact on the ability of the receiving water to reach the water quality standards in the 1988 Regulations listed in Table 2 below.

The purpose of the Environmental Objectives [Surface Water] Regulations is to achieve the environmental objectives of a water body [in this case of this assessment the Smithstown (Dealagh) River and the River Fergus] as a whole. The environmental objective in the case of these rivers, where the surface water ecological status is Good, is that the current status should not be allowed to deteriorate [Regulation 28].

Parameter	Concentration	Standard
BOD_5	<5.0mg/l O_2	>95% of samples over a period of 12 months where sampling is carried out at least once per month

SS	<25.0mg/l	Average concentration over a period of 12 months
Nitrites	<0.05mg/l NO_2	>95% of samples over a period of 12 months where sampling is carried out at least once per month
Total Ammonium	<1mg/l NH_4 or <0.8mg/l - N	>95% of samples over a period of 12 months where sampling is carried out at least once per month

Note: the Freshwater Fish Directive states a limit for BOD_5 of 3mg/l.

Table 2 Salmonid Water Quality Standards

The wastewater treatment works at Kilfenora is only one of many diffuse and point sources which discharge to groundwater (and, due to the karstified nature of the region, therefore to surface waters) within the catchment of the River Fergus. Diffuse sources include septic tanks, forestry and agriculture.

In the case of the Smithstown River and the River Fergus, the most relevant Physico-Chemical parameter in the surface water regulations is Phosphates and Ortho-Phosphates, while it is clear that the there is also a responsibility to maintain the biological quality of the receiving water.

Under the Surface Water Regulations S.I. 272 of 2009 the following criteria are applicable to a 'good' physico-chemical status river.

Waterbody	Smithstown (Dealagh) and Fergus	**WFD Status**	Good
Parameter	**All flow conditions**	**50%ile Flow Concentrations**	**95%ile Flow Concentrations**
Thermal Conditions:			
Temperature	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone		
Oxygenation Conditions:			
BOD mg O_2/l		≤ 1.5	≤ 2.6
Dissolved Oxygen Lower limit			>80% saturation
Dissolved Oxygen Upper limit			<120% saturation
Acidification Status			
pH	Soft Water 4.5< pH < 9.0 Hard Water 6.0< pH < 9.0		
Nutrient Conditions			

Total Ammonia (NH_3) mg N/l (1)		≤ 0.065	≤ 0.14
Molybdate Reactive Phosphorus (MRP) mg P/l		≤ 0.035	≤ 0.075

Note: (1) = 82.2% of Ammonia is N, Soft = Water hardness ≤ 100 mg/1 CaCO3, Hard = Water hardness > 100 mg/1 CaCO3

Table 3 River Fergus Surface Water Regulations standards

2.4. Waste Water Discharge (Authorisation) Regulations 2007 - SI684

The purpose of these regulations, implemented towards the end of 2007, is to give effect to Article 6 of the Dangerous Substances Directive and to implement the following measures required under the Water Framework Directive (WFD);

- Measures required to achieve the environmental objectives established by Article 4 of WFD
- Measures to ensure the protection of bodies of water used for the abstraction of drinking water
- Measures required under Article 16(1) and 16(8) of the WFD with the aim of progressively reducing pollution of surface waters by priority substances and the ceasing or phasing out of emissions, discharges and losses of priority hazardous substances
- Measures required under WFD to prevent and control pollution of groundwater

The requirements of the following Directives are addressed in the Regulations;

- Dangerous Substances Directive
- Water Framework Directive
- Birds Directive
- Groundwater Directive
- Drinking Water Directive and Drinking Water Standards (SI 278 of 2007)
- Urban Wastewater Treatment Directive
- Habitats Directive
- Bathing Water Directive

2.5. Phosphorus Regulations 1988

The Local Government (Water Pollution) Act 1977 (Water Quality Standards for Phosphorus) Regulations 1998(SI No. 258 of 1998) were introduced to counter eutrophication observed throughout Irish watercourses (rivers and lakes only) and also to comply with the 1976 Dangerous Substances Directive. The Regulations oblige Local Authorities to maintain or

improve the water quality at any part on a river or lake, by 2007, by reference to the biotic indices/Q-rating or to the concentration of molybdate-reactive phosphate (MRP) although the Q-rating is seen as a better indicator of long term water quality than the MRP. No deterioration in water quality is allowed. The target values are as indicated in Table 4.

Existing Q Value	Target Q-Value	Target MRP (µg P/l)
5	5	15
4/5	4/5	20
4	4	30
3/4	4	30
3	3/4	50
2/3	3/4	50
<2	3	70

Table 4 Phosphorus Regulations Target Value

2.6. Nitrates Directive

Council Directive 91/676/EEC (The Nitrates Directive) 1991 is concerned with the protection of waters from pollution caused by nitrates from agricultural sources. Under Ireland's implementation of the Nitrates Directive the whole country has been designated as a Nitrate Vulnerable Zone. The River Fergus is designated sensitive water for Eutrophication (i.e. reported Lough Inchiquin enrichment issues every summer) and therefore consideration should be given to the discharge of Total Nitrogen concentrations in the effluent of 15mg/l N'. Although the Smithstown River is not a 'designated sensitive water for Eutrophication' the nitrogen concentrations stipulated for the Fergus should also be, as a minimum be applicable for the Smithstown River.

Parameter	Concentration	
Total Nitrogen	15	mg/l

Table 5 Nitrates Regulations Target Values

2.7. Memorandum No. 1 Water Quality Guidelines 1978

The Eighth Report of the Royal Commission Standards on Sewage Disposal (dated 1912) formed the basis for Memorandum No. 1 Water Quality Guidelines 1978, as issued by the Department of the Environment's Technical Committee on Effluent and Water Quality Standards.

In accordance with the Commission the normal effluent standards were 20mg/l BOD_5 and 30 mg/l Suspended Solids with a minimum dilution factor of 1:8 in the discharge of the treated effluent to a watercourse, regardless of treatment. In addition the Commission advised that if a watercourse, following the discharge of a treated effluent, has a BOD_5 level of less than 4mg/l it will not show signs of pollution. The Royal Commission Standards have been superseded by the Urban Waste Water Directive but the dilution factor of 1:8 is still used as a guideline when determining the assimilative capacity of receiving waters.

2.8. Quality of Surface Water for the Abstraction of Drinking Water Regulations, 1999

Within the Fergus Catchment downstream of Kilfenora a number of private water supply boreholes are still operated for agricultural supply. Clare County Council have in recent years provided a connection from the Ballymacraven WTW Regional Water Supply Scheme to the Lisket and Leamaneh area to mitigate any potential contamination risk of groundwater domestic supplies. Drew has proven by tracing there is a direct linkage between Ballybreen Swallow Hole and borehole supplies in the Lisket and Leamaneh area in addition to identifying that there is definite interaction between the upper reaches of the River Fergus (over-ground channel) and the underlying aquifer due to the karstic nature of the region. Any effluent discharge to the Fergus catchment from Kilfenora WWTP, either to groundwater or surface water, should therefore be considered as discharging to an abstraction source and therefore the European Communities (Quality of Surface Water for the Abstraction of Drinking Water) Regulations, 1999 and Drinking Water Standards (SI 278 of 2007) are relevant. The limits set on Total Nitrogen and BOD_5 in regulations are 15mg/l and 5mg/l respectively.

Parameter	Emission Limit Value	Source of Emission Limit Value
BOD (mg/l)	25	Urban Waste Water Treatment Directive (91/271/EEC)
COD (mg/l)	125	
Suspended Solids (mg/l)	35	
Molybdate Reactive Phosphorus –MRP (µg/l P)	-	No human health criteria for phosphorous compounds
Nitrate (mg/l NO_3)	37.5	Groundwater Threshold Value (GVT) intended for human consumption
Ammonium (µg/l N)	175	GVT intended for human consumption / Drinking Water Standards (SI 278 of 2007)
Nitrite (µg/l NO_2)	375	Groundwater Threshold Value (GVT) intended for human consumption
E. Coli (counts/100ml)	<1	Drinking Water Standards (SI 278 of 2007)
Enterococci (counts/100ml)	<1	
Clostridium Perfringens (counts/100ml)	<1	

The Smithstown River, which lies in a poor aquifer (i.e. poor interaction between surface water and groundwater), is not used for abstraction and therefore the regulations are not directly applicable in this case.

Appendix 3

Rainfall (Shannon Airport) versus Flows (Kilfenora WWTP FFT) for August 2014

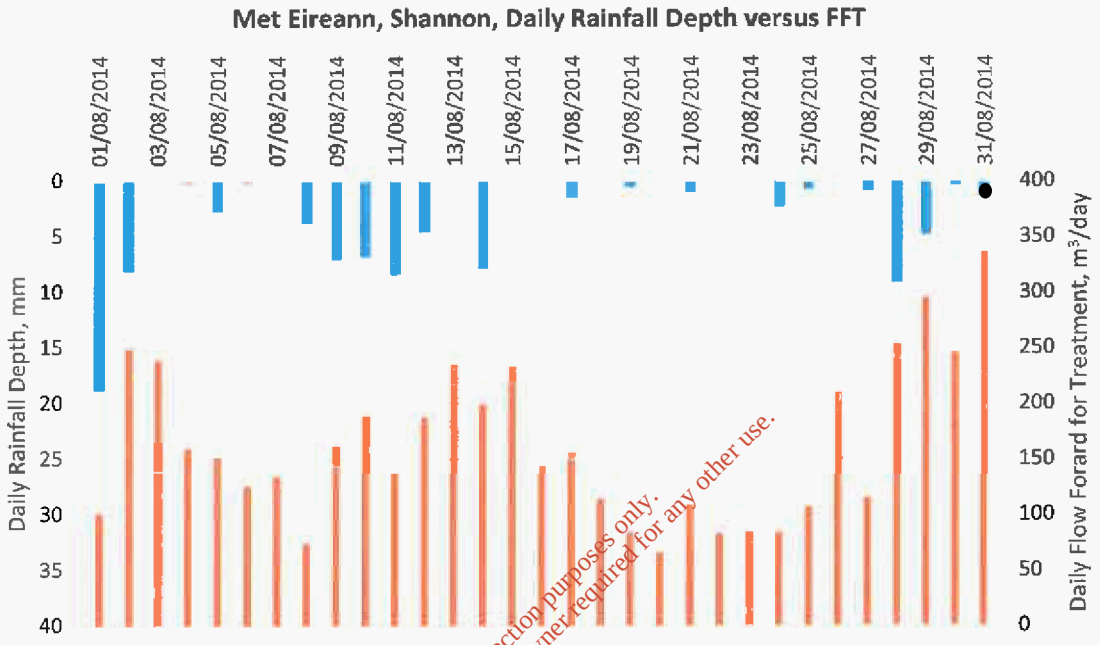


Chart 2: Met Eireann Rainfall during August 2014

Rainfall (Shannon Airport) for August and September 2014

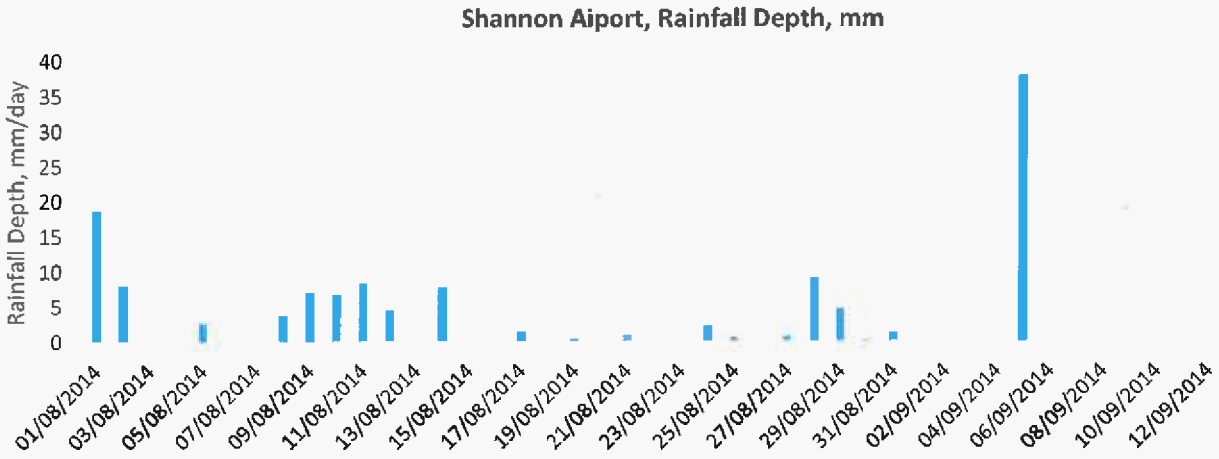


Chart 3: Met Eireann Rainfall during August and early September 2014

Appendix 4

Background to Pumping Operation Cost Estimate

The pumping operation costs (excluding maintenance) have been calculated based on pump efficiency rate of 65%, power to pump efficiency rate of 88%, design flow based on a self-cleansing velocity of 0.7m/s, ks=0.3mm pipe roughness coefficient for the treated effluent rising mains, ks=1.5mm pipe roughness coefficient for the untreated effluent rising main and the unit power cost of €0.15/kWh. The average pump rate was calculated based on a self-cleansing velocity of 0.7m/s. The pumping operation costs for Option W2 include for the additional pumping cost at Lisdoonvarna main lift pumping station due to the increased hydraulic loading from Kilfenora Sewerage Scheme.

The preliminary estimated operational cost are summarised below:

Option	Rising Mains, m	DWF, m3/day	Diameter, mm	Static head, m	Pump Flow, l/s	Pump Time, hrs	Pipe Loss m/km	Total Pump head, m	Power, kW	Est. Pump, kW	Daily Cost, €	Annual Cost
W2	7,750	101.25	125 mm	87	8.6	3.3	8.25	150.9	22.2	30	€14.73	€5378
S1	3,640	101.25	100 mm	19	1.2	24	0.4	20	0.4	1.10	€3.96	€1445
G2	350	101.25	75mm	14	1.2	24	1.6	14.6	0.3	0.5	€1.80	€657

Table 13.1: Preliminary Estimate Pumping Operational Costs

Note: Actual pumping costs etc. will be based on pump selected

Appendix 5

The following table summarises the estimates of chemical and pathogenic reductions in effluent consequent to secondary treatment (with or without UV treatment) and following tertiary filtration (with or without UV treatment)

Table: Estimates of chemical and pathogenic reductions in effluent following treatment

Parameter	Final Effluent following Secondary Treatment	Final Effluent following Secondary and UV disinfection	Final Effluent following Secondary Treatment and Tertiary (Sand) Filtration	Final Effluent following Secondary Treatment, Tertiary (Sand) Filtration and UV disinfection
BOD_5	20mg/l	20mg/l	10mg/l	10mg/l
Suspended Solids	35mg/l	35mg/l	10mg/l	10mg/l
Molybdate Reactive Phosphorous (MRP)	8mg/l	8mg/l	8mg/l	8mg/l
E.Coli	$1X10^6$ per 100 ml	1-2 x 10^4 per 100ml depending on UV dose rate and the unfiltered UVT of wastewater	5 X 10^4 per 100ml	5 x 10^2 or less depending on UV dose rate and the increase in UVT of wastewater post filtration
Enterococci	5 X 10^5 per 100ml	5 x 10^3 per 100ml or less depending on UV dose rate and the unfiltered UVT of wastewater	1 X 10^4 per 100ml	1 x 10^2 or less depending on UV dose rate and the increase in UVT of wastewater post filtration

The unchanged chemical figures and the reduction in pathogenic reduction following filtration can be explained by reference to the following;

Tertiary filtration presents a physical 0.45µm barrier to wastewater contaminants (>500,000 molecular weight) which may be contained in secondary treated effluent namely;

- Suspended matter (typically 2 - 100µm in size),
- Rotifiers (100-500µm)
- Ciliates (20-100µm in size)
- Protozoa (5-20µm in size)
- Bacteria including E.Coli and Enterococci (0.1 -20 µm)
- Organic Colloids (typically 0.1 - 10µm in size),
- Viruses (0.01 -0.1um)
- Dissolved Organic Compounds (0.001- 0.45 µm)
- Dissolved Inorganic Compounds (0.001- 0.45 µm)

Dissolved nutrients such as total N ,total NH_4, DIN and MRP typically range in molecular weight from 200 - 5,000 and as such will pass through the physical sand barrier (0.45um or >500,000 molecular weight) unaltered.

The 1 - 1.5 log removal of bacteria (0.1 -20 µm) will be achieved by the 0.45µm tertiary filtration sand barrier although most remaining viruses should pass the tertiary barrier as biofilms will not develop on tertiary filter sand.

Appendix 2

Appropriate Assessment- Natura Impact Statement

Irish Water Report

Natura Impact Statement as part of the Kilfenora Waste Water Discharge Licence Application: A0079-01

Contents

Introduction

This Natura Impact Statement provides an Appropriate Assessment (AA) of the existing Waste Water Treatment Plant (WwTP), located at Kilfenora, Co. Clare, for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007), as amended. It assesses whether the on-going operation of the plant, alone or in combination with other plans and projects, is likely to have significant effects on a European Site(s) in view of best scientific knowledge and the conservation objectives of the site(s). European Sites are those identified as sites of European Community importance designated as Special Areas of Conservation under the Habitats Directive or as Special Protection Areas under the Birds Directive.

This report follows the guidance for AA published by the Environmental Protection Agency's (EPA) '*Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)*' (EPA, 2009); and takes account of the Department of the Environment, Heritage and Local Government's guidelines '*Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities*' (DoEHLG, 2009) and Circular L8/08 '*Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments*' (DoEHLG, 2008).

The report was prepared by Ryan Hanley Consulting Engineers on behalf of Irish Water.

Legislative Context

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, better known as "The Habitats Directive", provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000. These are Special Areas of Conservation (SACs) designated under the Habitats Directive and Special Protection Areas (SPAs) designated under the Conservation of Wild Birds Directive (79/409/ECC) as codified by Directive 2009/147/EC.

Articles 6(3) and 6(4) of the Habitats Directive set out the decision-making tests for plans and projects likely to affect Natura 2000 sites (Annex 1.1). Article 6(3) establishes the requirement for Appropriate Assessment (AA):

> *Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

Article 6(4) states:

> *If, in spite of a negative assessment of the implications for the [Natura 2000] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.*

Methodology

Guidance Followed

Both EU and national guidance exists in relation to Member States fulfilling their requirements under the EU Habitats Directive, with particular reference to Article 6(3) and 6(4) of that Directive. The methodology followed in relation to this AA has had regard to the following guidance:

- Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007). Environmental Protection Agency, (EPA, 2009).
- Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. Department of Environment, Heritage and Local Government, (DoEHLG, 2010).
- Circular L8/08 – Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments. Department of Environment, Heritage and Local Government, (DoEHLG, 2008).
- Communication from the Commission on the Precautionary Principle. Office for Official Publications of the European Communities, Luxembourg, (EC, 2000a).
- Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg, (EC, 2000b).
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels (EC, 2001).
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission. Office for Official Publications of the European Communities, Luxembourg, (EC, 2007).
- Nature and biodiversity cases: Ruling of the European Court of Justice. Office for Official Publications of the European Communities, Luxembourg (EC, 2006).
- Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document, National Parks and Wildlife Service, Dublin (NPWS, 2012).
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No.477 of 2011).
- Interpretation Manual of European Union Habitats. Version EUR 28. European Commission (EC, 2013).

Stages Involved in the Appropriate Assessment Process

Stage 1: Screening / Test of Significance
This process identifies whether the on-going operation of the plant is directly connected to or necessary for the management of a European Site(s); and identifies whether the on-going operation of the WwTP plant is likely to have significant impacts upon a European Site(s) either alone or in combination with other projects or plans.

The output from this stage is a determination for each European Site(s) of not significant, significant, potentially significant, or uncertain effects. The latter three determinations will cause that site to be brought forward to Stage 2.

Stage 2: Appropriate Assessment
This stage considers the impact of the on-going operation of the plant on the integrity of a European Site(s), either alone or in combination with other projects or plans, with respect to (1) the site's conservation objectives; and (2) the site's structure and function and its overall integrity. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts

The output from this stage is a Natura Impact Statement (NIS). This document must include sufficient information for the EPA to carry out the appropriate assessment. If the assessment is negative, i.e. adverse effects on the integrity of a site cannot be excluded, then the process must consider alternatives (Stage 3) or proceed to Stage 4.

Stage 3: Assessment of Alternatives
This process examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the European Site. This assessment may be carried out concurrently with Stage 2 in order to find the most appropriate solution. If no alternatives exist or all alternatives would result in negative impacts to the integrity of the European sites then the process either moves to Stage 4 or the project is abandoned.

Stage 4: Assessment Where Adverse Impacts Remain
An assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

Field Walkover Surveys

Field walkover surveys were undertaken during 30th of May 2014 to identify the potential for qualifying species and habitats in the surrounding environs of the Kilfenora WwTP and discharge point. The habitats are described as per Fossitt (2000) and as per (EC, 2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission where they are found to have links or to correspond to Annex I habitats.

Consultation

Consultation with National Parks and Wildlife Service (NPWS) was not undertaken at this stage in the process. The EPA, as the competent authority, will seek NPWS advice as may be required in reaching their decision, and the NPWS can only communicate with the applicant (Irish

Water) on request from the competent authority, when the formal application process to the competent authority has already commenced.

Stage 1: Screening

The Environmental Protection Agency has requested that Irish Water review and update, as appropriate, the screening (Stage 1) for Appropriate Assessment and the (Stage 2) Appropriate Assessment submitted as part of the further information received by the Agency on the 14th November 2011 under Kilfenora Waste Water Discharge Licence Application: A0079-01.

The updated screening process is described below in terms of source-pathway-receptor chains and the various pathways by which impacts can occur i.e. groundwater, surface water and land & air pathways in accordance with the relevant guidance documents for Appropriate Assessment (e.g. Ryan Hanley, 2014b).

Source

The WwTP at Kilfenora currently provides secondary treatment for a population equivalent (PE) of 280 and discharges directly to a swallow hole in the townland of Ballybreen, referred to as the Ballybreen swallow hole, just south of Kilfenora village, Co. Clare. The monthly water quality monitoring results (2013) for Kilfenora WwTP show that influent and effluent water quality for Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS) are below their respective emission limit values as per the Urban Waste Water Directive (UWWD) conditions placed on the WwTP. However the direct discharge to groundwater at Kilfenora has not been found to meet with Regulation 8 and 14 of the Groundwater Regulations (S. I. No. 9 of 2010). It is understood that Irish Water has engaged engineering consultants to complete a design upgrade for the WwTP at Kilfenora. This includes the provision of tertiary treatment with either a percolation area or reed bed system and other measures designed to reduce the pollutant loading from the discharge. The percolation area will have the effect of ending the 'direct discharge' to groundwater by achieving 'indirect discharge' and improve the final effluent quality.

In addition to the existing discharge from Kilfenora WwTP, there is a potential source of indirect impacts arising from the construction stage of the proposed upgrade to the plant e.g. from the accidental release of silt laden waters or hydrocarbons during works with potential for impacts on Natura 2000 sites via groundwater and surface water pathways. There is also potential for direct and indirect impacts to Qualifying Interests and Special Conservation Interests of Natura 2000 sites (outside of a Natura 2000 site) were they to occur within or adjacent to the works area via land & air pathways. Non-native invasive species may also be disturbed during works.

Pathways

Locally at Kilfenora karst features dominate similar to the adjacent Burren landscape. A series of swallow holes are present including the Ballybreen swallow hole. As a result the surface water is closely interlinked with groundwater through swallow holes and caves to surface water courses and springs via conduits and diffuse pathways. In order to inform the screening process Irish Water commissioned Geosyntec Consultants to prepare a report entitled "Tier 3 Hydrogeology Assessment Kilfenora WWTP Discharge, Co Clare" (refer to Geosyntec Consultants, 2014). Geosyntec Consultants (2014) undertook a review of tracer test studies previously carried out at Ballybreen swallow hole by Drew (2001; 2012), which demonstrated that conduit flow is significant in the area, in addition to the construction of a conceptual site model (CSM). Following a review of Geosyntec Consultants (2014), GIS data downloaded from the NPWS .

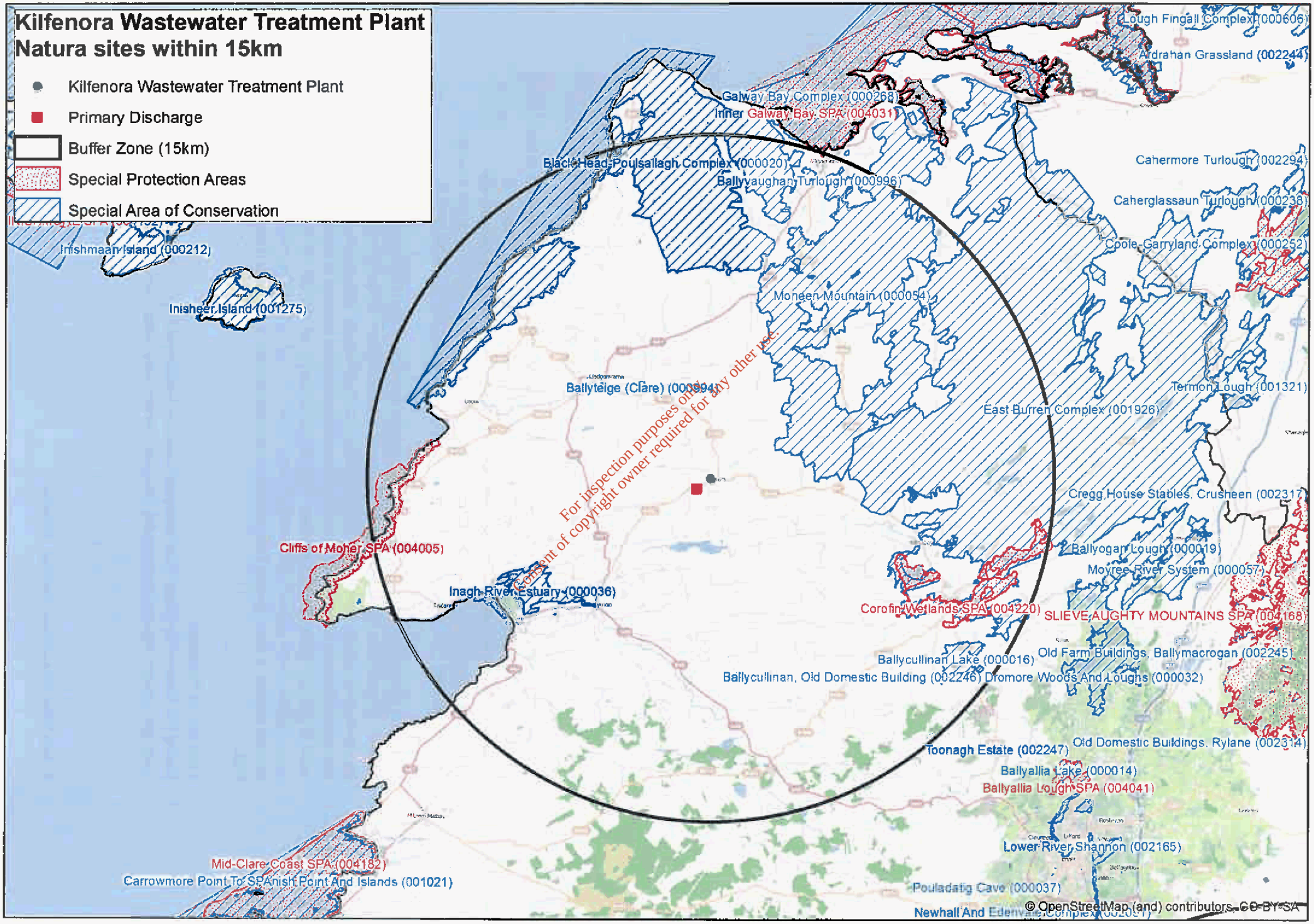
map-viewer (see Figure 1) and the GSI Groundwater Data viewer a number of groundwater, surface water and land & air pathways and receptors have been identified from the Ballybreen swallow hole and the WwTP:

Groundwater and Surface Water Pathways

1. The Ballybreen swallow hole is connected via a karstic conduit to a spring system located 6.5km down gradient and to the southeast i.e. Roughan, Poulnaboe and Elmvale Springs which in turn provide the head waters of the River Fergus (in townlands of the same name) upstream of Lough Inchiquinn. The River Fergus and Lough Inchiquinn are designated as the East Burren Complex SAC and Corofin Wetlands SPA 1.85km (approximately) downstream of the nearest spring system/source (*i.e.* Elmvale Spring).
2. A component of groundwater flow from the Ballybreen swallow hole migrates (especially under high flow conditions) to feed the local surface water system at Cloongarve Stream 0.7km west of the swallow hole (in a townland of the same name) which flows into the Smithstown River. The Smithstown River is a 1st order tributary of the Dealagh River (Henry, 2006). The estuaries of both the Inagh and Dealagh Rivers converge before O'Brien's Bridge (Clare County Council, 2011) and enter the Inagh River estuary and ultimately Liscannor Bay. The Inagh River estuary is designated as the Inagh River Estuary SAC 15km (approximately) downstream of Cloongarve Stream.
3. The Cliffs of Moher SPA is located 5km (approximately) further west along the coastline from Liscannor Bay. Given the distance, dilution effects and the terrestrial nature of the Cliffs of Moher SPA i.e. designated for coastal cliffs supporting a number of special conservation interests a complete source-pathway-receptor chain via surface water is unlikely.
4. Moneen Mountains SAC is located 3.7km (approximately) up gradient and to the northeast of the WwTP. While Moneen Mountains SAC supports a number of groundwater dependent habitats and species it is located up gradient of Ballybreen swallow hole and the tracer studies did not identify any pathway via groundwater between the Ballybreen swallow hole and this SAC. Therefore a complete source-pathway-receptor chain between Ballybreen swallow hole and Moneen Mountain SAC is unlikely.
5. Ballyteigue (Clare) SAC is located 4.8km (approximately) up gradient and to the northwest of the WwTP. While Ballyteigue SAC supports a groundwater dependent habitat it is located up gradient of Ballybreen swallow hole and the tracer studies did not identify any pathway via groundwater between the Ballybreen swallow hole and this SAC. Therefore a complete source-pathway-receptor chain between Ballybreen swallow hole and Ballyteigue (Clare) SAC is unlikely.
6. During the construction stage of the proposed upgrade to Kilfenora WwTP there is a potential pathway for pollutants e.g. the accidental release of silt laden waters or hydrocarbons between the works area and the East Burren Complex SAC, Corofin Wetlands SPA and Inagh River Estuary SAC via the Ballybreen swallow hole (and other karstified features in the immediate area) and/or percolation to groundwaters. Percolation is likely given that the subsoil is thin or absent based on the aquifer vulnerability of 'extreme with rock at surface/Karst features' for the Miltown Malbay_2 Groundwater Body (GWB) which underlies the WwTP and Ballybreen swallow hole.

Land and Air Pathways

7. During the construction stage of the proposed upgrade to Kilfenora WwTP there is potential for direct and indirect impacts on Qualifying Interests and Special Conservation Interests were they



occur within the footprint of or adjacent to the proposed works via land and air pathways. There is also potential for the disturbance of non-native invasive species during works.

Receptors

Clare County Council provided Geosyntec Consultants with surface water quality monitoring (for the period 2009-2013) at Poplar Bridge monitoring location on the River Fergus which is down stream of the main spring discharges which form the River Fergus and up stream of the East Burren Complex SAC and Corofin Wetlands SPA at Lough Inchiquin (see Figure 1). The surface water quality of the River Fergus in this location is classified by the EPA under the Water Framework Directive as 'Good' ecological status and 'Good' draft fish ecological status (Shannon CFRAM Study, 2012). This indicates that the discharges from the final effluent are not having a significant impact on the water quality of the River Fergus. Considering the fact that the discharges from other sources such as agricultural inputs and Onsite Waste Water Treatment Systems (OSWWTS) could be contributing to the detections at Poplar Bridge, and that the results indicate a good water quality status (Geosyntec, 2014) it can be concluded that the current discharge is not having a significant impact on the water quality of the East Burren Complex SAC and Corofin Wetlands SPA.

It is understood that no monitoring of water quality is undertaken for the Cloongarve Stream which periodically may receive water from the Ballybreen swallow hole under high flow conditions, as such it is not possible to evaluate the degree of impact, if any, resulting from this connection (Geosyntec Consultants, 2014) with the Inagh River Estuary SAC. The River Dealagh is currently classified as 'Good' ecological status at River Dealagh Bridge near Smithstown House upstream of the confluence with the Cloongarve Stream and downstream of the confluence at Aughvackeen Bridge. There has been a recent drop in water quality in the River Dealagh; agriculture is the main pressure and possibly localised impacts, e.g. cattle access in places (West Clare WMU Action Plan, 2010). The Shannon River Basin District Transitional and Coastal Waters Action Programme identifies the Inagh River Estuary as having 'Good' ecological status. While these is no available monitoring data for the Cloongarve Stream the status of the River Dealagh upstream at Smithstown Bridge and downstream at Aughvackeen Bridge of the confluence with the Cloongarve Stream together with the status of the Inagh River Estuary indicates that the discharges from the final effluent are not having a significant impact on the water quality of the River Inagh Estuary. Given the distance (15km) downstream, dilution and dispersion effects and considering the fact that the discharges from other sources such as agricultural inputs and OSWWTS could be contributing to Inagh River Estuary it can be concluded that the current discharge is not having a significant impact on the water quality of the Inagh River Estuary SAC.

In addition to the above, it is currently proposed to upgrade Kilfenora WwTP to provide tertiary treatment in order to meet with Regulation 8 and 14 of the Groundwater Regulations (S. I. No. 9 or 2010). The proposed upgrade of Kilfenora WwTP will reduce the current pollutant loading from the existing discharge by passing it through a percolation area thus resulting in an improved final effluent quality over the existing discharge to groundwater at Ballybreen swallow hole.

While it has been concluded that there is no significant impact on the water quality of the East Burren Complex SAC, Corofin Wetland SPA and Inagh River Estuary SAC arising from the current and future (post upgrade) discharges from Kilfenora WwTP there is a number of potential

source-pathway- receptor chains in relation to the construction stage of the proposed upgrade to Kilfenora WwTP as outlined above.

In summary, the determination for an Appropriate Assessment is based on the following complete source-pathway-receptor chain:

- During the construction stage of the proposed upgrade to Kilfenora WwTP there is a potential pathway for pollutants e.g. the accidental release of silt laden waters or hydrocarbons between the works area and the East Burren Complex SAC, Corofin Wetlands SPA and Inagh River Estuary SAC via the Ballybreen swallow hole (and other karstified features in the immediate area) and/or percolation to groundwaters. Percolation is likely given that the subsoil is thin or absent based on the aquifer vulnerability of 'extreme with rock at surface/Karst features' for the Miltown Malbay_2 (GWB) which underlies the WwTP and Ballybreen swallow hole.
- During the construction stage of the proposed upgrade to Kilfenora WwTP there is potential for direct and indirect impacts on Qualifying Interests and Special Conservation Interests where they occur within the footprint of or adjacent to the proposed works via land and air pathways. There is also potential for the disturbance of non-native invasive species during works.
- There is potential for cumulative impacts on East Burren Complex SAC, Corofin Wetlands SPA and Inagh Estuary SAC arising from other sources, e.g. Ennistymon WwTP, agricultural inputs, cattle access, OSWWTS etc.

Therefore, applying the Precautionary Principle and in accordance with Article 6(3) of the Habitats Directive, the proposed construction of the upgrade to the Kilfenora WwTP plant to provide tertiary treatment will be brought forward for a Stage 2 Appropriate Assessment.

Stage 2: Appropriate Assessment

The East Burren Complex SAC, Corofin Island SPA and Inagh Estuary SAC which have been determined as requiring AA, are described and all the potential impacts resulting from the proposed construction of the upgrade to the Kilfenora WwTP plant to provide tertiary treatment are discussed in relation to the conservation objectives of these designated sites.

Description of the Project

Kilfenora village is located close to the southern edge of the Burren National Park, approximately 27 km north-west of Ennis, 8 km north-east of Ennistymon and 9km south-east of Lisdoonvarna. Kilfenora is a small village in a rural location. The WwTP is located to the west of Kilfenora Village immediately surrounded by agricultural land with a school close by to the south. A private dwelling is constructed to the east of the WwTP in relatively close proximity to the site boundary.

The existing Kilfenora WwTP was constructed in 1974 and is understood to provide secondary treatment (activated sludge unit) for sewage from a population equivalent (PE) of 280. There are two discharges from the WwTP at Kilfenora. The stormwater overflow which discharges to a swallow hole on the northern boundary of the WwTP at Grid Coordinates 303836.048E, 173007.714N.

Kilfenora WWTP operates as an activated sludge process, with component elements as set out hereunder:

- Inlet screening and Balance Tank
- Storm Water Holding Tank
- Aeration tank
- Settlement tank
- Sludge Holding Tank
- Administration control house

Sludge arising on site is removed by tanker to Lisdoonvarna WwTP for further processing. The treated effluent is pumped via a 75mm rising main and is discharged to a swallow hole at Grid Coordinates 303838.287E, 172997.714N situated approximately 600m to the west of the village at Ballybreen adjacent to the R476 known as the Ennistymon Road. The locations of the WwTP and the discharge point at Ballybreen swallow hole are illustrated by Figure 1. As such the current discharge at Kilfenora WwTP is deemed to be a direct discharge to groundwater.

According to Geosyntec Consultants (2014) the influent and effluent water quality monitored monthly for Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS) is below their respective emission limit values as per the UWWD conditions placed on the WwTP. BOD/COD/SS pollutant loading reductions were 96%, 88% and 86% respectively through the current treatment system in 2013. The average influent flow rate for the year 2013 was 146 m^3/day with a maximum of 304 m^3/day (Geosyntec Consultants, 2014).

The EPA published "Guidance on the Authorisation of Discharges to Groundwater in 2011 (EPA, 2011) and draft 'Guidance on the Authorisation of Direct Discharge to Groundwater' in January 2014. According to Geosyntec Consultants (2014) the current direct discharge to Ballybreen

swallow hole does not comply with the requirements specified in EPA (2011; 2014) and the Groundwater Regulations underpinning this guidance for the authorisation of 'direct discharges to groundwater' as the current discharge does not fall within any of the permissible or exempted pollutant inputs defined by Regulations 8 & 14 of the Groundwater Regulations (S. I. No. 9 or 2010).

It is understood that Irish Water has engaged engineering consultants to complete a design upgrade for the WWTP at Kilfenora. This will examine the possibility of tertiary treatment with either a percolation area or reed bed system and other measures designed to reduce the pollutant loading from the discharge. The percolation area will have the effect of ending the 'direct discharge' to groundwater by achieving 'indirect discharge' and improving the final effluent quality. An ultra violet treatment system will also need to be considered as part of this design to ensure final discharges do not include microbial pathogens.

According to Geosyntec Consultants (2014) there is likely to be limited potential to develop a percolation system at the site using the natural soil profile as part of the planned upgrade. In this regard the construction of the percolation area together with pipework from the WwTP will require stripping of topsoil (if any), excavation and rock breaking resulting in potential localised habitat loss and disturbance, dust and noise. The excavation for the percolation area is likely to strike groundwater and to result in a large body of standing silt laden water with potential for suspended solids to access groundwaters. The percolation area will require the importation of soil and stone with the risk of introducing non-native invasive species. There is also a risk of spreading non-native invasive species present within the site. For landscape and visual purposes, percolation areas are generally seeded with grass mixes and screened with landscape planting with the potential for importation of non-native invasive species or foreign genotypes of native species. The presence of plant machinery may result in the accidental release of hydrocarbons e.g. during refuelling and maintenance activities or in the absence of maintenance. There may also be a requirement for the construction of site compound and haul or access roads.

Description of the Receiving Environment and Monitoring Results

The regional geology of the Kilfenora area is dominated by Dinantian Pure Bedded Limestone's to the east (Lissylisheen and Ballyelly members) and Namurian Shales (Clare shale formation) to the west with the result that Ballybreen is surrounded on all sides by shale except to the east. Locally karst features dominate, similar to the adjacent Burren landscape. Drew (2012) describes the local geology of the area as having a series of swallow holes along the eastern boundary between the Carboniferous Limestone and the Namurian Shales including the Ballybreen swallow hole. As a result both the surface hydrology and hydrogeology of the area is complex and surface water is closely interlinked with groundwater. Many of the surface water courses sink underground before rising to the surface further down-gradient and then sinking again. Depending on rainfall and water levels throughout the catchment, rivers also vary from being losing rivers (i.e. where river water flows to groundwater through the river bed), to gaining rivers where the rivers are fed by groundwater. There are also links between swallow holes and caves to surface water courses and springs via conduits and diffuse pathways. The large open conduits within limestone can transport groundwater great distances over relatively short periods of time. This rapid migration of groundwater (and dissolved or suspended contaminants) is such

that beyond dilution and dispersion, little or no contaminant attenuation occurs within the groundwater system between a pollutant source and a receptor (Geosyntec Consultants, 2014).

Clare County Council commissioned Dr David Drew to undertake a tracer test study at the Ballybreen swallow hole (i.e. the discharge point of the Kilfenora WwTP) in 2001 and 2012 (Drew, 2001; 2012). The main aim of the initial tracer study was to determine the location of the outlets from the swallow hole and comment on how this interacts with the local hydrology and hydrogeology of the area. The second study in 2012 aimed to better characterise the underground flow path(s) between the Ballybreen swallow hole and its known reappearance in springs feeding the River Fergus. The results of the 2001 and 2012 demonstrate that conduit flow is significant in the area. The following groundwater, surface water and land & air pathways have been identified from the Ballybreen swallow hole and Kilfenora WwTP:

1. The Ballybreen swallow hole is connected via a karstic conduit to a spring system located 6.5km down gradient and to the southeast i.e. Roughan, Poulnaboe and Elmvale Springs which in turn provide the head waters of the River Fergus (in townlands of the same name) upstream of Lough Inchiquinn. The River Fergus and Lough Inchiquinn are designated as the East Burren Complex SAC and Corofin Wetlands SPA 1.85km (approximately) downstream of the nearest spring system/source (i.e. Elmvale Spring).
2. A component of groundwater flow from the Ballybreen swallow hole migrates (especially under high flow conditions) to feed the local surface water system at Cloongarve Stream 0.7km west of the swallow hole (in a townland of the same name) which flows into the Smithstown River. The Smithstown River is a 1st order tributary of the Dealagh River (Henry, 2006). The estuaries of both the Inagh and Dealagh Rivers converge before O'Brien's Bridge (Clare County Council, 2011) and enter Inagh River estuary and ultimately Liscannor Bay. The Inagh River estuary is designated as the Inagh River Estuary SAC 15km (approximately) downstream of Cloongarve Stream.
3. During the construction stage of the proposed upgrade to Kilfenora WwTP there is a potential pathway for pollutants between the works area and the East Burren Complex SAC, Corofin Wetlands SPA and Inagh River Estuary SAC via the Ballybreen swallow hole (and other karstified features in the immediate area) and/or percolation to groundwaters. Percolation is likely given that the subsoil is thin or absent based on the aquifer vulnerability of 'extreme with rock at surface/Karst features' for the Miltown Malbay_2 GWB which underlies the swallow hole and the WwTP.
7. During the construction stage of the proposed upgrade to Kilfenora WwTP there is potential for direct and indirect impacts on Qualifying Interests and Special Conservation Interests were they occur within the footprint of or adjacent to the proposed works via land and air pathways. There is also potential for the disturbance of non-native invasive species during works.

Note the GWB underlying the study area is Miltown Malbay_2 and the adjacent Craggaunboy GWB. Miltown Malbay_2 and Craggaunboy GWB are classified by the EPA as a poorly productive aquifer. However, the tracer studies have demonstrated that the limestone bedrock in the study catchment area exhibits karstic features which would suggest that a Karst Aquifer classification may be more accurate for these GWB. The classification for both the neighbouring Burren and Ennis GWBs is Karst.

Clare County Council provided Geosyntec Consultants with surface water quality monitoring (for the period 2009-2013) at Poplar Bridge monitoring location on the River Fergus which is down stream of the main spring discharges which form the River Fergus and up stream of the East Burren Complex SAC and Corofin Wetlands SPA at Lough Inchiquin (see Figure 1). The surface water quality of the River Fergus in this location is classified by the EPA under the Water Framework Directive as 'Good' ecological status and 'Good' draft fish ecological status (Shannon CFRAM Study, 2012).

It is understood that no monitoring of surface water quality is undertaken for the Cloongarve Stream which periodically may receive water from the Ballybreen swallow hole under high flow conditions. as such it is not possible to evaluate the degree of impact, if any, resulting from this connection (Geosyntec Consultants, 2014) with the Inagh River Estuary SAC. The River Dealagh is currently classified as 'Good' ecological status at River Dealagh Bridge near Smithstown House upstream of the confluence with the Cloongarve Stream and downstream of the confluence at Aughvackeen Bridge. There has been a recent drop in water quality in the River Dealagh; agriculture is the main pressure and possibly localised impacts, e.g. cattle access in places (West Clare WMU Action Plan, 2010). The Shannon River Basin District Transitional and Coastal Waters Action Programme identifies the Inagh River Estuary as having 'Good' ecological status.

Field Walkover Survey

The Kilfenora WwTP is situated to the west of Kilfenora village. The habitats within the site of the Kilfenora WwTP at time of survey consisted largely of Dry meadow and grassy verge (GS2) with Yorkshire Fog (*Holcus lanatus*), Cock's Foot (*Dactylis glomerata*), False Oat Grass (*Arrhenatherum elatius*), Oxeye Daisy (*Leucanthemum vulgare*), Dock (*Rumex* sp.), Buttercup (*Ranunculus* sp.), Nettles (*Urtica dioica*) and Willow Saplings (*Salix* sp.). Brambles (*Rubus fruticosus* agg.) are present growing adjacent to the wire fence on the boundary of the site. There are large patches of Butterbur (*Petasites hybridus*) scattered throughout the Dry meadow and grassy verge areas. The remainder of the WwTP consists of habitat classified as Buildings and artificial surfaces (BL3). The access road leading up to the entrance gate on the northern boundary of the WwTP contains large patches of Japanese Knotweed (*Fallopia japonica*) growing close to the track.

The WwTP is bordered to the north by a Treeline (WL2) dominated by a higher canopy of Sycamore (*Acer pseudoplatanus*), and a low canopy of Elder (*Sambucus nigra*) and Hawthorn (*Crataegus monogyna*) and to the east by a Treeline (WL2) dominated by Ash (*Fraxinus excelsior*) and Hawthorn. The south and west are bordered by Improved agricultural grassland (GA1).

The vegetation along the route of the existing below ground rising main leading from the WwTP to the effluent discharge point traverses Improved agricultural grassland (GA1) with Perennial Rye Grass (*Lolium perenne*), Dandelion (*Taraxacum officinale* agg.), Crested Dog's Tail (*Cynosurus cristatus*), White Clover (*Trifolium repens*), Daisy (*Bellis perennis*), Buttercup (*Ranunculus* sp.), Yorkshire Fog (*Holcus lanatus*) and rushes (*Juncus* sp.). Areas of rocky outcrop or Exposed calcareous rock (ER3) within the improved agricultural grassland support species poor patches of Dry neutral grassland (GS1) with Bird's Foot Trefoil (*Lotus corniculatus*), Hawkbit (*Leontodon* sp.), Yarrow (*Achillea millefolium*), Ladies Bedstraw (*Galium verum*) and Cut-leaved Cranesbill (*Geranium dissectum*). Stone walls and other stone work (BL1) and areas

of Recolonising bare ground (ED3) with Nettles, Herb Robert (*Geranium Robertianum*), Buttercup, Dock species, Brambles and Sycamore saplings were also recorded as present.

The sewer line discharges in a stream which enter a swallow hole located in a fenced-off section of a field in the townland of Ballybreen, 600m to the south west of Kilfenora WwTP. The field is dominated by Improved agricultural grassland (GA1) with Perennial Rye Grass (*Lolium perenne*), Crested Dog's Tail, White Clover, Buttercup and Ribwort Plantain (*Plantago lanceolata*). The fenced-off section of the field, within which the swallow hole is located, also consists of Improved agricultural grassland (GA1) with Recolonizing bare ground (ED3) along the access track into the swallow hole. Species recorded present included Dock (*Rumex sp.*), Creeping Buttercup (*Ranunculus repens*), Dandelion (*Taraxacum officinale* agg.), Creeping Thistle (*Cirsium arvense*), Silverweed (*Potentilla anserina*), Yorkshire Fog, Crested Dog's Tail and Yellow Flag (*Iris pseudacorus*), with Brambles, Cow Parsley (*Anthriscus sylvestris*), Meadowsweet (*Filipendula ulmaria*) and Herb Robert (*Geranium robertianum*) growing close to the fence.

The swallow hole is fed by a small stream which runs in a south to north direction. It is culverted under the R481 before it enters the field. Within the field it is visible for approximately 10m running to the east of the access track. The stream has very little water at this point and flow is extremely slow. It is about 1.0m wide and 0.1m deep and consists mostly of boulders. It then flows west and goes under the access track. Thereafter it is met by a Drainage ditch before widening into a pool about 0.4m deep consisting of boulders (30-40%) and silt (60%). The wider pool area is surrounded by Wild Angelica (*Angelica sylvestris*), Greater Plantain (*Plantago major*), Meadow Vetchling (*Lathyrus pratensis*), Common Valerian (*Valeriana officinalis*), Brambles, Goosegrass, White Clover and Creeping Thistle. At the pool area the stream disappears underground for a few metres.

The Drainage ditch (FW4) which flows from the west before joining the stream is 0.1-0.15m deep and consists of cobbles (80%) and gravels (20%), with very slow flow. Brambles, Nettles, Bush Vetch, Horsetails, Valerian and Buttercup are present on either side of the drainage ditch. There were no instream macrophytes recorded. The field to the west of the fenced-off discharge area, close to the drainage ditch consists of Wet grassland (GS4) with Rushes (*Juncus* sp.), Yellow Flag, Meadowsweet, Buttercup, Hawkbit and an abundance of Common Spotted Orchid (*Dactylorhiza fuchsii*).

The stream reappears for a short stretch in a depression before it enters the swallow hole. The stream at this point consists primarily of cobbles and moss-covered boulders, is less than 1.0m wide and about 0.1m deep, The depression including the swallow hole is surrounded by Scrub (WS1) vegetation consisting of Brambles, Nettles, Creeping Thistle, Bush Vetch (*Vicia sepia*), Meadowsweet, Cock's Foot, False Oat Grass, Horsetail (*Equisetum* sp.), Goosegrass (*Galium aparine*) and Willowherb (*Epilobium* sp.)

To the north of the swallow hole is another depression surrounded by Brambles, Meadowsweet, Creeping Thistle, Yorkshire Fog, Cut-leaved Cranesbill (*Geranium dissectum*), Nettles, Crested Dog's Tail, Cock's Foot and Rushes. It is fed by another Drainage ditch (FW4), which was dry at the time of the field walkover survey, which would likely flow in a north-west direction.

The field walkover surveys did not reveal the presence of any Annex I habitat listed as Qualifying Interests for East Burren Complex SAC or Inagh River Estuary SAC or suitable wetland habitat to support Article 12 bird species listed as Special Conservation Interests for Corofin Wetlands SPA (see Table 5.0).

Suitable habitat for the following Annex II Species was recorded upstream of the Ballybreen swallow hole (see Table 6.0):

- Otter (*Lutra lutra*) [1355].
- Brook lamprey (*Lampetra planeri*) [1096];

And suitable habitat for the Annex V Species was recorded at the swallow hole

- Common Frog (*Rana temporaria*) [1213].

Description of the Natura 2000 Sites Affected

East Burren Complex SAC

The East Burren Complex SAC encompasses all of the high ground in the east Burren in Counties Clare and Galway, and extends south-eastwards to include a complex of calcareous wetlands. The area consists of a range of limestone habitats that include limestone pavement and associated calcareous grasslands and heath, scrub and woodland together with a network of calcareous lakes and turloughs. This SAC has some of the best examples and most extensive areas of oligotrophic limestone wetlands in the Burren and in Europe.

The limestone pavement within the East Burren Complex SAC is interspersed with species-rich calcareous vegetation communities. Grassland species such as Blue Moor-grass (*Sesleria albicans*), Mountain Everlasting (*Antennaria dioica*), Bloody Crane's-bill (*Geranium sanguineum*) and Wild Thyme (*Thymus praecox*) are typically found on or near the pavement. Where soil cover is more extensive purer grassland communities, which are often rich in orchid species, can be found. The following orchid species have been recorded within the site: Pyramidal Orchid (*Anacamptis pyramidalis*), Frog Orchid (*Coeloglossum viride*), Fragrant Orchid (*Gymnadenia conopsea*), Bee Orchid (*Ophyrs apifera*), Fly Orchid (*Ophyrs insectifera*), Butterfly Orchid (*Platathera chlorantha*) and Dense-flowered Orchid (*Neotinea maculata*).

Limestone heath with Heather (*Calluna vulgaris*) and Bell Heather (*Erica cinerea*) is well developed in parts of the uplands. The rare and Red Data Book listed plant species, Hoary Rock-rose (*Helianthemum canum*) and Pyramidal Bugle (*Ajuga pyramidalis*) are both found in this habitat. An alpine heath Communityis found to the South East along the western shores of Lough Bunny where Bearberry (*Arctostaphylos uva-ursi*) is found at one of its few inland, lowland locations in the Burren. Juniper scrub with Juniper (*Juniperus communis*) and Crowberry (*Empetrum nigrum*) is sometimes found associated with areas of heath at this site.

The Ballyeighter Loughs Complex, a large network of calcareous hardwater lakes and turloughs with associated fen, cut-away bog and calcareous marsh, lies to the east. The complex contains many species of plant and animal that are found in areas of fluctuating water levels. There is a well developed alkaline fen flora with large areas of Great Fen-sedge (*Cladium mariscus*) and Black Bog-rush (*Schoenus nigricans*). Some of the best and most extensive calcareous swamp fen communities in the country occur within this complex and further north-east around the

shores of Lough Bunny. Between this lake and the Coole-Garryland turlough complex to the north-east of the site, another area of oligotrophic limestone wetlands occurs. This type of ecosystem is now very rare in Europe and many of the habitats found are listed on Annex I of the E.U. Habitats Directive.

The site has at least eight known examples of Turloughs including those at Carran, Knockaunroe, Lough Mannagh, Castle Lough, Lough Aleenaun, Turloughmore, Tulla and Roo. These turloughs represent some of the best examples of this habitat type found in Ireland and display a wide diversity in trophic status, water fluctuations, water retention and vegetation types. The aquatic plant communities are well developed and the rare, Red Data Book species, Mudwort (*Limosella aquatica*), occurs here. This species is listed in the Flora (Protection) Order, 1999.

Most of the lakes in the southern part of this site are considered examples of hard water lakes, a type listed in Annex II of the E.U. Habitats Directive. These are classic marl lakes, often surrounded by limestone pavement and scrub. They range from extreme oligotrophic types, such as Lough Bunny, to more mesotrophic or even eutrophic systems. Stonewort (*Chara* spp.) beds are common in Lough Inchiquin (and at Lough Bunny), along with pondweeds (*Potamogeton* spp.). *Nitella tenuissima*, a rare species found in calcareous fens, has been recorded in the Ballyeighter Loughs. A number of other interesting *Chara* species have been recorded from waterbodies in the area.

The River Fergus is the only major overground river within the site. Between Lough Inchiquin and Lough Atedaun the river is slow moving and meanders through an area with wet grassland where water-crowfoot (*Ranunculus peltatus-penicillatus*) and the moss species *Fontinalis antipyretica* are found.

Good examples of petrifying springs with well developed bryophyte and lichen communities are found at the cliffs at Slieve Carran.

Lowland hay meadows are also found at this site. These grasslands typically have a low, open sward dominated by herbs and poor-yield grasses, and are mown rather than grazed. Some common species include Oxeye Daisy (*Leucanthemum vulgare*), Yellow-rattle (*Rhinanthus minor*), Eyebrights (*Euphrasia* spp.) and Common Knapweed (*Centaurea nigra*).

Scrub cover is relatively good in this area of the Burren, with large expanses of Hazel (*Corylus avellana*) intermixed with Spindle (*Euonymous europaeus*), Guelder-rose (*Viburnum opulus*) and Blackthorn (*Prunus spinosa*). A scrub community of Alder Buckthorn (*Frangula alnus*), a Red Data Book species, Buckthorn (*Rhamnus catharticus*) and Shrubby Cinquefoil (*Potentilla fruticosa*), also a Red Data Book species, fringes the shores of some of the lakes and turloughs to the east.

Ballyeighter Wood to the east is an unusual scrub community on limestone, with regenerating oak (*Quercus* sp.) amongst Hazel, Ash (*Fraxinus excelsior*), Holly (*Ilex aquifolium*) and Hawthorn (*Crataegus monogyna*). This is an example of a woodland type that is rare in the Burren region. The eastern edge of Slieve Carran is dominated by steep cliffs and scree slopes over which Ash

and Hazel wood is developed. This represents one of the few remaining woodland habitats in the Burren.

A narrow band of alluvial woodland occurs along the karstic stream at the north-east corner of Lough Gortlecka. This is considered to be a unique variant of this uncommon woodland type. The wood is dominated by Hazel, Ash, Wych Elm (*Ulmus glabra*) and Rusty Willow (*Salix cinerea subsp. oleifolia*), with Ramsons (*Allium ursinum*) and a variety of other herbs occupying the flooded areas of the woodland floor.

Caves are a feature of this site, with four known natural limestone caves showing a variety of formations and passage types. Vigo Cave has one of the best undisturbed cave entrance facies in Ireland and is considered a valuable karst heritage landform. Glencurrane Cave shows some fine phreatic solution features and one passageway, known as "Crinoid Tower" shows an abundance of crinoids which have been etched out by splashing water. Gortlecka Cave and a series of small caves above Lough Inchiquin are other fine examples of this habitat.

In the east Burren wetlands Mute Swan and Whooper Swan occur in internationally important concentrations, while Wigeon, Lapwing, Dunlin, Black-tailed Godwit and Goldeneye are also very numerous. Also found in wetlands on the site (e.g. Lough Carran Turlough, Lough Aleenaun, Lough Inchiquin, Lough Bunny, Lough Cullaun, Muckanagh Lough) are Bewick's Swan, Teal, Mallard, Gadwall, Shoveler, Tufted Duck, Curlew, Golden Plover, Coot and Little Grebe. The site also supports a flock of Greenland White-fronted Goose. Several of these species are listed in the Red Data Book and on Annex I of the E.U. Birds Directive.

A nesting pair of Peregrine Falcon, a species listed on Annex I of the E.U. Birds Directive, occur on Glasgeivnagh Hill. The east Burren wetlands are frequented by Sparrowhawk, Kestrel and Hen Harrier, a rare species which is also listed on Annex I of the E.U. Birds Directive. Pine Marten and Otter have been recorded regularly within the site - both are listed in the Red Data Book as they are considered threatened in Europe, the latter also on Annex II of the E.U. Habitats Directive.

The site supports an internationally important population of Lesser Horseshoe Bat, with an estimated 400 individuals. There are two known nursery roosts, a transition roost and four known winter sites, the latter all in natural limestone caves. Pipistrelle and Brown Long-eared Bats also occur. All of these species are listed in the Red Data Book, the former also on Annex II of the E.U. Habitats Directive. The Lesser Horseshoe Bat is a small, delicate bat which is confined to six western counties, Mayo, Galway, Clare, Limerick, Kerry and Cork. It forages close to woodland and at the edges of water. The Irish population of this species is estimated to be about 12,000 individuals and may be the largest national population in Europe. The Pipistrelle Bat is the smallest bat to occur in Ireland and is the commonest and most widespread species. Pipistrelle Bats forage where small insects gather, in gardens, along hedgerows and trees, over ponds and along rivers. The Brown Long-eared Bat is the second most common bat in Ireland and is easily identified by its long ears which are nearly as long as its body. The Brown Long-eared Bat forages in and along woodland where they glean insects off foliage.

The site includes a large population of Marsh Fritillary, a species of butterfly listed on Annex II of the E.U. Habitats Directive. The site also supports the only known populations of Slow Worm

(Anguis fragilis) in Ireland - this lizard is believed to have been introduced in about 1970. Arctic Char (Salvelinus alpinus), a Red Data Book fish species, has been recorded from Lough Inchiquin.

Most of the site is grazed by cattle and sheep, and in some areas, particularly the uplands, by feral goats. Slieve Carran is a Statutory Nature Reserve, while some 750 square km within the region of Mullaghmore makes up the Burren National Park. Clearance and intensification of agriculture has caused damage to some parts of the site. This threatens the heath and scrub communities and may cause eutrophication (nutrient enrichment) of the lakelands to the east. Drainage and land reclamation have occurred in places around the edges of wetlands, while some marginal fen areas have been afforested. Areas of agriculturally-improved land have been included within the site in order to protect the hydrology and nutrient status of the wetland system.

The East Burren Complex is of international scientific interest owing to the presence of fine examples of typical Burren habitats, together with an oligotrophic wetland complex of lakes, turloughs, fen, cut-over bog and calcareous marsh. The Ballyeighter complex represents an excellent example of a nutrient-poor calcareous lake and fen system, of European significance.