Kepak Longford

Assimilative Capacity of the Inny River for Final Discharge from Kepak Longford WWTP

Location:

Ballymahon,
Co. Longford.

Discharge Licence Number Ref:

W.P. 4/86

Date of Report:

February 2018

Consultant:

Ciaran Farrell
BSc MSc

Rowan Engineering Consultants Ltd.
Unit 1 Scurlockstown Business Park
Trim
Co. Meath
Tel: 046-9030102
Web: www.rec.ie
Email: info@rec.ie

Table of Contents

Page No.

1. INTRODUCTION 3

1.1 BACKGROUND INFORMATION 3
1.2 METHODOLOGY OF WASTE ASSIMILATION CAPACITY (WAC) 3

2. SITE DESCRIPTION 3

2.1 SITE LOCATION AND PROCESSES 3
2.2 WASTE WATER TREATMENT PLANT (WWTP) ..... **ERROR! BOOKMARK NOT DEFINED.**
2.3 CURRENT DISCHARGE PARAMETERS 4

3. BAT AND BREF GUIDANCE 4

4. REQUIRED WATER QUALITY AS PART OF S.I. NO. 272 2009 5

5. PRESENT WATER QUALITY AND FLOW OF RIVER CLAREEN 5

5.1 REQUIRED WATER QUALITY OF CLAREEN RIVER 5
5.2 EXISTING CLAREEN QUALITY 6
5.3 RIVER FLOW 7

6. WASTE ASSIMILATION CAPACITY (WAC) 8

6.1 WAC METHODOLOGY 8
6.2 ASSIMILATION CAPACITY AND MIXING CALCULATIONS OF A NOTIONALLY CLEAN RIVER 9

7. WAC STUDY CONCLUSION 9

REFERENCES 11

APPENDIX A: EPA HYDROTOOL 12

APPENDIX B: WAC CALCULATIONS 19

1. Introduction

1.1 Background Information

Rowan Engineering Consultants (REC) were contracted to carry out a Waste Assimilative Capacity (WAC) study on behalf of Kepak Longford. The assimilation capacity calculations are to inform the IE application process with the EPA.

1.2 Methodology of Waste Assimilation Capacity (WAC)

The WAC has been carried out in accordance with the following legislation and guidelines:

- Water Services Training Group (WSTG) – 'Guidance to Application for a Licences to Discharge to Surface Waters'; and
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment 2015.

2. Site Description

2.1 Site Location and Processes

Kepak Longford is based just outside Ballymahon, Co. Longford (Figure 1) and is within the catchment of the River Inny - the surface waterbody being less than 200m northwest of the facility. The effluent generated from the process on site is treated in an onsite Waste Water Treatment Plant (WWTP) before being discharged (under licence) to the local river near the site boundary.

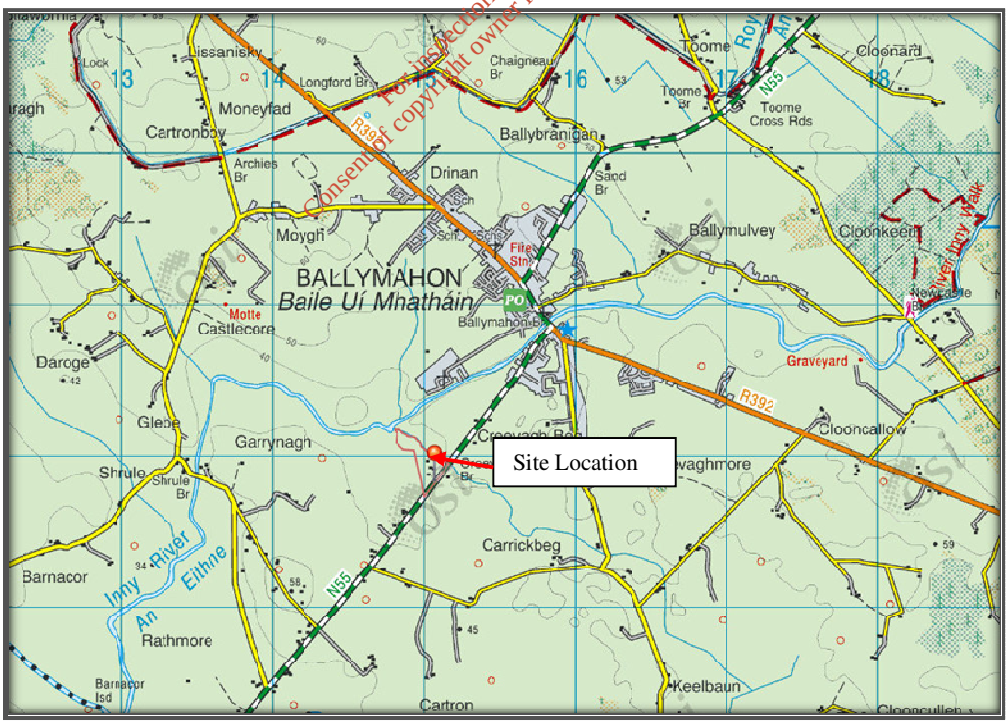


Figure 1: Site Location

2.3 Current Discharge Parameters

At present the WWTP is discharging treated effluent to the River Inny. The current Emission Limit Values (ELV's) for the final discharge from the WWTP are as per Table 1.

Parameter	Licence Kg/day	Licence mg/l
Flow (m^3/day)	110m^3/day	5m^3/hr
COD	11	100
BOD	2.2	20
Total Ammonia	0.055	0.5
Total P	0.055	0.5
Suspended Solids	3.3	30
FOG	1.1	10

Table 1: Kepak Longford Emission Limit Values

3. BAT and BREF Guidance

The EPA published a 'BAT Guidance Note on Best Available Techniques for the Food, Drink and Milk Sector'. This document is based on and references the European Communities 'Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries May 2005'. The wastewater treatment system described above adheres to the BAT and BREF guidelines. The BAT guidance provides the appropriate emission limit values for a slaughtering facility which are displayed in Table below.

Parameter	Units	Current Discharge ELV	BAT Food, Drink and Milk Industries	BAT Disposal or Recycling of Animal Carcasses and Animal Waste
pH	pH units	6-8.5	6-9	6-9
Biological Oxygen Demand (BOD)	mg/l	20	<25	>90% removal, or 20-40mg/l
Chemical Oxygen Demand (COD)	mg/l	100	<125	>75% removal or 125-250mg/l
Suspended Solids (SS)	mg/l	30	<50	50
Ammonia (as N)	mg/l	0.5	-	10-25
Total Phosphorus (as P)	mg/l	0.5	0.4-5	>80% removal, or 0.5-2mg/l
Fats, Oils & Grease (FOG)	mg/l	No deleterious effect on receiving water	<10	10-15

Table 2: BAT & BREF ELV's for Discharges to Water

Based on above, some increases in the ELVs of certain parameters within the licence (assuming the receiving environment can assimilate such an alteration) would still be considered BAT for this industry.

4. Required Water Quality as part of S.I. No. 272 2009

The most recent Irish legislation set down as part of the Water Framework Directive to provide guidelines for river water quality in Ireland is SI No. 272 of 2009 known as The European Communities *'Environmental Objectives (Surface Waters) Regulations 2009*'.

Part III of the regulations sets the Environmental Objectives for water bodies in Ireland-

> *'(1) A surface water body whose status is determined to be high or good ecological status (or good ecological potential as the case may be) and good surface water chemical status, when classified by the Agency in accordance with these Regulations shall not deteriorate in status.*

> *(2) A surface water body whose status is determined to be less than good (or good ecological potential and good surface water chemical status as the case may be) when classified by the Agency in accordance with these Regulations shall be restored to at least good status (or good ecological potential and good surface water chemical status as the case may be) by not later than 22 December 2015 unless otherwise provided for by these Regulations'.*

The Surface Water regulations provide targets for water quality in December 2015, based on the existing water quality. These target values are included in Schedule 5 of the regulation and include:

- Biological quality elements
- Oxygenation conditions (BOD)
- Nutrient conditions (Ammonia and Ortho-Phosphorous).

If rivers are achieving 'Good Status' there is a requirement for the river to maintain same (or good ecological potential and good surface water chemical status as the case may be) under the *'Environmental Objectives (Surface Waters) Regulations 2009*'.

5. Present Water Quality and Flow of Inny

The site is located in the Shannon River Basin District within Hydrometric Area 26 in the Upper Shannon catchment. The Inny flows in a predominantly westerly direction and is less than 200m at its closest point to the site. The River Inny then flows into the Lough Ree.

5.1 Required Water Quality of Inny River

Schedule 5 of the Surface Water Regulations 2009 is included as Tables 3 and 4 below, with the appropriate targets for the Inny highlighted in orange.

Oxygenation Conditions (Biological Oxygen Demand)	
Oxygenation Conditions	**River Water Body**
BOD mg O_2/l	High Status <1.3 (mean) or <2.2 (95%ile)
	Good Status <1.5 (mean) or <2.6 (95%ile)

Table 3: Oxygenation Conditions

Nutrient Conditions	
Nutrient Conditions	**River Water Body**
Total Ammonia (mg N/l)	High Status <0.040 (mean) or <0.090 (95%ile)
	Good Status <0.065 (mean) or <0.140 (95%ile)
Molybdate Reactive Phosphorous (MRP) (mg/l)	High Status <0.025 (mean) or <0.045 (95%ile)
	Good Status <0.035 (mean) or <0.075 (95%ile)

Table 4: Nutrient Conditions

The above tables and the EPA classification of the river informs us that if the River Inny is to achieve a river quality of 'Good Status' it will require to have the following conditions as detailed in Table 5 below at 95%ile flow rate.

Parameter	Good Status(95%ile)
BOD mg O_2/l	**<2.6**
Total Ammonia (mg N/l)	**<0.14**
Molybdate Reactive Phosphorous (MRP) (mg/l)	**<0.075**

Table 5: River 95%ile Good Status limits for water body

5.2 Existing Inny Quality

The Environmental Protection Agency routinely monitors water quality in rivers across Ireland. The EPA online maps currently shows the Inny WFD Status 2010-2016 as 'Moderate Status' and the EPA are maintaining a 'Review' status on the WFD Risk Scoring. Notwithstanding this, the most recent Biological Quality Rating (Q Values) Monitoring from the EPA of the Inny were completed in August 2014 (See tables 6 and 7 below for results). The only station still being regularly monitored is that at Shrule downstream of the Kepak Longford discharge and this is rated at 4 which is classified as Good Status.

Station Code	Station Location	Co-ordinates
RS26I011300	**Ballymahon Bridge**	**215851 256906**
RS26I011320	**500m d/s of Ballymahon Bridge**	**215252 256484**
RS26I011350	**Shrule Bridge**	**213497 255849**

Table 6: Station Locations & Co-ordinates

Station	1981	1984	1987	1992	1996	1999	2002	2005	2008	2009	2011	2014
RS26I011300	**4**	**4-5**	**4-5**	**4**								
RS26I011320		**4-5**	**4-5**		**3-4**							
RS26I011350	**4-5**	**4-5**	**4-5**	**4-5**	**3-4**	**4**	**4**	**4**		**4**	**4-5**	**4**

Table 7: Biological Quality Rating (Q Values) Inny

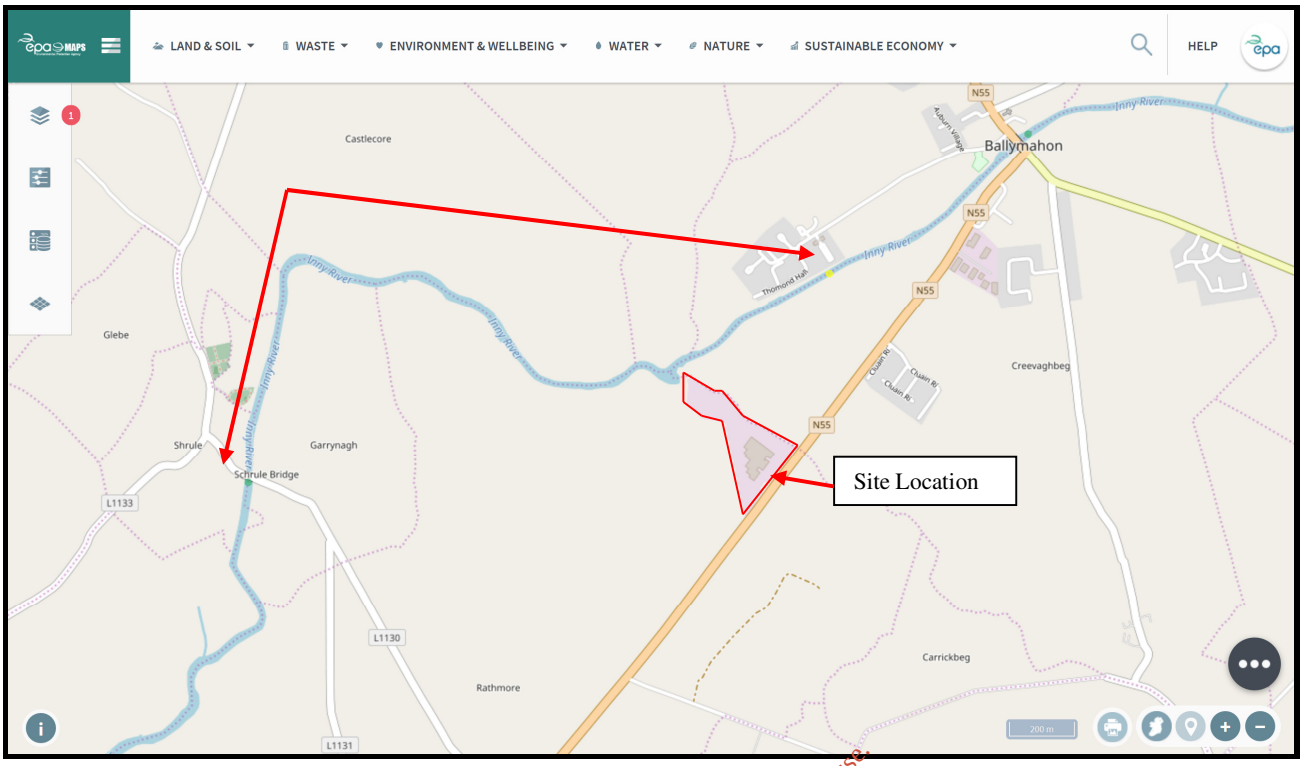


Figure 2: Q Value Stations Shown as Green and Yellow dots on river – Shrule Bridge station has most recent data

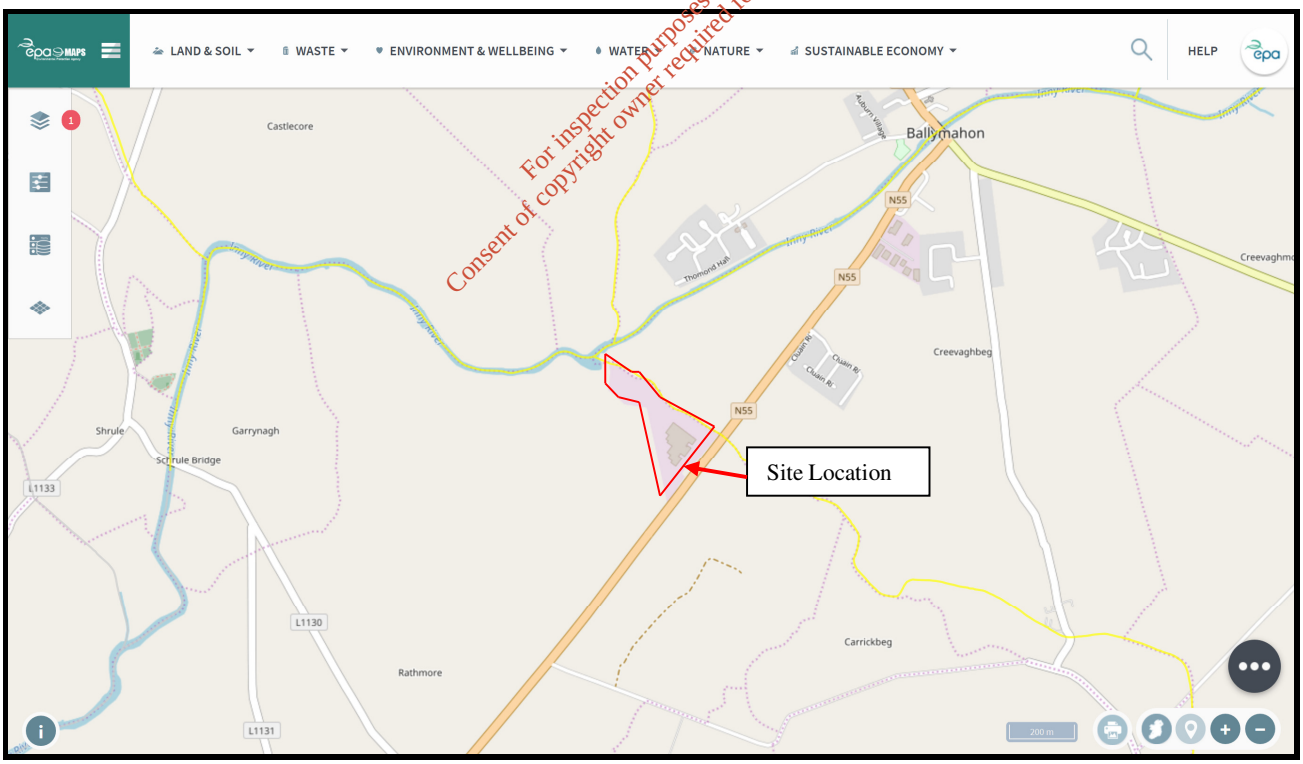


Figure 3: Water Quality Status – Inny - Moderate

In concluding their last assessment of water quality at this stretch of river, the EPA noted that there was *Good ecological condition was found at four out of eleven sites surveyed on the Inny in 2014. The lower reaches exhibited high macroinvertebrate diversity and were of satisfactory ecological condition in 2014.*

In summary the water quality in the Inny downstream of the Kepak site is Good based on Q values, but the EPA continue to assess the risk of deteriorating water quality.

On the basis that the Inny currently has 'moderate' status we have also assessed the WAC with poorer background conditions to assess a worse scenario using the below background concentrations. These equate to half of the maximum concentrations allowed to achieve Good status.

	Units	BOD	Ammonia	Total P
Notional clean river values provided by the EPA	mg/l	0.26	0.008	0.005
Moderate quality river - Assumed values	mg/l	1.30	0.070	0.037

5.3 River Flow

According to the EPA HydroTool website, the River Inny (at the stretch of river that Kepak Longford discharge to) has an estimated 95%tile flow of 2.513m^3/s and 50%tile flow of 16.147m^3/s. The estimation of flow duration curve for the River Inny is shown in Appendix 1. As per accepted guidance, the 95%tile flow (obtained from the EPA HydroTool website) was used as the DWF to complete the WAC analysis.

6. Waste Assimilation Capacity (WAC)

6.1 WAC Methodology

The definition of assimilative capacity, as used by the Environmental Protection Agency (EPA), is *'the ability of a body of water to cleanse itself; its capacity to receive waste waters or toxic materials without deleterious effects and without damage to aquatic life or humans who consume the water'.* Guidance issued by the EPA and Water Services Training Group on the assessment of assimilative capacity was used in this study. The guidance details the following:

a) Assess the assimilative capacity with respect to BOD, Ammonia and Orthophosphate (P), in accordance with S.I. No. 272 of 2009 (Surface Water Regulations) using the following calculations.

WAC Formula 1
Assimilative capacity = (C_{max} – C_{back}) x F95 x 86.4kg/day
Where: C_{max} = Maximum permissible concentration (mg/l) Cback = Background upstream concentration (mg/l) F95 = $95_{\%ile}$ flow in river/stream (m^3/s) 86.4kg/day = 60x60x24

b) Assess the impact of the treated effluent on the River using the mixing calculation:

Mixing Calculation Formula
$\text{Downstream C} = \frac{(\text{Upstream flow} \times \text{upstream C}) + (\text{discharge flow} \times \text{discharge C})}{\text{Upstream flow} + \text{discharge flow}}$

6.2 Assimilation Capacity and Mixing Calculations of a Notionally (and Moderately) Clean River

A number of WWTP throughputs (both volumetric and effluent strength variations) were assessed using the WAC methodology, current and potential ELVs and using the advised receiving waterbody quality data. The waste assimilation capacity detailed calculations can be seen in Appendix B. Selected results are summarised in table 8 below.

Parameter	ELV's	% Capacity taken at Clean	% Capacity taken at Moderate
Flow (m^3/day)	110	0.05	0.05
BOD	20	0.40	0.80
Ammonia	0.5	0.20	0.40
Total P	0.5	0.40	0.70
Flow (m^3/day)	110	0.05	0.05
BOD	20	0.40	0.80
Ammonia	5	1.90	3.60
Total P	1	0.80	1.30
Flow (m^3/day)	200	0.09	0.09
BOD	20	0.80	1.40
Ammonia	5	3.40	6.60
Total P	1	1.40	2.40
Flow (m^3/day)	200	0.09	0.09
BOD	25	1.00	1.80
Ammonia	10	6.80	13.20
Total P	5	6.90	12.10
Flow (m^3/day)	200	0.09	0.09
BOD	25	1.00	1.80
Ammonia	15	10.5	19.70
Total P	5	6.90	12.10

Table 8: Waste Assimilation Capacity & Mixing Calculations based on a certain WWTP throughputs and a Notionally and Moderately Clean River Inny

7. WAC Study Conclusion

These results would suggest the following;

- Under current licence conditions, and water quality status of the Inny river, the Kepak Longford discharge is 'using' less than 1% of the river capacity for BOD and Orthophosphate and Ammonia;
- The volume of the discharge is not a limiting factor – the effluent volume could be increased to 200m^3/day and still only contribute less than 1% to the river's DWF; and,
- Ammonia is the limiting factor of the three parameters assessed, i.e., nitrogen discharges will result in ambient concentrations in the receiving environment to reach acceptability thresholds before BOD and Orthophosphate.

This WAC study that the reciveing water body has capacity to take up to 200m^3 of effluent a day at parameters of 25mg/l BOD, 15 mg/l Ammonia and 5mg/l Phosphorus, while only taking up 20% of the river capacity – even at moderate water quality conditions. It is also worth noting that a discharge of BOD up to 25mg/l and up to 5mg/l P is considered BAT for this type of industry.

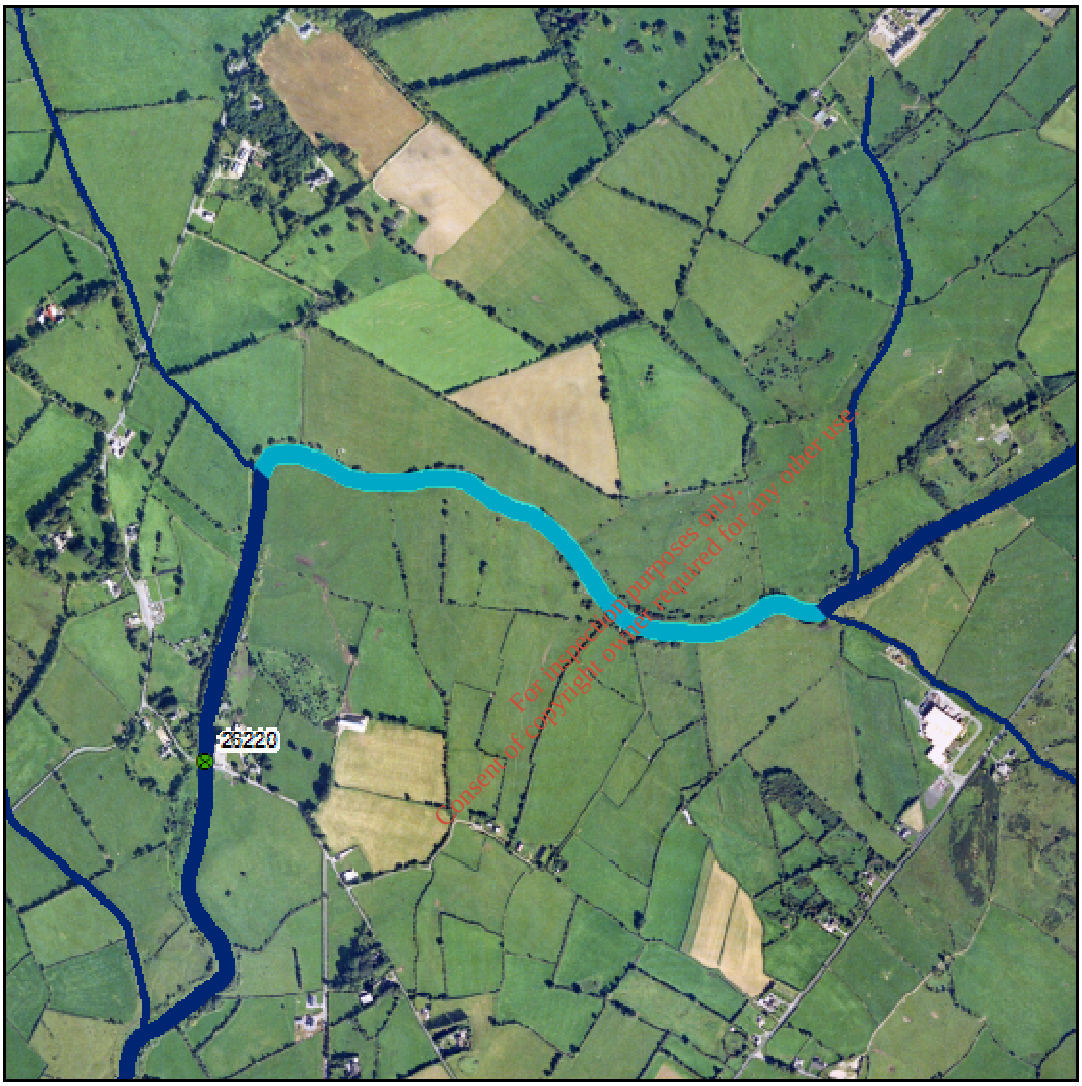
References

Ref	Description
1.	European Communities (Quality of Surface Waters Intended for The Abstraction of Drinking Water) Regulations 1989. S.I. No. 294 of 1989.
2.	European Communities. Environmental Objectives (Surface Waters) Regulations 2009. S.I. No. 272 of 2009.
3.	European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2009. S.I. No. 386 of 2015.
4.	EPA Biological River Quality Surveys (http://www.epa.ie/QValue/webusers/PDFS/HA30.pdf?Submit=Get+Results) – Accessed Jan 2018
5.	EPA Surface Water Quality Parameters (https://www.epa.ie/pubs/advice/water/quality/Water_Quality.pdf) – Accessed Jan 2018
6.	Geological Survey of Ireland Databases (www.gsi.ie) - Accessed Jan 2018
7.	EPA Hydrotool (http://watermaps.wfdireland.ie/HydroTool/Authentication/Login.aspx?ReturnUrl=%2fHydroTool%2fDefault.aspx) – Accessed October 2017
8.	Environmental Protection Agency (EPA) Maps website (www.epa.ie) – Accessed Jan 2018
9.	Water Services Training Group (WSTG) Guidance to Applicant Discharge to Surface Waters (http://www.wstg.ie/publications/) - Accessed Jan 2018

Appendix A: EPA HydroTool – Inny River Flows

River Name	Inny [Shannon](26_940)
XY Location	214024,256460 (ING)

River Segment Map



Disclaimer

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

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

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

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

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

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

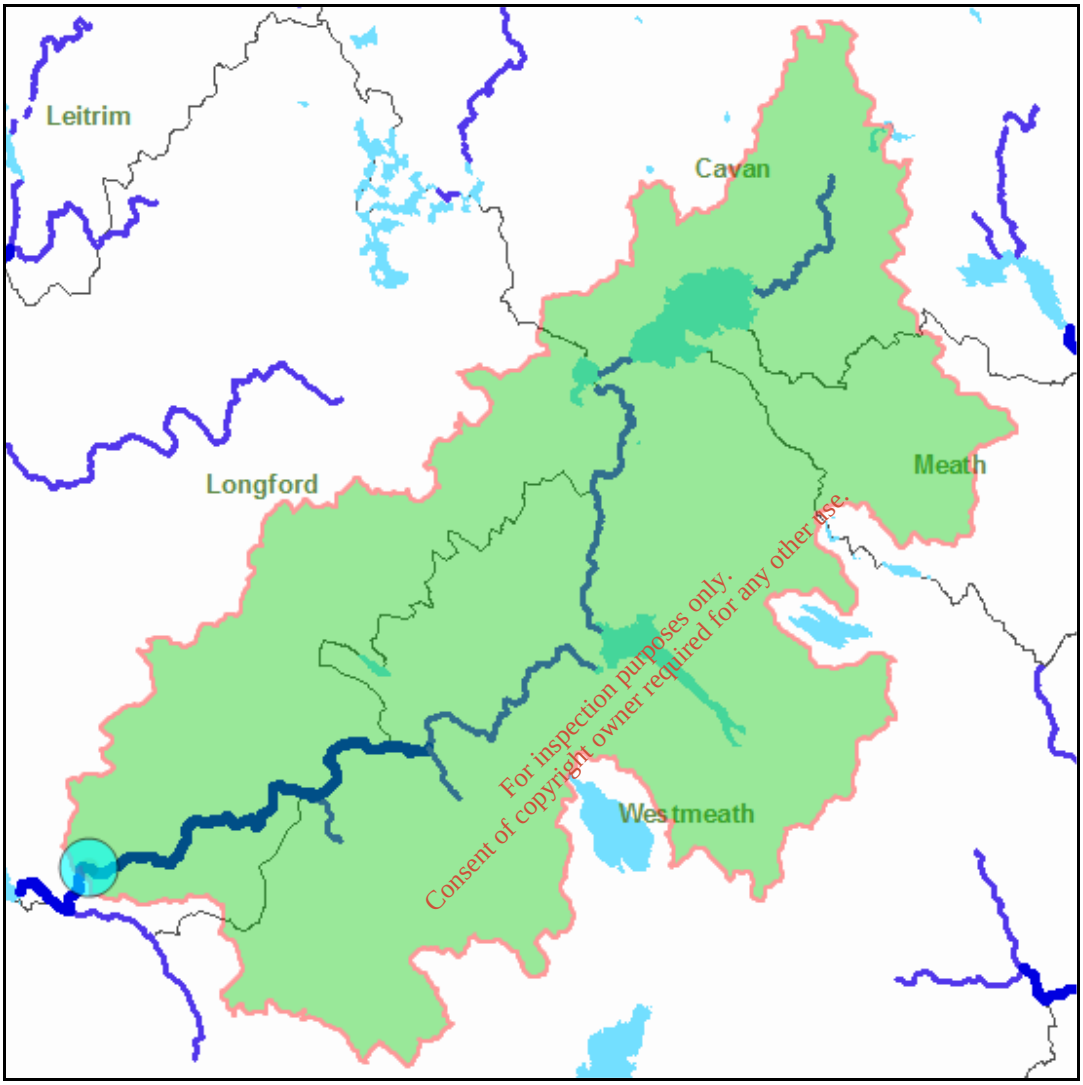
Please note that the model does not provide estimates of flood peaks and, specifically, should not be used for that purpose.

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

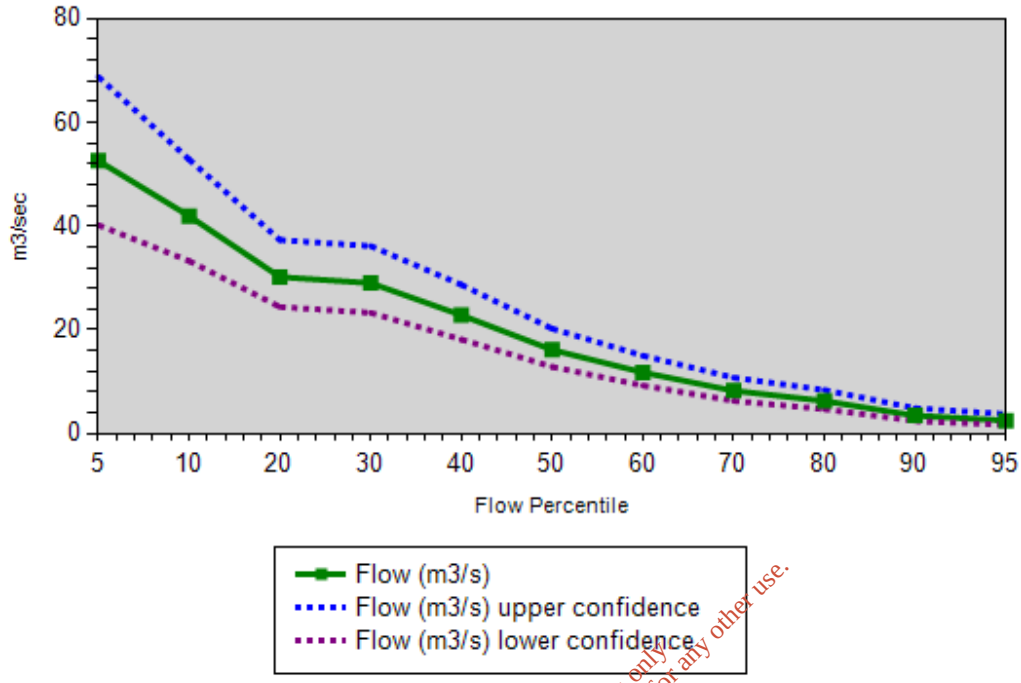
The data produced by the model for specific stations should be compared to the data contained in this file of DWF and long term 95percentile flows.

River Name	Inny [Shannon](26_940)
XY Location	214024,256460 (ING)

Nested Catchment Map



Flow Duration Curve (Flow in m3/sec)



%ile	flow(m3/sec)	upper 95% confidence limit m3/sec	lower 95% confidence limit m3/sec
5	52.571	68.763	40.192
10	41.933	52.836	33.28
20	30.193	37.319	24.428
30	29.023	36.162	23.293
40	22.826	28.692	18.159
50	16.147	20.232	12.886
60	11.809	15.033	9.276
70	8.263	10.799	6.322
80	6.3	8.411	4.719
90	3.477	4.91	2.463
95	2.513	3.77	1.675

Catchment Descriptors		
General		
Descriptor	**Unit**	**Value**
Area	sq km	1086.5
Average Annual Rainfall (61-90)	mm/yr	951
Stream Length	km	822.6
Drainage Density	Channel length (km)/catchment area (sqkm)	0.8
Slope	Percent Slope	3.2
FARL	Index (range 0:1)	0.8

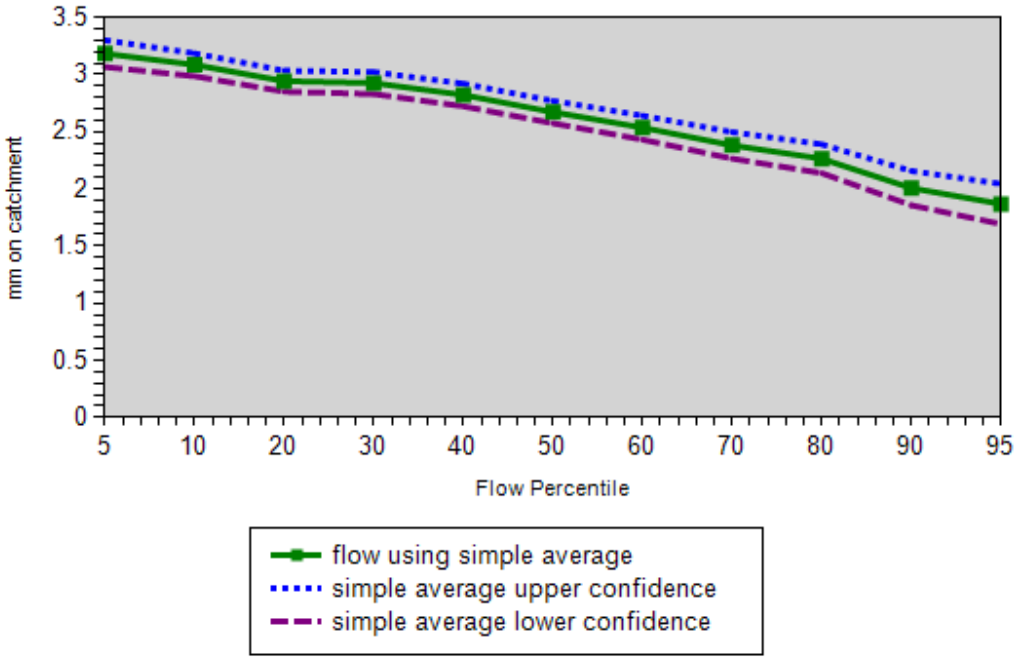
Soil	
Code	**% of Catchment**
Poorly Drained	18.3
Well Drained	54
Alluvmin	2.4
Peat	21.9
Water	3
Made	0.4

Subsoil Permeability		
Code	**Explanation**	**% of Catchment**
H	High	3.3
M	Moderate	34.1
L	Low	25.2
ML	Moderate/Low	0.9
NA	No Subsoil/Bare Rock	33.5

Aquifer		
Code	**Explanation**	**% of Catchment**
LG_RG	LG:Locally important sand-gravel aquifer RG: Regionally important sand-gravel aquifer	0.8
LL	Locally important aquifer which is moderately productive only in local zones	70.5
LM_RF	LM: Locally important aquifer which is generally moderately productive RF: Regionally important fissured bedrock aquifer	1
PU_PL	PU: Poor aquifer which is generally unproductive PL: Poor aquifer which is generally unproductive except for local zones	10.2
RKC_RK	Regionally important karstified aquifer dominated by conduit flow	0
RKD_LK	Regionally important karstified aquifer dominated by diffuse flow	13.9

Stations in Pooling group			
%ile Flow	**Station 1**	**Station 2**	**Station 3**
5	26021	36010	24008
10	26021	36010	24008
20	26021	36010	24008
30	26021	26012	35005
40	26021	26012	35005
50	26021	26012	36029
60	26021	26012	36029
70	26021	26012	36029
80	26021	26012	36027
90	26021	26012	36027
95	26021	26012	36027

Flow Duration Curve (mm on catchment)



Log Flow (mm on catchment)			
%ile	mm	upper 95% confidence limit	lower 95% confidence limit
5	3.184	3.301	3.067
10	3.086	3.186	2.986
20	2.943	3.035	2.851
30	2.926	3.022	2.83
40	2.822	2.921	2.723
50	2.672	2.77	2.574
60	2.536	2.641	2.431
70	2.381	2.497	2.265
80	2.264	2.39	2.138
90	2.007	2.157	1.857
95	1.868	2.044	1.692

Appendix B: WAC Calculations

Parameters used in calculations	Units	BOD	Ammonia	Total P
Discharge Concentration	mg/l	20	0.5	0.5
Discharge Volume (Maximum Discharge)	m^3/day	110	110	110
Discharge Volume (Maximum Discharge)	m^3/s	0.0013	0.0013	0.0013
Weight of parameter discharged per day	**kg/day**	**2.2**	**0.055**	**0.055**
Regulation requirement/	mg/l	2.6	0.14	0.075
Notional clean river values provided by the EPA	mg/l	0.26	0.008	0.005
Moderate quality river - made up values	mg/l	1.30	0.070	0.037
95%ile River Flow F95	m^3/s	2.513	2.513	2.513
50%ile River Flow F_{50}	m^3/s	16.147	16.147	16.147

WAC of River	Units	BOD	Ammonia	Total P
C max	mg/l	2.6	0.14	0.075
C back	mg/l	1.30	0.07	0.04
F 95	m3/sec	2.513	2.513	2.513
Multiplying factor		86.4	86.4	86.4
WAC = (Cmax-C back) * F 95 x 86.4kg/day)	kg/day	282.26	15.20	8.25
Maximum Flow permitted at expected concentration	**m^3/day**	**14,113.01**	**30397.25**	**16,501.36**
% of capacity to be assimilated at proposed discharge rate		**0.8%**	**0.4%**	**0.7%**