Mercury Renewables (Jennings O'Donovan)

Firlough Green Hydrogen

Preliminary Discharge & Assimilative Capacity Assessment (pDACA)

Project no. 603676 (07) pDACA

RSK

RSK GENERAL NOTES

Project No.: 603676

Title: Preliminary Discharge & Assimilative Capacity Assessment (pDACA)

Client: Mercury Renewables

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05	28/06/2023	Revision
06	29/06/2023	Revision

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

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1 INTRODUCTION

RSK Ireland was commissioned by Mercury Renewables to carry out a Preliminary Discharge & Assimilative Assessment for wastewater discharge associated with the Proposed Development i.e., Hydrogen Plant.

The Hydrogen Plant Site is situated in Co. Sligo, on the Co. Sligo and Co. Mayo border, 5.5 kilometres west of Bunnyconnellan, Co. Mayo

This report is accompanied by the following Appendices;

Appendix A – Figures

- Figure 1 - Site Location
- Figure 2 – Proposed Development
- Figure 3 – Site Location & Surface Water Baseline Locations
- Figure 4 – Conceptual Process & Treatment Train Flow Diagram

Appendix B – Groundwater, Surface Water & Wastewater Database

Appendix C – Assimilative Capacity Calculations

The Proposed Development and specifically the Hydrogen Plant is described in EIAR Chapter 2: Project Description (Figure 2 - Proposed Development Layout).

1.1 Scope of Work

The scope of work completed under this report includes;

- Establishing a good understanding of the wastewater streams, their volume / discharge rates, and likely contaminant loading.
- Identify the potential variability in wastewater volumes, discharge rates and contaminant loading.
- Evaluate and propose conceptual wastewater management, treatment and discharge of wastewater at the site.
- Estimate and qualify likely impact of discharging to receiving surface waters.
- Consider and evaluate potential alternatives.
- Identify significant data gaps if applicable.
- Make recommendations for the proposed development in terms of further assessment required, monitoring, and wastewater management.

1.2 Statement of Authority

RSK (Ireland) Ltd. (RSK), part of RSK Group, is a consultancy providing environmental services in the hydrological, hydrogeological and other environmental disciplines. The company and group provide consultancy to clients in both the public & private sectors. More information can be found at www.rskgroup.com. The principal members of the RSK EIA team involved in this assessment include the following persons;

- Project Manager & Lead Author: Sven Klinkenbergh – B.Sc. (Environmental Science), P.G. Dip. (Environmental Protection) – Principal Environmental Consultant with c. 10 years' experience in hydrology, hydrogeology and geology disciplines.

1.3 Sources of Information

The following sources of information were reviewed:

- EPA Maps (Accessed December 2022) (EPA, 2022)
- EPA HydroTool (Accessed December 2022) (EPA, 2022)
- EPA Hydronet (Accessed December 2022) (EPA, 2022)
- GSI Maps (Accessed December 2022) (GSI, 2022)

1.4 Limitations

RSK cannot be held responsible for any omissions, misrepresentations, errors for inaccuracies with the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report in whole or in part.

All opinions expressed are based upon current design standards and policies in force at the date of this report. These standards may be subject to change with the passage of time.

The opinions expressed herein are intended to provide general guidance as to how a problem related to a particular development might be resolved. Given the paucity of the original information, and the often-indirect nature of information received, they should not be relied upon as absolute or definitive guidance as to any particular solution. Such conclusions can only sensibly be arrived at upon detailed design.

As a consequence of the above, RSK. will not be held liable for any consequential losses, howsoever caused, as a consequence of inaccurate missing, incomplete, or erroneous data contained in this report, nor any data capable of being subject to variable interpretation by means of its generalised nature.

2 METHODOLOGY

2.1 Watercourse Nomenclature

Catchment and watercourse / surface water nomenclature is in line with names stated on EPA/WFD maps and datasets.

Non-mapped features follow the nomenclature of the source for information including appended reports.

2.2 Monitoring – Timing

Monitoring included initial site walkover and 1 no. round of surface water baseline sampling round.

Initial site walkover was conducted on 27th October 2022.

Surface Water Monitoring Event no. 1 was conducted on 2nd December 2022

2.3 Monitoring – Locations

Baseline sampling was carried out at 2 no. locations;

- FHP-SW1 (Upstream)
- FHP-SW2 (Downstream)

Surface water monitoring locations are presented in **Appendix A – Figure 3**.

2.4 Water Sampling & Field Hydrochemistry

Sampling was carried out in line with RSK Ireland standard practices and quality control checks.

During the sampling event, the physical characteristics of the river channel, and associated feeder drains (if applicable), as well as river water depth (3 no. locations), and estimated velocity were recorded.

Field hydrochemistry was assessed during the sampling event. The following field hydro chemical parameters were assessed and recorded.

- Colour
- Estimated Total Suspended Solids
- Odour
- Obvious Contaminants (e.g. Hydrocarbon)
- Temperature
- pH
- Electrical Conductivity

2.5 Laboratory Analytical Hydrochemistry

Surface water samples obtained during the monitoring event were sent to an accredited laboratory for analytical hydro chemical analysis.

Parameters analysed included key parameters with relevant Environmental Quality Standards (EQSs) associated, including, inter alia;

- Biological Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Nutrients - N (Nitrogen) and P (Phosphorous) compounds.
- Metals

Full parameter list is presented in Appendix **B** – Groundwater & Surface Water Database.

2.6 Reported River Water Quality

Desktop assessment included consultation with EPA, GSI and other relevant opensource maps. Data available on surface and groundwater quality including WFD 2016-2021 Status and latest cycle Risk classifications, etc.

2.7 Preliminary River Flow Data

Subject river discharge rate (Q_R) was assessed by on site and desktop assessments.

On site flow or discharge rate assessments were conducted as part of Surface Water (SW) sampling event (02/12/2022). Data obtained during the SW sampling event included data on depth, width, velocity (measured by float distance over time, average of three measurements), qualification of river bed characteristics and friction coefficients. Sectional area of the river water at the sampling point is calculated

*((Depth 1 * (Width / 3))/2)+ (Depth 1 * (Width / 3))+ ((Depth 1 * (Width / 3))/2)*

Sectional area (m^2) * Velocity (m/s) = Discharge (Q) (m^3/sec).

Note: This is considered in low accuracy discharge assessment undertaken at a single point in time.

Desktop assessment included consultation with EPA Water, EPA HydroTool and EPA Hydronet maps, assessing data availability associated with the subject catchment, and to ascertain the Q95%ile discharge rate for the subject river, and to infer a likely Q95%ile discharge rare for the subject river at the approximate location of the proposed discharge point.

2.8 Groundwater Quality & Levels

Available data obtained as part of the Minerex Pump Test (Minerex Environmental, 2023, Groundwater Supply Report) includes results of detailed hydrogeological desktop assessment, mapping of hydrogeological features including springs, borehole geological logging, long duration water logging, and groundwater environmental and groundwater characterisation analytical laboratory data.

Groundwater hydro-chemical data is used by the design team to provide indicative wastewater quality, and for interpretation of surface water hydro-chemical quality and hydrological / discharge properties of the subject river.

2.9 Conceptual Process Water Demand and Wastewater Treatment Assessment

The Hydrogen Plant will require volumes of treated water for use. The proposed facility design team (Black and Veatch) have provided indicative predictive wastewater quality data, and predicted water demand and peak production flow rates.The Hydrogen Plant will require volumes of wastewater to be treated water for discharge to surface waters. Using data provided (Black and Veatch etc) this report assesses the water balance, and treatment train required at the site in order to achieve minimal impact to the receiving environment.

Due to the uncertain nature of the wind resource (among other factors) that determines renewable energy production from a project such as the Wind Farm, the industry uses probability-based forecasting methods to estimate future production.

These methods are presented as probability density functions, for example a normal distribution or bell curve. The P50 probability representing an energy generation forecast that the relevant wind farm will at least achieve 50% of the time. As the mean average, this represents the most likely outcome for the Wind Farm.

Conversely, assuming the Hydrogen Plant would operate at 100% output for a year carries a probability of 0% as the Wind Farm will not operate at 100% utilisation for a full year based on collected wind data supplemented with long term data sets and due to normal operation and maintenance down time requirements at either the Wind Farm or the Hydrogen Plant.

Figures used in this document on process water, and wastewater discharge requirements of the Hydrogen Plant, are based on P50 production values of the Wind Farm.

2.10 Preliminary Effluent Discharge & Assimilative Capacity Assessment

The Hydrogen Plant will discharge treated trade effluent to surface waters. The discharge of trade effluent is a licenced activity, and considering the nature and scale of the Hydrogen Plant the proposed activities are likely to be listed on the First Schedule of the EPA Act. In the event that an IE licence is not required, at minimum the Hydrogen Plant will require a Section 4 Water Protection Act Discharge Licence from the local authority.

Anticipating the requirement for a licence application, this report assesses the likely / predicted effluent discharge quality, quantity or discharge rate, and the assimilative capacity of the receiving surface water, as well as screening requirements set out in relevant guidance for the purposes of applying for licence to discharge to surface waters.

Relevant guidance includes *EPA (2018) Licence Application Form Guidance – Industrial Emissions (IE), Integrated Pollution Control (IPC) and Waste*. This guidance document includes for the assessment and characterisation of emissions, namely; Emissions to Surface Water. The guidance lists items of information required for completing application templates, including requirements to establish the nature and quality of the emission or effluent. For the purpose of this preliminary assessment the following items are sited (this does not detail the full list of requirements, the following is sited for the purposes of assessing the potential impact as part of EIA);

Within the template document you are required to provide emission point details including:

1. *Details of the emission source.*
2. *The typical days usage/year.*
3. *The measures to reduce/minimise/prevent emissions (where an environmental quality standard consideration require measures stricter than BAT the measures are to be included in bold)*
4. *The receiving water type (River', 'Ditch', 'Estuary', 'Lake', 'Land Drain' or 'Other' (where 'Other' is selected please enter a description).*
5. *The receiving water code.*
6. *Identification of the relevant parameters emitted to water*
7. *The proposed emission limits and sampling/monitoring arrangements.*

To identify the relevant chemical parameters you are required to consider:

1. *Substances listed in the Schedule of EPA (Industrial Emissions)(Licensing) Regulations 2013, S.I. No. 137 of 2013.*
2. *The fate of materials/substances, intermediates, products and by products used or produced through the process particularly substances of very high concern, substances carrying the Hazard statement H400 to 413 (hazardous to the aquatic environment) and hazardous substances with damaging effects on sensitive plants and ecosystems.*
3. *Any reaction substances likely to appear as a result of treatment or natural breakdown processes with damaging effects on sensitive plants and ecosystems.*
4. *Any substances with the potential to cause odour nuisance off site.*
5. *List I and List II substances listed in the Annex to EU Directive 2006/11/EC (as amended).*

To determine the emission levels the applicant must consider the following:

1. *Environmental quality standards and objectives.*

The EPA 2018 guidance lists other items to consider and assess, including developing detailed procedures in line with EPA Best Available Techniques (BAT). These items are not addressed under this report. However, under the scope of this report, and to assess the potential impact for the purposes of EIA, this report will also look at guidance relating discharge licence applications to local authorities which sets out methodologies for assessing and qualifying the assimilative capacity of the receiving surface water.

It is noted that the receiving river is on the Co. Sligo and Co. Mayo Border, however this preliminary assessment of key criteria including assimilative capacity calculations has been carried out following Sligo County Council (SCC) (2011) *Guidance on Applying for a Discharge Licence to Surface Waters.*

Information required will include;

1. *Plans and other particulars to describe the premises, drainage system and any works, apparatus or plant from which the effluent is to be discharged;*
2. *Identify the waters to which the discharge is to be made and the point of discharge;*
3. *Particulars of the nature, chemical composition, anticipated temperature, volume and rate of discharge;*
4. *Details of the proposed method of any treatment of the effluent and the period or periods during which the effluent is to be discharged;*
5. *A general description of the process or activity giving rise to the discharge;*
6. *The results of any investigation made into the impact of the discharge on the receiving waters;*
7. *Particulars of the quality of the receiving waters. This is to include as a minimum, a description of the chemical and bacteriological condition of the receiving water at the point of discharge.*
8. *Particulars of the volume and flow rate of receiving waters, indicating 95%ile flow and Dry Weather Flow (DWF);*
9. *Details of the effects of the discharge on the receiving waters, which is to address the chemical and ecological qualities of the receiving water.*

Other information required will include;

1. A biological quality assessment / ecological assessment of the receiving waters;
2. Toxicity testing of the effluent;
3. Details of proposals for dealing with sludge.

SCC *Guidance on Applying for a Discharge Licence to Surface Waters* provides manual *Appendix C – Assimilative Capacity and Mass Balance Calculations* which details procedures to calculate;

- Assimilative Capacity for pollutant.
- Percentage of Assimilative Capacity used based on expected conditions.
- Mass Balance for estimating pollutant impact downstream based on expected conditions.

These calculations are used to preliminary assess the assimilative capacity of the subject river to receive treated trade effluent without significantly adversely affecting the Environmental Quality Standards (Surface Water Regulations reference limits) and Water Framework Directive (WFD) status of the receiving surface water network.

2.10.1 Assessment of Variable Conditions

In order to assess the likely impact of the proposed discharge, guidance sited stipulates that the assimilative capacity must be assessed using representative

Q95%ile and Dry Weather Flow Rate, the latter being ‘worst case’ scenario.

Q95%ile represents flow in cubic meters per second which was equalled or exceeded 95% of the flow record, and is a significant low flow parameter particularly relevant in the assessment of river quality consent conditions.

Due to limited available data on river discharge rates at the Hydrogen Plant Site, and in line with relevant guidance, the discharge values for the subject river will be inferred using data available for suitable neighbouring catchments. Furthermore, this assessment will look at variable effluent and river discharge rates under 3 no. scenarios, including the Base Case on which the conclusion of this report are based.

- Scenario A - Using Inferred Constant River HHYDRO Tool Q95%ile and Monthly Average Discharge Rate
- Scenario B - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and NO Restricted Discharge Rate
- Scenario C (Base Case) - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and WITH Restricted Discharge Rate

2.11 Consultation Meeting with EPA

The project team engaged with the EPA and a pre-application consultation meeting which took place on the 29th March 2023 The Hydrogen Plant water balance, treatment and discharge was discussed. Main points raised include the following in summary;

- The EPA noted that the proposal to abstract water from the ground for the hydrogen plant would be subject to the Water Environment (Abstractions and Associated Impoundments) Act 2022 given the volume of water required(By law, if you abstract 25 cubic meters (25,000 litres) of water or more per day, you must register this abstraction with the EPA).
- The EPA noted that an Industrial Emissions Licence would be required for the hydrogen plant under the Industrial Emissions Directive.
- The EPA noted that it is likely that the production of hydrogen would come under classification 5.13 of the First Schedule of the EPA Act 1992 as amended.
- The EPA noted that BAT (Best Available Techniques) and BREF (Best Available Technique Reference Document) details would need to be included in the licence applications.
- The EPA noted that the constructed wetlands and vegetated swales must be sealed by an impermeable liner.
- The EPA noted that the discharge design must be based on a worst-case scenario (i.e. dry weather flow).
- The EPA noted that there need to be separate sampling points for the process

and foul water treatment systems.

These items have been considered in the preliminary design and in this assessment of the Hydrogen Plant in terms of identifying any likely significant impacts at EIA stage.

3 RESULTS & INTERPRETATION

3.1 Catchments & Surface Water Features

3.1.1 WFD Catchments

WFD Catchment = 34, Moy & Killala Bay

WFD Sib-Catchment = 34_11, Leaffony_SC_010

WFD River Sub Basin = RATHROEEN STREAM_010

3.1.2 Subject River / Catchment

EPA HydroTool Catchment = 34_622

Subject River = DOOYEAGHNY_or_CLOONLOUGHAN_010

HYDRO Catchment Data = No

National Water Monitoring Station Data =

Yes, mapped station, *DOOYEAGHNY_or_CLOONLOUGHAN - Interstitial, 1st Br u/s from May_34 R conf.* However, no data available (Contact EPA / County Council).

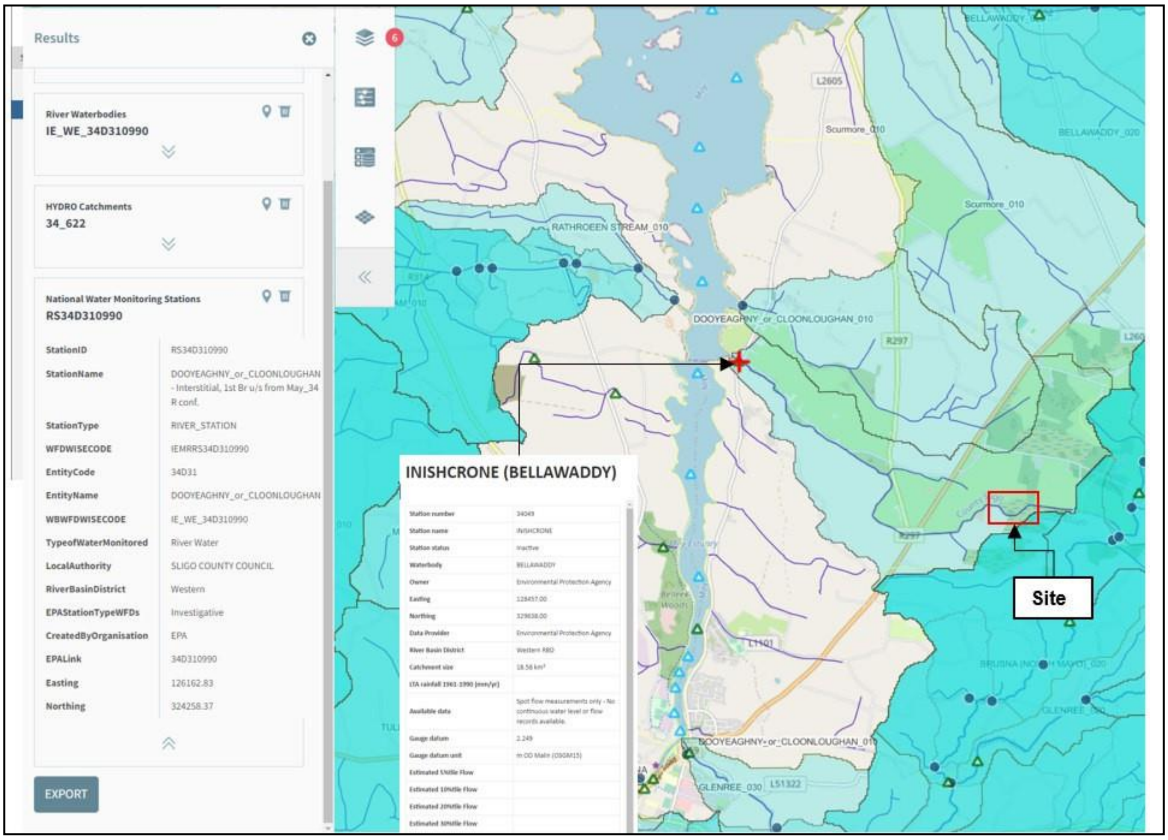

Plate 1 - Subject HYDRO Catchment 34_622

3.1.3 Neighbouring River/s / Catchment

EPA HydroTool Catchment = 34_1372

Neighbour River = NEWTOWN 34

HYDRO Catchment Data = Yes. HYDRO catchment node is positioned at outfall of HYDRO catchment. River Flow Estimate – Hydrotool data available

Hydrotool Model Data = The NATQ95%ile is reported to be 0.014 m^3/sec, or 14 l/sec.

National Water Monitoring Station Data = No

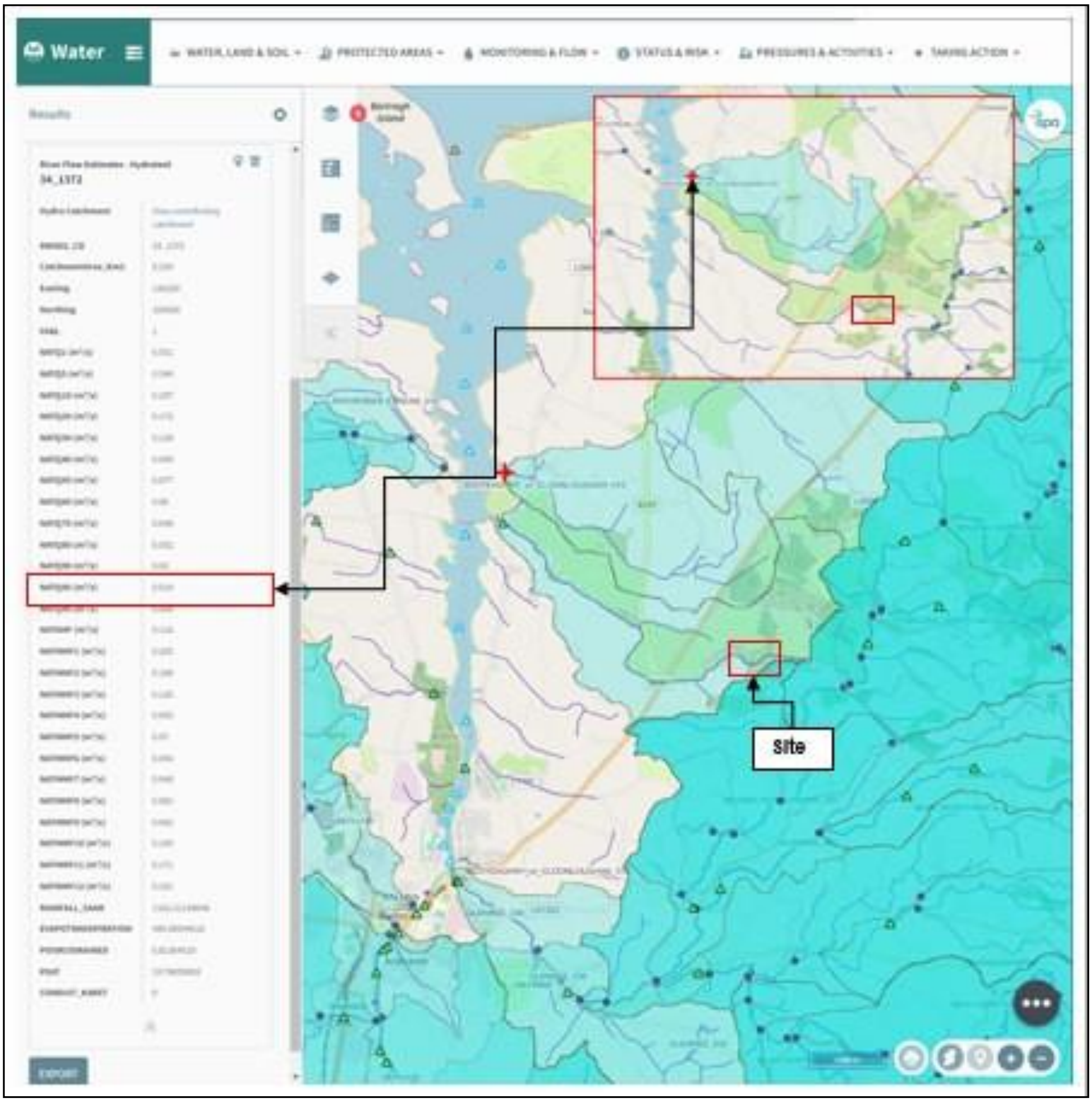

Plate 2 – Neighbouring HYDRO Catchment 34_1372

3.2 River Flow Data

3.2.1 Available and Adapted River Flow Data

Guidance on calculating the assimilative capacity indicates that the EPA Hydrotool data from a neighbouring catchment can be used, provided the catchment size and soils types are similar (**App A – Figure 1 - Site Location & SW Discharge Data**).

The HYDRO tool river flow data available in the neighbouring catchment is presented in the **Table 1.** The HYDRO Node associated with the neighbouring catchment is positioned at the outfall of the catchment, therefore represents the entire or 100% HYDRO catchment. When using the below data to infer a river flow (Q) rate at the proposed site Discharge Point (DP) of the Hydrogen Plant Site, it is important to consider the position of the DP relative to the position of the HYDRO node being used to infer data.

The DP is position approximately 66% upstream of the HYDRO catchment outfall / Hydrotool data node, i.e. approximately 33% of the subject catchment is available to contribute to river discharge at DP.

Table 1 – HYDRO Catchment & Adapted Data

HYDRO Catchments	Site		Neighbour		Neighbour
RWSEG_CD	34_622		34_1372		34_1372
NODE_ID	34_622_6		34_1372_2		34_1372_2
CatchmentArea_km2	6.281		5.254		5.254
National Water Monitoring Stations	Yes		No		No
Data	No (?)		n/a		n/a
River Flow Estimates - Hydrotool	No		Yes		Hypothetical
Location in catchment / Area %	n/a		100%		33%
Hydrotool Data					
RWSEG_CD			34_1372		34_1372
CatchmentArea_Km2			5.254		1.73382
Easting			126220		Site
Northing			324920		Site
FARL			1	33%	0.33
NATQ1 (m^3/s)			0.551	33%	0.18183
NATQ5 (m^3/s)			0.346	33%	0.11418
NATQ10 (m^3/s)			0.257	33%	0.08481
NATQ20 (m^3/s)			0.172	33%	0.05676
NATQ30 (m^3/s)			0.128	33%	0.04224
NATQ40 (m^3/s)			0.099	33%	0.03267
NATQ50 (m^3/s)			0.077	33%	0.02541
NATQ60 (m^3/s)			0.06	33%	0.0198
NATQ70 (m^3/s)			0.046	33%	0.01518
NATQ80 (m^3/s)			0.032	33%	0.01056
NATQ90 (m^3/s)			0.02	33%	0.0066
NATQ95 (m^3/s)		100%	0.014	33%	0.00462
NATQ99 (m^3/s)			0.008	33%	0.00264
NATAMF (m^3/s)			0.116	33%	0.03828
NATMMF1 (m^3/s)			0.205	33%	0.06765
NATMMF2 (m^3/s)			0.168	33%	0.05544
NATMMF3 (m^3/s)			0.126	33%	0.04158
NATMMF4 (m^3/s)			0.092	33%	0.03036
NATMMF5 (m^3/s)			0.07	33%	0.0231
NATMMF6 (m^3/s)			0.056	33%	0.01848
NATMMF7 (m^3/s)			0.048	33%	0.01584
NATMMF8 (m^3/s)			0.062	33%	0.02046
NATMMF9 (m^3/s)			0.063	33%	0.02079
NATMMF10 (m^3/s)			0.105	33%	0.03465
NATMMF11 (m^3/s)			0.171	33%	0.05643
NATMMF12 (m^3/s)			0.191	33%	0.06303

HYDRO Catchments	Site		Neighbour		Neighbour
RAINFALL_SAAR			1102.212	33%	363.7298235
EVAPOTRANSPIRATION			485.083	33%	160.0775372
POORLYDRAINED			0.814	33%	0.268502913
PEAT			33.781	33%	11.14759471
CONDUIT_KARST			0	33%	0

The NATQ95%ile is reported to be 0.014 m3/sec, or 14 l/sec. Assuming (inferred estimate) 33% of that discharge flow rate is indicative of the NATQ95%ile at the proposed DP, a Q95%ile value of 0.0046 m3/sec, or 4.6 l/sec will be used for this assessment.

3.2.2 Baseline Sampling & Flow Measurements

Peak river flow measurements / estimates at SW sampling locations are presented in Appendix **B** – Groundwater & Surface Water Database, and summarised as follows;

- FHP-SW1 (02/12/2022) = 32.3 l/sec
- FHP-SW2 (02/12/2022) = 65.8 l/sec

Weather conditions on the day of sampling (02/12/2022) and a number of days preceding the event were dry. However, the two months preceding the event were exceptionally wet, as presented in the following tables.

3.2.3 Rainfall Data

Rainfall data for the days and months preceding the Surface Water (SW) sampling event is presented in the following tables.

Monthly Long Term Average (LTA) rainfall is also presented, this data is included and used in preliminary assimilative capacity assessments presented in Appendix C – Preliminary Assimilative Capacity Assessment.

Table 2 – Daily Rain at Knock Airport (Up to 02/12/2022)

Daily Rain Data for KNOCK AIRPORT

02/12/2022	0
01/12/2022	0
30/11/2022	1.3
29/11/2022	0
28/11/2022	6.6
27/11/2022	11.6
26/11/2022	5.3
25/11/2022	3.3
24/11/2022	
23/11/2022	
22/11/2022	
21/11/2022	
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16/11/2022	
15/11/2022	

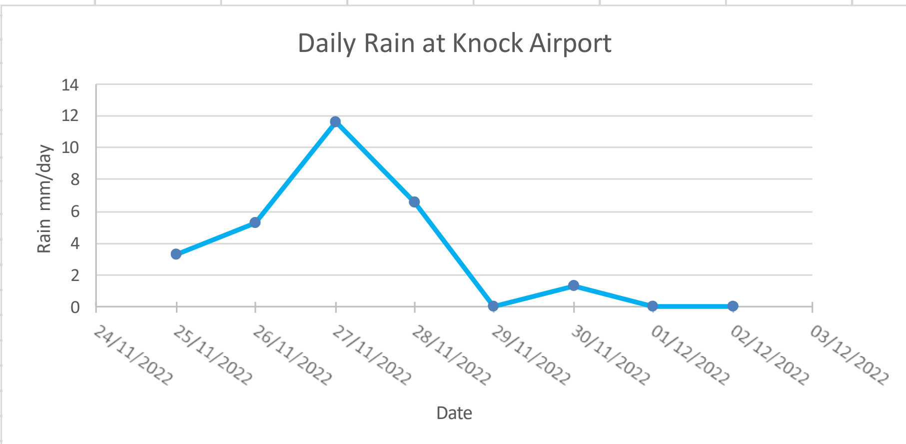


Table 3 - Monthly Rain Data for Knock Airport (Ref. Met Eireann).

Monthly Rain Data for KNOCK AIRPORT up to 21-dec-2022

Total rainfall in millimetres for KNOCK AIRPORT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2022	72.7	186.8	61.5	77.2	101.7	128.8	39.8	59.4	97	217.5	172.8	35.3	1250.5
2021	129.3	118.7	118.9	41.6	115.6	50.2	122.8	117.7	147.7	166.4	105.7	129.9	1364.5
2020	122.5	277.4	117.6	21	30.8	126.8	159.6	104.9	75.4	178.8	129.3	161.8	1505.9
2019	93.2	99.2	182.4	96.5	78.1	114.2	85.9	207.6	116.7	104.6	103	174	1455.4
LTA	135.4	102.9	118.1	81.6	92	91.5	95.7	107.9	111.3	141.3	134.2	141.4	1353.3

3.2.4 Anecdotal Data

Anecdotal evidence (Pers. Comm. Land Owner) suggests that the subject river, Dooyeaghny or Cloonloughan Stream is in constant flow year round.

3.2.5 Groundwater Data

Review of available data, including recent Minerex (2022) Groundwater Supply Assessment (Ref. 3131-043 Rev1)

> *The site is located in the Moy and Killala Bay catchment, Leaffony sub catchment and the Dooyeaghny or Cloonloughan sub basin. The Dooyeaghny or Cloonloughan stream flows westwards along the southern boundary of the site. A groundwater spring SP1 rises at the south west corner of the site. This is likely one source of the South Corbally stream which is mapped as rising at the south west boundary of the site flowing westwards before joining the Dooyeaghny or Cloonloughan stream which eventually flows to the Moy.*

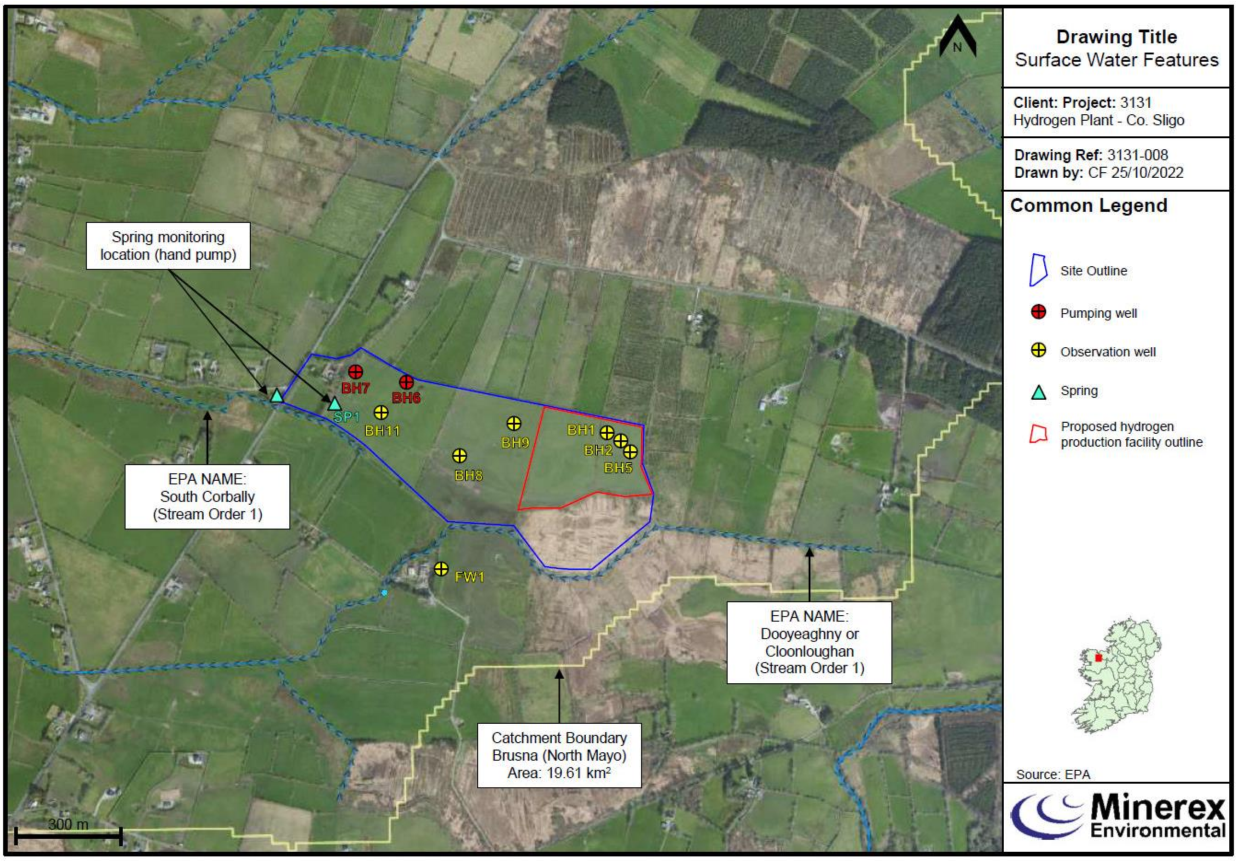


Plate 3 - Mapped Springs (Ref. Minerex 3131-043 rev1)

The SP1 and SP2 springs discharge to the Corbally river, not the subject river, however the presence of springs in combination with; anecdotal evidence of constant flow, and surface water hydrochemistry (namely elevated conductivity), the river discharge is likely comprised of a relatively steady groundwater fed baseflow.

Note on Aquifer Vulnerability. Between the two HYDRO catchments under review (subject and neighbour) there is a notable difference in mapped aquifer vulnerability, particularly in the top c. 33% of the subject catchment. The general area of catchments downstream of the proposed DP range in extreme to high vulnerability. The headwater 33% of the subject catchment is mapped as ranging from high to low vulnerability. This would likely impact on the actual flow duration curve for the subject catchment, and potentially a more buffered response to rainfall compared to that of the neighbouring catchment i.e. a more constant flow rate with additional infiltration and groundwater flow times, compared to the neighbouring catchments which could be more 'flashy' than the subject catchment and therefore could potentially have a lower Q95%ile flow rate as a result.

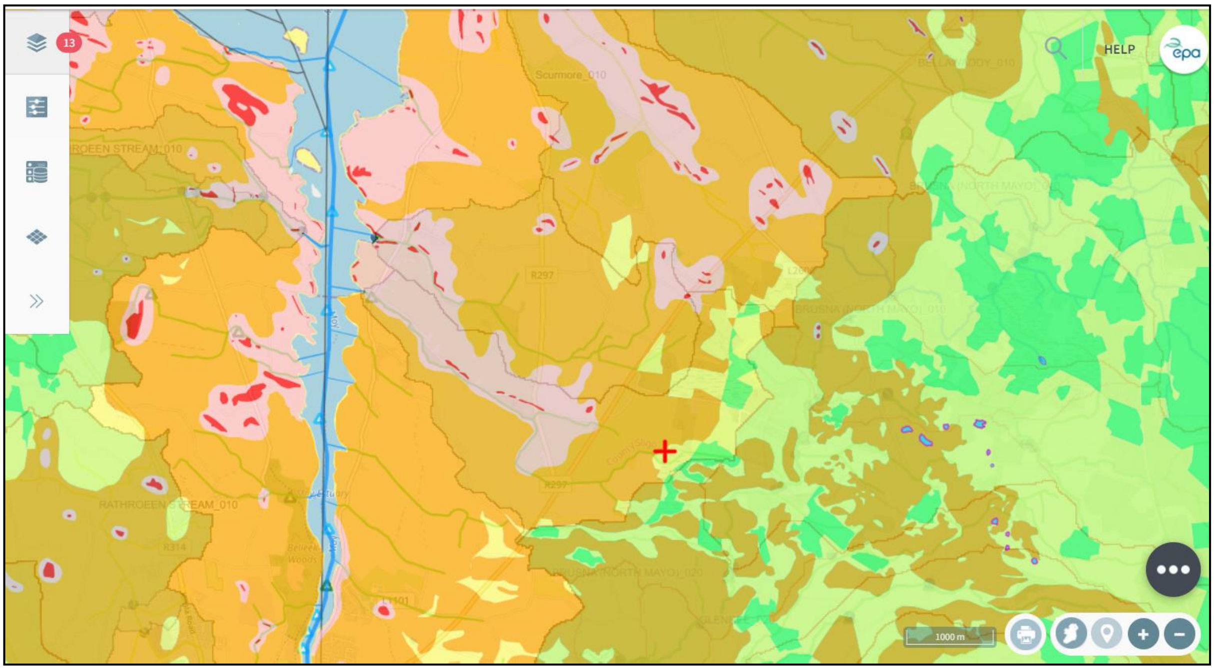


Plate 4 – Aquifer Vulnerability over HYDRO Catchments (Ref. EPA / GSI, 2022)

3.3 River Hydrochemistry

3.3.1 Water Framework Directive

Subject River = DOOYEAGHNY_or_CLOONLOUGHAN_010

WFD Status 2016-2021 = Good (Assessment Technique: Modelling)

WFD Risk 3rd Cycle = Review

River Q Values = No Data

3.3.2 Field & Analytical Surface Water Quality

Field and laboratory analytical analysis data for samples obtained during Surface Water (SW) sampling events are presented in Appendix **B** – Groundwater & Surface Water Database.

Laboratory results for SW samples obtained at FHP-SW1 and FHP-SW2 (02/12/2022) have been screened against relevant reference limits including Surface Water Regulations for Good water quality (95%ile).

Results indicate good water quality with the exception of Nitrates (c. 4.1 mg/l) which exceeds the SW Regs Good (95%ile) reference limit of 2.6 mg/l.

Electrical Conductivity (EC) is noted to be elevated (c. 596 uS/cm). This is not in exceedance of reference limits, however it is likely an indication that the subject river is potentially impacted by poor quality agricultural runoff, and/or receiving a relatively high volume of groundwater discharge i.e. groundwater fed river.

3.4 Process Wastewater Quality

Hydrochemical data for groundwater samples obtained by Minerex for the Groundwater Supply Assessment, and estimated waste water composition are presented in Appendix B.

Preliminary design details provided by Black & Veatch include the treatment of raw groundwater and production of demineralised water for use in the Hydrogen Plant electrolyser (Appendix A – Figure 4). The process water will be treated with an efficiency of approximately 70% and produce a process wastewater equating to approximately 30% volume of raw water used (assuming groundwater only, no supplementary rainwater). The hydro chemical signature of the resulting wastewater is therefore likely to be similar to hydrochemical signature of baseline groundwater samples, but with elevated concentrations. Black and Veech have provided expected wastewater composition based on baseline groundwater samples (Appendix B), however it is important to note the potential for variable groundwater chemistry, particularly during and after periods of groundwater extraction over prolonged periods of time.

As a result the expected composition of the wastewater, or effluent includes several substances which will be listed in the Schedule of EPA (Industrial Emissions)(Licensing) Regulations 2013, S.I. No. 137 of 2013, or listed in the Annex to EU Directive 2006/11/EC (as amended), including general groundwater properties such as nitrogen or phosphorous based compounds i.e. nutrients with the potential to impact on oxygen availability among others. With the potential for variable groundwater quality, and the potential for sources of contaminants within the zone of contribution associated with the Hydrogen Plant groundwater extraction point, other contaminants have the potential to be introduced to the system.

The system will be dosed with some cleaning and anti-scaling products. Black and Veech provide the following information:

Anti-scalants

- Example data sheets for proprietary products BV has used on previous projects for maintenance of treatment systems membranes (Reverse Osmosis).
- These would be expected to be dosed into the system at less than 10mg/L,

typically 5 mg/L

- Used to prevent mineral scale formation on the RO membrane surface
- The data sheets show that there are no ecotoxicity effects at the maximum dosing level
- Storage of antiscalants would be contained to prevent spills

Sodium Bisulphite

- Example data sheets for proprietary products BV has used on previous projects for maintenance of treatment systems
- This would be expected to be dosed into the system at less than 5mg/L, typically 2-3mg/L
- Datasheet shows it is a non-hazardous solution commonly used as a waste water dichlorination agent. High concentrations will contribute to elevated chemical oxygen demand in aquatic environments, however, maximum dosing is far below exposure limits.
- Storage of sodium bisulphite would be contained to prevent spills

It is understood that Sodium Bisulphite will be used only if mains water is used as a raw water source. This is unlikely to happen except for exceptional circumstances where the preferred raw water sources, groundwater and rain water, are not available.

These products are not likely to cause significant adverse impact at the low concentrations they will be dosed into the system, which will further reduce following on site primary and secondary treatment. However, in their raw form these products have the potential to cause a more significant impact, and in line with typical safety datasheets associated with these products, the use of these products will be managed and monitored, and accidental release avoided through appropriate measures, including diverting away from drainage systems. The products that will be used for the Hydrogen Plant system will be not include any substances which are persistent and/or bioaccumulate.

3.5 Process Wastewater Discharge Flows

Preliminary water balance assessment data provided by Black & Veatch is presented in the following table.

Table 4 - Predicted Wastewater Rate per Month

Predicted Wastewater Rate per Month					
Month	Avg Waste Water (m3)	m3/day	m3/hour	l/hour	l/sec
Jan	1,726.89	57.563	2.398	2398.458	0.666
Feb	2,029.27	67.642	2.818	2818.431	0.783
Mar	1,550.09	51.670	2.153	2152.903	0.598
Apr	1,269.43	42.314	1.763	1763.097	0.490
May	1,281.02	42.701	1.779	1779.194	0.494
Jun	1,222.71	40.757	1.698	1698.208	0.472
Jul	880.17	29.339	1.222	1222.458	0.340

Predicted Wastewater Rate per Month					
Month	Avg Waste Water (m3)	m3/day	m3/hour	l/hour	l/sec
Aug	1,165.98	38.866	1.619	1619.417	0.450
Sep	1,287.65	42.922	1.788	1788.403	0.497
Oct	1,707.79	56.926	2.372	2371.931	0.659
Nov	1,556.83	51.894	2.162	2162.264	0.601
Dec	1,855.96	61.865	2.578	2577.722	0.716
Min	880.17	29.34	1.22	1,222.46	0.34
Max	2,029.27	67.64	2.82	2,818.43	0.78
Mean	1,461.15	48.70	2.03	2,029.37	0.56
Total	17,533.79				

Peak average wastewater equates to 2.82 m3/hour or c. 0.78 l/sec (February).

The above wastewater values are included in Appendix C – Preliminary Assimilative Capacity Assessment and are used as the discharge flow rate in preliminary assimilative capacity assessments.

It must be noted that the above predicted discharge rates, or wastewater volumes arising from the Hydrogen Plant are derived assuming; the Hydrogen Plant is operating on 100% wind take from the Wind Farm in line with predicted potential wind energy per month (50th percentile (20yr) average).

Figure 4 – Conceptual Process & Treatment Train Flow Diagram

3.6 Preliminary Assimilative Capacity Assessment

A preliminary assimilative capacity assessment has been completed (Appendix C).

Biological Oxygen Demand (BOD) has been assessed under 3 no. scenarios.

- **Scenario A** – Using;
  - Inferred Constant River HHYDRO Tool Q95%ile and
  - Monthly Average Wastewater Discharge Rate, combined with
  - Wastewater Storage and NO Restricted Discharge Rate

  Results:

  Assimilative Capacity = Pass

  Mass Balance = Pass

  Comment = At inferred Q95 of c. 4.6 l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will not have a significant adverse impact on surface water quality.

- **Scenario B** – Using;
  - Inferred Variable River Q95%ile or and
  - Monthly Average Wastewater Discharge Rate, combined with
  - Wastewater Storage and NO Restricted Discharge Rate

  Results:

  Assimilative Capacity = Fail in July (Indicative Dry Weather Flow).

  Mass Balance = Pass

  Comment = At inferred variable Q95 or indicative seasonal discharge rate l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will have a significant adverse impact on surface water quality during some months of the year.

- **Scenario C (Base Case)** – Using;
  - Inferred Variable River Q95%ile (HHYDRO Tool Derived) and
  - Monthly Average Wastewater Discharge Rate, combined with
  - Wastewater Storage and WITH Restricted Discharge Rate

  Results:

  Assimilative Capacity = Pass

  Mass Balance = Pass

  Comment = At inferred variable Q95 or indicative seasonal discharge rate l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will not have a significant adverse impact on surface water quality during some months of the year.

3.7 Results Interpretation & Commentary

The following points are noted;

i. The proposed Base Case, allowing excess wastewater storage enables regulating of discharge rates. Reducing peak flow by 50% (Appendix C, Scenario C) will result in pass for the July in contrast to Scenario B discussed previously. This Base Case indicates that the proposed mitigation will be sufficient in managing discharge loading of assessed contaminants and achieving Environmental Quality Standards for river water quality and maintaining WFD status.

ii. Assuming very low flow conditions during dryer months, discharge at peak rates (no utilization of designed wastewater storage) and discharging in line with indicative discharge licence limits (BOD 10mg/l used in assessment, with an EQS water quality reference of 5mg/l), the discharge has the potential to significantly impact on surface water quality i.e. loading with contaminants with a result of elevating downstream concentrations above environmental quality standards (Salmonid Regs reference limits). Results (Appendix C) indicate that the assimilative capacity test failed, but the mass balance passed, under the Scenario B in July. This highlights the requirement for dynamic mitigation and the monitoring and regulation of both discharge and river properties in the proposed Base Case above.

iii. This indicates the requirement to manage and reduce discharge during excessively dry conditions. Monitoring will be required to specify and actively manage the treatment and discharge system.

iv. Wastewater volumes generated at the site will be variable month to month depending on and in line with potential wind energy production, the utilisation of the energy and the utilisation capacity at the Hydrogen Plant Site. As a result, the Hydrogen Plant will have largest volumes of wastewater generated in February, with lowest volumes in summer months. This is also generally in line with rain fall trends through out year.

v. The wastewater volumes provided for this assessment are based on fully installed capacity of the Hydrogen Plant operating on 100% wind take of the Firlough Wind Farm (assuming 50th percentile (20yr) average generation forecast). These rates will not be achieved until the installed capacity of the Hydrogen Plant reaches 80MWs. Loading and rates of discharge from the Hydrogen Plant Site are expected to be linear from no installed Hydrogen Plant capacity up to 80MW of installed Hydrogen Plant capacity, on which this report is based.

The following points are noted;

i. Wastewater volumes generated at the site will be variable month to month depending on and in line with potential wind energy production, the utilisation

ii. of the energy and the utilisation capacity at the Hydrogen Plant . As a result, the Hydrogen Plant will have largest volumes of wastewater generated in February, with lowest volumes in summer months. This is also generally in line with rain fall trends through out year.

The wastewater volumes provided for this assessment are peak rates based on utilising the output of the Wind Farm (Modelled using P50 data) .

4 CONCLUSIONS

With reference to assumptions, results and interpretation outlined in the previous sections, this preliminary Discharge and Assimilative Capacity report assesses the potential for adverse impact on the receiving surface water network, addresses the minimum requirements for assessing discharge to surface water in line with licence application procedures, and with a view to quantifying and qualifying potential impact, identifying data gaps and scoping of further detailed assessment. In line with the assessment approach outlined in **Section 2.10**, the following items are addressed;

Plans and other particulars to describe the premises, drainage system and any works, apparatus or plant from which the effluent is to be discharged;

Preliminary project layout and design presented in Figure **2** - Proposed Development Layout. Detailed design to be completed pending planning application consent and will include full details on the proposed facility and ancillary infrastructure.

Conceptual water management and treatments train/s discussed Section 3 and presented in Figure **4** – Conceptual Process & Treatment Train Flow Diagram.

Identify the waters to which the discharge is to be made and the point of discharge;

Receiving surface waters are identified, discussed Section 3, and presented in;

Figure **1** - Site Location

Figure **2** - Proposed Development Layout

Figure **3** - SW Monitoring Locations

Particulars of the nature, chemical composition, anticipated temperature, volume and rate of discharge;

As discussed under this report, envisaged contaminant loading in effluent is likely to be relatively low. At a minimum, wastewater treatment and management on site will achieve quality in line with typical / prescribed discharge licence limits. Refer to Appendix B Database. Additional detail will be required with the discharge licence application.

Details of the proposed method of any treatment of the effluent and the period or periods during which the effluent is to be discharged;

Source water will be treated as part of the hydrogen production process, the wastewater arising from this process will treated by means of constructed wetland and regulated discharge rates. Any particular contaminant which is observed to be excessively high in incoming source water will be targeted with specific wastewater treatment.

A detailed wastewater management plan is to be established. Additional detail will be required with the discharge licence application.

A general description of the process or activity giving rise to the discharge;

Raw water treatment for hydrogen production.

The results of any investigation made into the impact of the discharge on the receiving waters;

Results of preliminary Discharge Assimilative Capacity in the subject river to receive trade effluent discharge from the proposed facility is presented in Appendix C – Preliminary Assimilative Capacity Assessment.

- Scenario A - Using Inferred Constant River HHYDRO Tool Q95%ile and Monthly Average Discharge Rate

  Results:

  Assimilative Capacity = Pass

  Mass Balance = Pass

  Comment = At inferred Q95 of c. 4.6 l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will not have a significant adverse impact on surface water quality.

- Scenario B - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and NO Restricted Discharge Rate

  Results:

  Assimilative Capacity = Fail in July (Indicative Dry Flow conditions).

  Mass Balance = Pass

  Comment = At inferred variable Q95 or indicative seasonal discharge rate l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will have a significant adverse impact on surface water quality during some months of the year.

- Scenario C (Base Case) - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and WITH Restricted Discharge Rate

  Results:

  Assimilative Capacity = Pass

  Mass Balance = Pass

  Comment = At inferred variable Q95 or indicative seasonal discharge rate l/sec each month, based on available baseline data, and envisaged effluent loading, discharge will not have a significant adverse impact on surface water quality during some months of the year.

Particulars of the quality of the receiving waters. This is to include as a minimum, a description of the chemical and bacteriological condition of the receiving water at the point of discharge.

Appendix B. ***.*** Additional detail will be required with the discharge licence application

Particulars of the volume and flow rate of receiving waters, indicating 95%ile flow and Dry Weather Flow (DWF);

This is inferred using data for a neighbouring catchment. Additional detail will be required with the discharge licence application

Details of the effects of the discharge on the receiving waters, which is to address the chemical and ecological qualities of the receiving water.

Provided additional detail will be obtained and an effective wastewater management plan is implemented, in line with the recommendations provided here width (Section 5), the discharge of trade effluent at the site is unlikely to have a significant adverse impact on the receiving surface water quality and associated ecological attributes.

5 DISCUSSION & RECOMMENDATIONS

The following recommendations are made following preliminary assessment observations, and in line with requirements of relevant guidance for discharge to surface waters.

5.1 Process Source Water, Wastewater Management & Discharge

The following is recommended with a view to managing wastewater quality and volumes on site, and minimizing potential for discharge to have adverse impacts on receiving surface water quality;

- Groundwater quality will be monitored on a routine / continuous basis with a view to establishing site specific baseline water quality ranges managing source water and process water chemistry.
- Surface water quality will be monitored on a routine / continuous basis with a view to establishing site specific Q95 and baseline water quality ranges, and managing source water and process water chemistry.
- Groundwater levels will be monitored continuously.
- Surface water levels and discharge rate in the receiving river will be monitored continuously.
- Water sources (groundwater and harvested rainwater) will be utilized and combined at the beginning of the process to minimize contaminant loading in the process source water generally with a view to minimizing loading on downstream wastewater treatment systems.
- Groundwater abstraction volumes will be monitored and recorded continuously. It is likely that the development will exceed abstraction volumes of 25m^3/day. Therefore, the facility will be required to register with the EPA and follow any associated guidance or legislated responsibility.
- ‘Water Environment (Abstractions and Associated Impoundments) Act 2022’, the bill sets out a process for the registration, assessment and licensing of both surface water and groundwater abstractions.
    - All abstractions, including group water schemes, that reach a minimum daily threshold of abstraction (25m3 per day) will be required to register its abstraction in a similar fashion. Those that abstract 2,000m3 or more will automatically require an abstraction licence.
    - EPA will assess abstractions and if deemed necessary due to potential environmental risk certain development will require EIA. EIAs for these abstractions will reviewed at least once every six years.
    - For groundwater, recharge times and impacts on connected surface waters are among the elements assessed.

- There is onus on stakeholders to ensure sustainable use of water, and in light of climate change and potential for extreme meteorological conditions, to work towards water sustainability gains.

- In line storage throughout the process will facilitate buffering flow through and discharge rates. This includes wastewater storage with a view to buffering inflow and regulating discharge from wastewater treatment works on site.
- Process water treatment will include at minimum the proposed design features i.e. Filtration, Reverse Osmosis, and Deionization. The process water treatment facility will be designed to include additional treatment features where required, for example; with the potential for increasing concentrations of contaminants being extracted from the Zone of Contribution (ZOC) over time, the engineered process source water treatment facility will be equipped when and if required to remove elevated concentrations of any particular contaminant which may overload or adversely impact on performance of downstream wastewater treatment facilities.
- All engineered water and wastewater treatment systems will be designed and specified by competent, qualified and experienced engineers.
- Two wastewater streams identified i.e. process wastewater and foul sewage arising from welfare facilities (toilets, canteen etc.) will be dealt with separately initially.
- Wastewater will be treated and managed through passive but managed nature-based solutions, including constructed wetlands (Note; engineered treatment solutions for waste water will be included upstream in the process source water treatment facilities.
- All nature based water and wastewater treatment systems (constructed wetlands) will be designed and specified by competent, qualified and experienced environmental engineers. It is recommended that this item is executed at an early stage of the detailed design. Constructed wetlands will be designed with particular characteristics and ecological attributes based on the expected contaminant loading, achievable retention time, and performance / discharge quality objectives. The wetland systems will likely take some time to become established and therefore will be required at an early stage of the construction stage of the development. The detailed assessment and design of constructed wetlands will follow the Department of Agriculture, Fisheries and Food guidance document (2011), Minimum Specification for Integrated Constructed Wetlands and Ancillary Works.
- Without advanced assessment of the site hydrogeological properties, including soil infiltration rates and potential for natural attenuation of contaminants, it is recommended that constructed wetlands are lined and do not permit infiltration or recharge to groundwater bodies..
- Foul sewage will undergo primary treatment by septic tank. The septic tank will be emptied by tanker in line with standard practices. The outfall of the septic tank will be transferred to the foul sewage constructed wetland (FCW) for secondary treatment. The FCW will be positioned in the northeast corner of the site and will be approximately 80m2 to facilitate the optimal retention time of c. 12 days to adequately treat the welfare effluent loading. The outfall of the FCW will be combined with process wastewater in storage before being transferred to the second constructed wetland configuration.

- The outfall of the foul constructed wetland (FCW) will be monitored and sampled in line with sampling frequency and reporting requirements set out in the discharge licence conditions, discussed in later points.
- The combined wastewater will be pumped to a secondary series of process constructed wetlands (PCW). The remaining area on the site will be utilized to maximize area of PCW and associated retention time. This includes a linear feature within the 5m easement along the southern boundary. Based on initial high level calculations, with the approximate space left available on site, and with regulation of loading and discharge rates, the PCW will achieve a minimum of 6 days retention time. This is lower than the required retention time for loading in line with foul sewage arising from welfare facilities, however the loading from process wastewater will be significantly less than that of welfare wastewater of sewage under normal circumstances*.

  *Potential for variable source water / groundwater quality
- Wastewater storage will be adequately sized (e.g., c. 1500m^3) to achieve ability to significantly reduce (e.g. 50%) discharge rates to surface water, or in emergency situations to completely halt discharging for a minimum duration of one month. Emergency situations in the context of this report includes observing prolonged drought conditions and prolonged low dry weather discharge rates in the receiving river, for example; under Scenario B described in this report, discharging under such conditions could significantly adversely impact on water quality in the receiving river. Therefore, this is an important piece to consider in the management of wastewater and effluent discharge.
- The production of hydrogen on an industrial scale is an activity listed in First Schedule of the Environmental Protection Agency Act, 1992 (as amended) and therefore an Industrial Emissions Licence may be required and the Developer will apply to the EPA for same. To the extent that the EPA do not consider the production of hydrogen at the facility to be on an industrial scale or otherwise not require an Industrial Emissions licence then the Developer will apply for a discharge license from the relevant local authority (Sligo Co. Co. / Mayo Co. Co.). The facility will be operated in accordance with all industrial emissions and discharge licences applicable to the facility and the discharge of waste water to the adjacent water course.

5.2 Detailed Discharge & Assimilative Capacity (DACA)

Pending consent for the Proposed Development, during the detailed design and post consent stage, and prior to construction / operational phase this preliminary Discharge & Assimilative Capacity Assessment will be refined and updated through further assessment (based on the framework established under this report, including EPA guidance for applying for IPC licence if required) of surface water discharge and additional baseline chemistry analysis will be carried out and wastewater management plan will be refined. Continuous monitoring through the life of the project will be used to review and update methodologies wherever appropriate on an ongoing basis, that is; the detailed water and wastewater management plan which will be developed prior to the construction phase of the development will be live document and procedures will be amended where relevant based on ongoing continuous and/or routine monitoring.

This will follow the requirements set out in EPA 2018 Licence Application Form Guidance including following relevant Best Available Techniques (BAT).

5.3 Detailed Monitoring Plan

As discussed and mentioned throughout this report, monitoring will be required at numerous locations to facilitate and ensure adequate management of a dynamic process in terms of expected source water, wastewater, and receiving water qualities. Detailed monitoring plans will be developed for the following;

- Input and Sources
  - Groundwater levels will be monitored continuously.
  - Ambient groundwater chemistry will be monitored in boreholes. As per likely licence conditions, a minimum of quarterly monitoring of groundwater chemistry will be required.
  - Rainfall at the site will be monitored continuously.
  - Harvested Rainwater & Storm Water volumes.
  - The use of storm water as a raw material requires pre-treatment via oil water separation during storage to prevent contamination of process by hydrocarbons. This will require regular monitoring and maintenance in line with standard practices.
  - Continuous monitoring of water sources being input to the facility and process water treatment works. Establishing site specific water quality ranges will be necessary to ensure consistent and appropriate loading in wastewater.
- Process Water Treatment & Output
  - It is assumed that the engineered water and wastewater treatment facilities will require a degree of continuous monitoring as standard. However at minimum the works will monitor flows and concentrations of key parameters in wastewater streams. This will be carried out on an ongoing basis to ensure that the water treatment systems are functioning adequately, and to monitor

the contaminant loading in wastewater transferred to nature based treatment systems downstream i.e. constructed wetlands.

- Welfare and Foul Sewage
    - Septic tanks will require monitoring and maintenance in line with standard practices.
    - The outfall of the Foul Constructed Wetland (FCW) will be monitored continuously for key chemical parameters and physically sampled in line with likely licence conditions.
    - FCW outfall volumes will be monitored on a continuous basis with a view to monitoring chemistry of combined FCW outfall and Process Wastewater.
- Wastewater Treatment
    - Volumes within wastewater buffer storage will be monitored continuously.
    - Quality data obtained from process water treatment and FCW outfall monitoring will be utilized to infer water quality within wastewater buffer storage, if chemistry in storage is monitored directly. This will be done on a continuous basis for key parameters.
    - The outfall / pumped volume from wastewater storage to the Process Constructed Wetland (PCW) will be monitored continuously.
    - Health and performance of all constructed wetlands will be monitored on an ongoing basis.
- Discharge & River
    - Routine and continuous monitoring of surface water quality in line with licence conditions and advised Environmental Quality Standard (EQS) chemical parameters including but not limited to; temperature, pH, turbidity, electrical conductivity, dissolved oxygen, nitrogen, phosphorous, and other key EQS parameters. This will be done with continuous monitoring equipment for a select key parameters and those which can practically be monitored in situ in real time. Other parameters which require physical sampling e.g. Biological Oxygen Demand (BOD) will be monitored on a routine basis, with high frequency e.g. weekly to inform the development of the detailed water management plan, that is; adequate data to establish representative baseline concentration trends of key parameters and to adjust assimilative capacity calculations accordingly.
    - Monitoring described above will be conducted at three monitoring locations on the river; upstream (FHP-SW-US), the discharging effluent at the discharge point (DP) or at a representative (of end of pipe) sampling location on the discharge line, and downstream (FHP-SW-DS) of development. Continuous real time monitoring data obtained at these locations will be used to manage and calibrate the wastewater and discharge regime at the site.
    - Discharge rates in the river will be monitored on a continuous basis. Data obtained will be used to establish a hydrograph and associated discharge (Q) percentiles (similar to EPA HydroTool) for the river at the point of monitoring

i.e. DP. Dray weather flow will also be qualified. Continuous real time monitoring data will be used to manage and calibrate the wastewater and discharge regime at the site e.g. restricting discharge during dry weather discharge rates will inadequate assimilative capacity.

- Overall Environmental Impact
  - All data obtained will be compiled, reviewed, assessed and used to inform ongoing review and assessment of overall impacts to the receiving environment in terms of sustainable use and interaction e.g. ongoing monitoring of effects on groundwater quality and levels, ongoing monitoring of river water discharge rates and quality.
- Reference Values
  - With reference to EPA 2018 Licence Application Form Guidance, full suite of relevant parameters will be identified, screened, and emission limit levels proposed as part of licence application procedures.

5.4 Detailed Design & Specification

The detailed design of all water and wastewater facilities and functions, including monitoring stations will be carried out by qualified and experienced engineers specializing in respective fields and following relevant standards and guidance associated with each. These elements include;

- Groundwater abstraction and ancillary works.
- Rain and storm water harvesting and ancillary works
- Source water storage and ancillary works.
- Process source water treatment and ancillary works.
- Welfare foul sewage systems including septic tanks and ancillary works.
- Wastewater buffer storage and ancillary works.
- Constructed wetland systems and ancillary works.
- Discharge points and ancillary works.
- Environmental and process systems monitoring, long-term and real time data and systems management, environmental assessment and interpretation.

6 REFERENCES

EPA (2018) Licence Application Form Guidance

Sligo County Council (No Date) *Guidance on Applying for a Discharge Licence to Surface Waters*

Minerex Environmental Ltd. (28/10/2022) *Firlough Hydrogen Plant – Groundwater Supply Assessment (Doc Ref. 3131-043 (Rev1))*

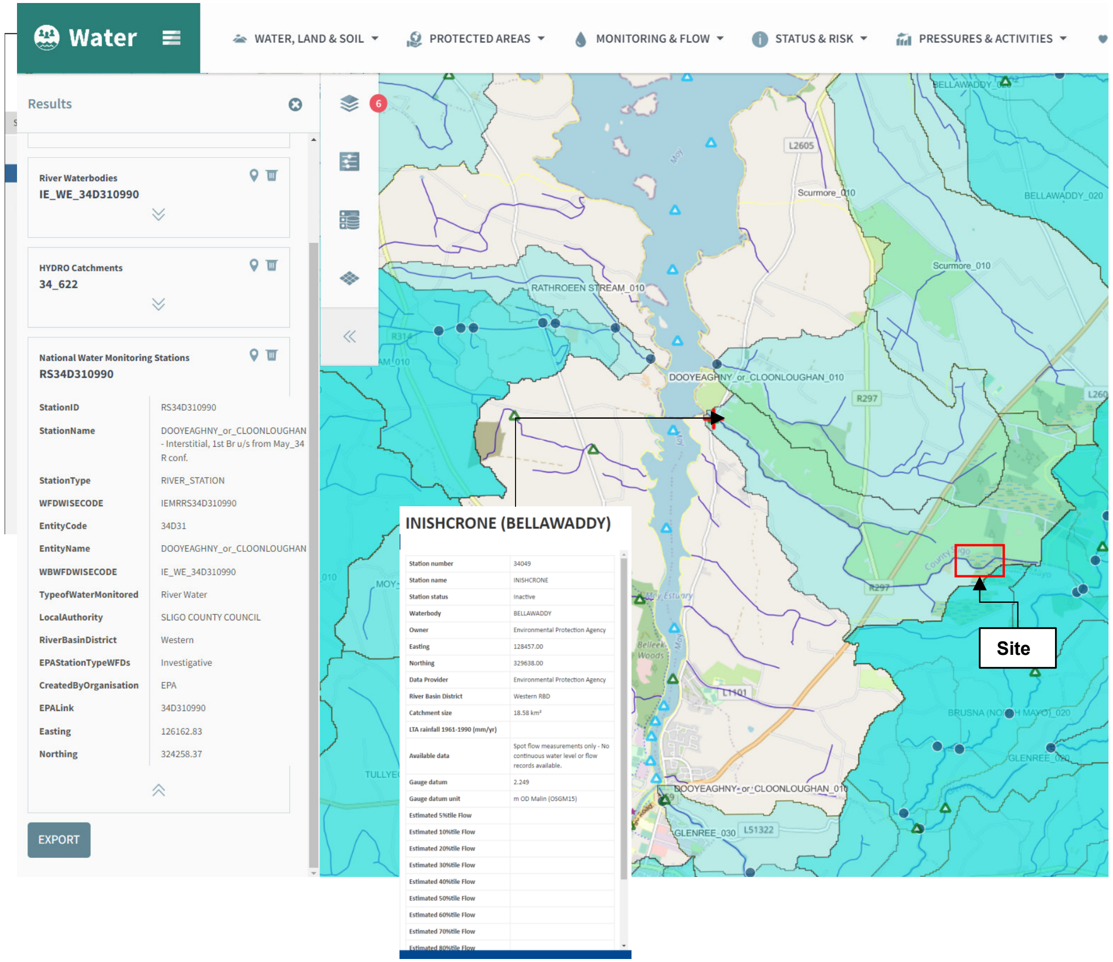
Environmental Protection Agency (EPA) *Water abstraction - An abstraction is the removal or diversion of water from a river, lake, stream, spring, groundwater well, borehole or estuary, for any purpose.* [Online] Available at: https://www.epa.ie/our-services/licensing/freshwater--marine/water-abstraction/ (Accessed May 2023)

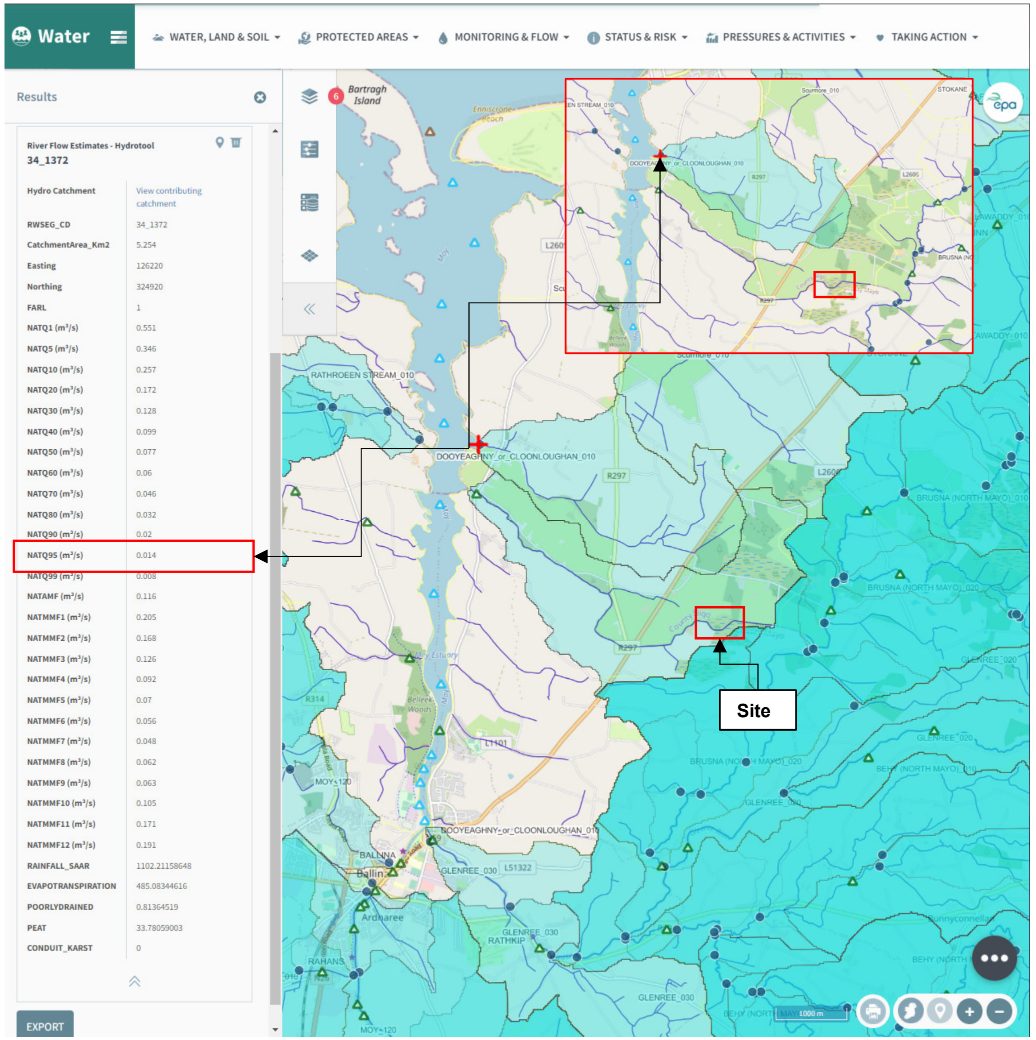
Constructed Wetland Association (CWA) (2017) *Guidelines – Constructed Wetlands to Treat Domestic Septic Tank Effluent*

Cawley A.M., Healy M. (2000) *Evaluation of the waste treatment performance of constructed wetlands with special reference to Williamstown Co. Galway Wetland System*

DEPARTMENT OF AGRICULTURE, FISHERIES AND FOOD (2011) Minimum Specification for Integrated Constructed Wetlands, and Ancillary Works.

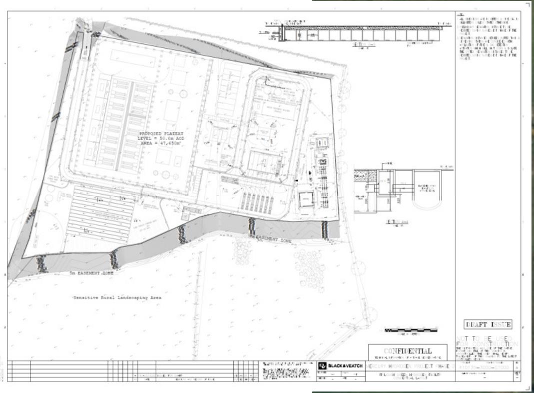
APPENDIX A

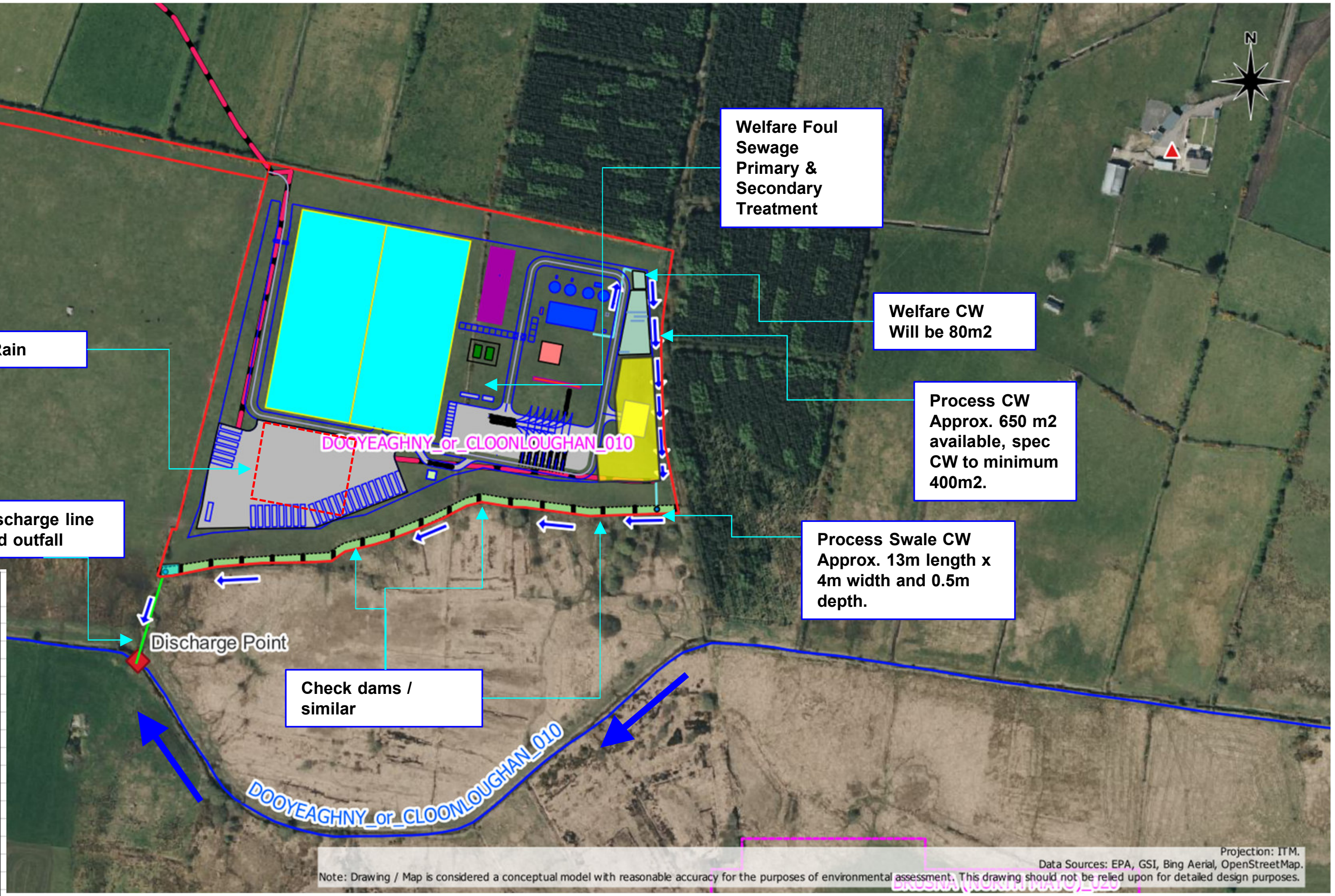




Site Name: **Firlough Green Hydrogen** **pDACA App. A**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Figure 1** **Site Location & SW Discharge Data**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



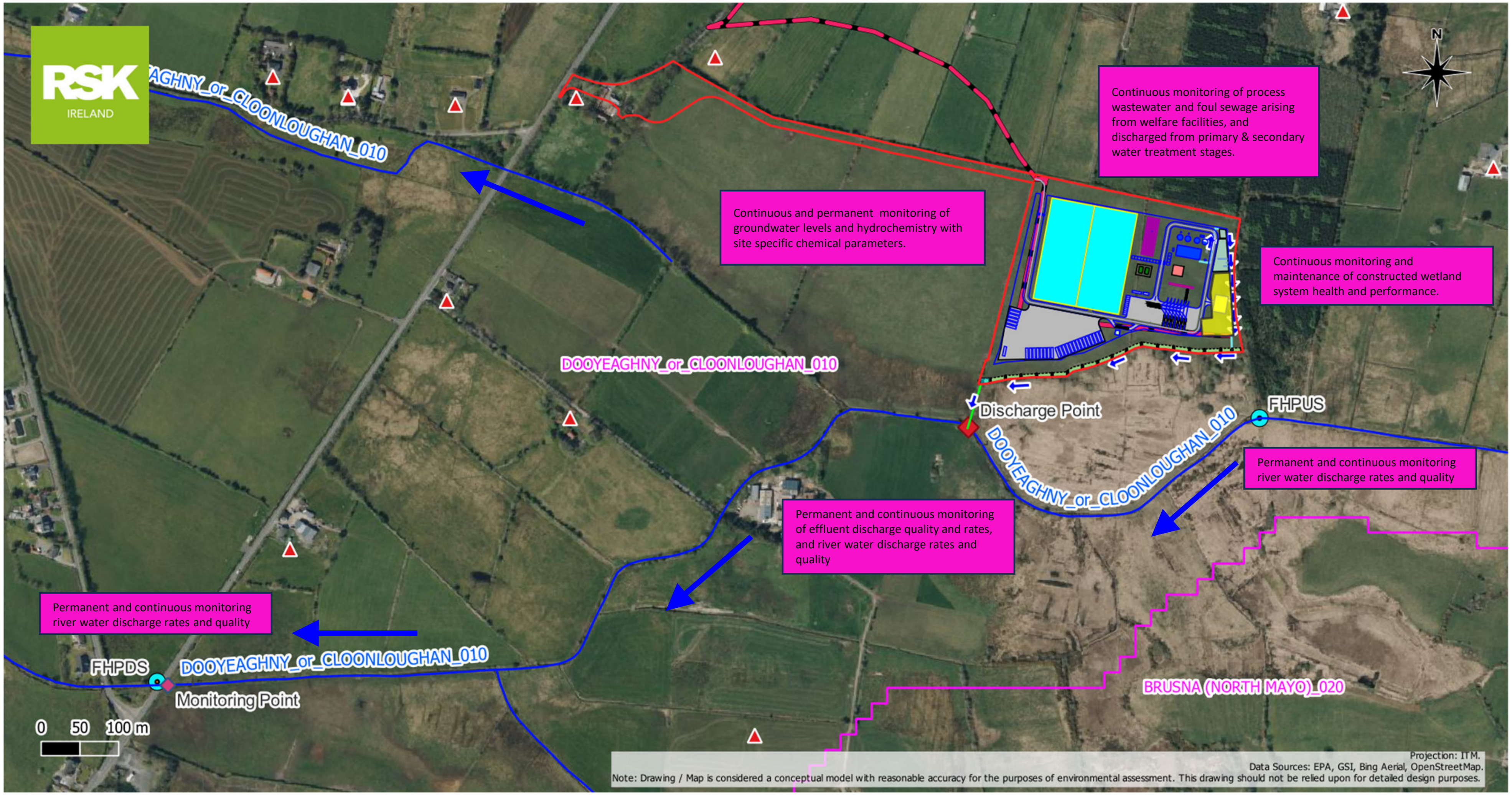


Desc.	Unit	Welfare CW	Process CW	Process SWALE	SUBTOTAL
L	m	10		131	
W	m	8		4	
Area	m2	80	400	524	
Note		web tool			
Feature Depth	m	0.5	0.5	0.5	
Feature Volume	m3	40	200	262	
Porosity	%	40%	40%	40%	
Water Volume	m3	16	80	104.8	
Flow, m3/day	m3/day	3.5			
Flow, m3/hr	m3/hr	0.1458	2.8	2.8	
Flow, l/sec	l/sec	0.0405	0.8	0.8	
Hydraulic retention time	Hours	285.7	114.28	90	204.28
Note		web tool			
Hydraulic retention time	Days	11.90	4.76	3.75	8.51

https://www.omnicalculator.com/chemistry/hydraulic-retention-time

Site Name: **Firlough Green Hydrogen pDACA App. A**	Project No.	603676	Drawn By:	Sven Klinkenbergh, Principal Environmental Consultant	
	Client:	Mercury Renewables			
Figure Name: **Figure 2 Proposed Development**	Date:	27/06/23	Reviewed By:	SK	
	Revision:	03			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

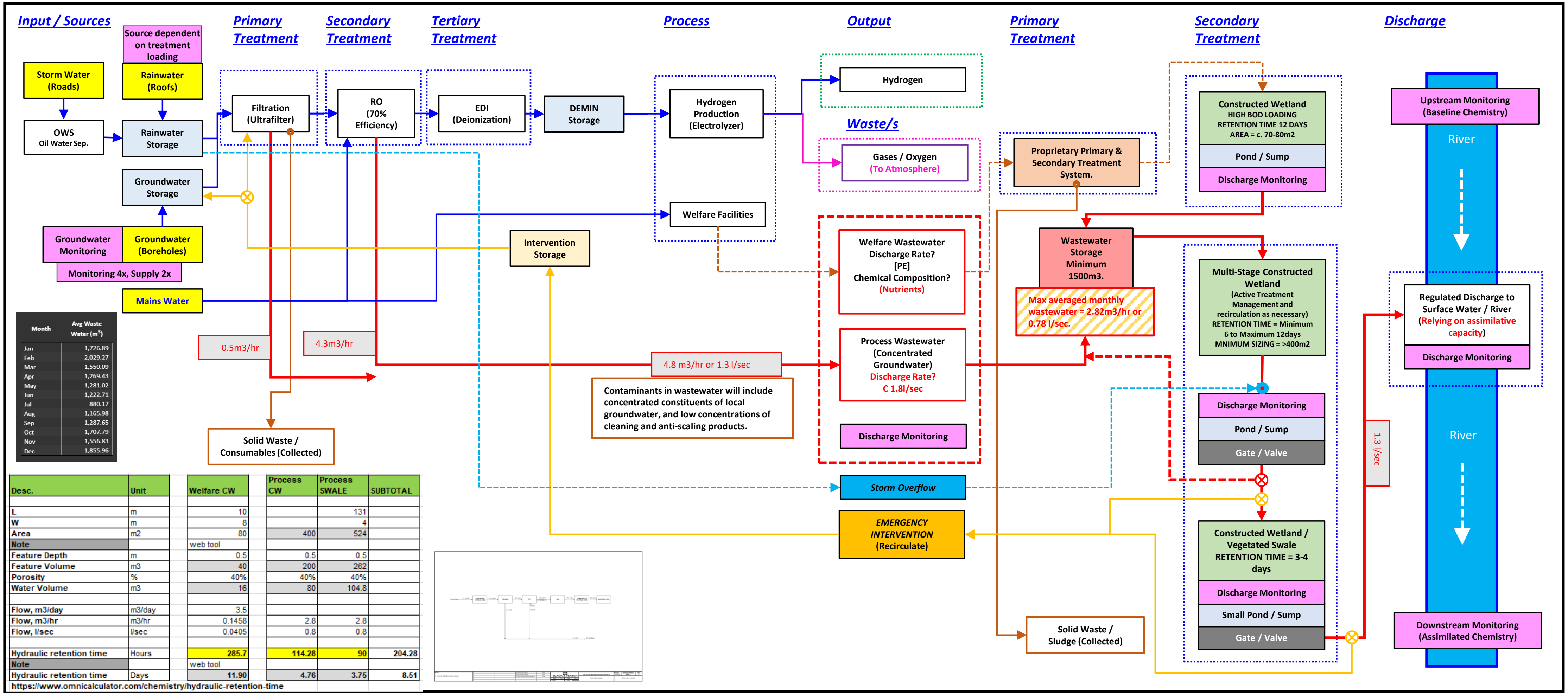


Site Name: **Firlough Green Hydrogen pDACA App. A**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Figure 3 Site Location & SW Baseline Locations**	**Date:**	27/06/23	**Reviewed By:**	SK	
	Revision:	03			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram

Indicative Flow / Discharge rates.



Month	Avg Waste Water (m^3)
Jan	1,726.89
Feb	2,029.27
Mar	1,550.09
Apr	1,269.43
May	1,281.02
Jun	1,222.71
Jul	880.17
Aug	1,165.98
Sep	1,287.65
Oct	1,707.79
Nov	1,556.83
Dec	1,855.96

Desc.	Unit	Welfare CW	Process CW	Process SWALE	SUBTOTAL
L	m	10		131	
W	m	8		4	
Area	m2	80	400	524	
Note		web tool			
Feature Depth	m	0.5	0.5	0.5	
Feature Volume	m3	40	200	262	
Porosity	%	40%	40%	40%	
Water Volume	m3	16	80	104.8	
Flow, m3/day	m3/day	3.5			
Flow, m3/hr	m3/hr	0.1458	2.8	2.8	
Flow, l/sec	l/sec	0.0405	0.8	0.8	
Hydraulic retention time	Hours	285.7	114.28	90	204.28
Note		web tool			
Hydraulic retention time	Days	11.90	4.76	3.75	8.51

https://www.omnicalculator.com/chemistry/hydraulic-retention-time

Site Name: **Firlough Green Hydrogen pDACA App. A**	**Project No.** 603676	**Drawn By:**	Sven Klinkenbergh, Principal Environmental Consultant
	Client: Mercury Renewables		
Figure Name: **Figure 4 Hydrogen Site – Conceptual Process & Treatment Train Flow Diagram**	**Date:** 27/06/23	**Reviewed By:**	SK
	Revision: 03		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

APPENDIX B

FHP & FWF - Wastewater, Groundwater & Surface Water Database

(RSK File Ref. 603676-Hydro-R01-App05-(00))
(SK, CMc, JS 16/02/2023)

RSK

Sample Details	Units	Environmental Quality Standard (EQS) Combination	Surface Water Regs: SW Regs (River)	Annual Average AA - EQS (Inland surface waters)	AA - EQS (Other surface waters)	Maximum allowable concentration: MAC - EQS Inland surface waters	MAC - EQS Other surface waters	SALMONID REGULATIONS (* FOR	WQ (Dangerous Substances) Regulations 2001 (applies to all waters other than groundwaters): Standard (ug/l) for fresh water <100 hardness / >100 hardness	Standard (ug/l) For Tidal Waters	EXAMPLE LICENCE: Discharge Licence D0206-01 Unnamed tributary of the Legarhill River GBNI1NW363602097	Discharge Licence D0437-01 Brogeen SW_18_2121
Sample ID												
Site												
Event / Date												
Reference												
Sample Type	Medum											
Grid Reference for Sampling Location	Irish Grid											
Field Data - Discharge												
Surface Water Feature	Type											
Description of sample location	Type											
Total Rain 3 Days Prior	mm/72hours											
Monitoring Conditions	desc											
Estimated Discharge Rate (Q) (SITE)	l/sec											
RIVER CHANNEL												
Width of Water Body	m											
Width / 3												
Depth Edge	m											
Depth 1	m											
Depth 2	m											
Depth 3	m											
Depth Edge	m											
Area	m2											
Distance												
Seconds												
Flow Velocity (V) - Approximate	m/sec											
Friction Comment	#											
Friction Loss Correction	%											
Discharge Rate (Q)	m3/sec											
Discharge Rate (Q)	l/sec											
Field Data - Hydrochemistry												
Clarity												
Colour												
Odour												
pH	pH Units	4.5 - 9	Soft water	n/a	n/a	n/a	n/a	6 - 9			6 to 9	6 to 9
Conductivity	mS/cm	1 .0mS/cm or										
Temperature	deg. C	<21.5 or no +1.5C	Not greater	n/a	n/a	n/a	n/a	21.5				
Laboratory Data - Hydrochemistry												
Alkalinity, Bicarbonate as CaCO3	mg/l											
Alkalinity, Total as CaCO3	mg/l											
Ammoniacal Nitrogen, NH4+												
NH4 to N convert factor												
Ammoniacal Nitrogen as N (low level)	mg/l	0.02						0.02 (Ammonia (non-ionized) =			0.1	0.5
Fats Oil & Greases	mg/l	No Impact on Fish										
Hardness, Total as CaCO3 unfiltered	mg/l											
Dissolved Orgniac Carbon	mg/l											
BOD, unfiltered	mg/l	5						5			2	15
Chloride	mg/l											
COD, unfiltered	mg/l	125									125	125
Conductivity @ 20 deg.C	mS/cm	1 .0mS/cm or 1000 uS/cm										
TOTAL ANIONS												
TOTAL CATIONS												
Nitrate as NO3	mg/l	25 (IGV)										
Nitrates, N	mg/l											
Nitrite as NO2	mg/l	0.05						0.05				
Nitrogen, Kjeldahl	mg/l											
pH		4.5 - 9	Soft water	n/a	n/a	n/a	n/a	6 - 9			6 to 9	6 to 9
Phosphate (Ortho as P)	mg/l	0.025 0.045	[ug/l] High status	n/a	n/a	n/a	n/a				0.075	0.3
Phosphorus (diss.filt)	µg/l											
Phosphorus (tot.unfilt)	µg/l											
Sulphate	mg/l											
Suspended solids, Total	mg/l	25						25			35	25
Turbidity	ntu											
True Colour	mg/l Pt/Co											
Temperature		<21.5 or no +1.5C	Not greater	n/a	n/a	n/a	n/a	21.5				
Apparent Colour	mg/l Pt/Co											
Filtered (Dissolved) Metals												
Aluminium (diss.filt)	µg/l											
Arsenic (diss.filt)	µg/l		n/a	25	20	n/a	n/a		25/25	20		
Barium (diss.filt)	µg/l											
Cadmium (diss.filt)	µg/l											
Calcium (Dis.Filt)	mg/l											
Chromium (diss.filt)	µg/l											
Copper (diss.filt)	µg/l	5						5 - with water hardness of 10	5/30	5		
Iron (Dis.Filt)	mg/l											
Lead (diss.filt)	µg/l		n/a	1.2	1.3	14	14					
Magnesium (Dis.Filt)	mg/l											
Manganese (diss.filt)	µg/l											
Mercury (diss.filt)	µg/l	0.07		n/a	n/a	0.07	0.07					
Nickel (diss.filt)	µg/l											
Potassium (Dis.Filt)	mg/l											
Selenium (diss.filt)	µg/l											
Sodium (Dis.Filt)	mg/l											
Zinc (diss.filt)	µg/l	8	n/a	8 (AA	40	n/a	n/a	30 - with water	8/50/100	40		

Firlough Hydrogen Plant Groundwater (GW) BASELINE
(Minerex File Ref. 3131-043 (Rev1) 28/10/2022)

Sample Details							
Sample ID	3131-BH6A-	3131-BH6B-	3131-BH7A-	3131-BH7B-	3131-BH6C-	3131-BH7C-	**AVERAGE**
Site	FHP	FHP	FHP	FHP	FHP	FHP	**FHP**
Event / Date	11/07/202	2/07/202	1/07/202	2/07/202	2/07/202	2/07/2022	
Reference	3131-028	3131-028	3131-028	3131-028	3131-028	3131-028	**3131-028-COC2**
Sample Type	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	**Groundwater**
Grid Reference for Sampling Location							
Field Data - Discharge							
Surface Water Feature	Borehole	Borehole	Borehole	Borehole	Borehole	Borehole	**Borehole**
Description of sample location							
Total Rain 3 Days Prior							
Monitoring Conditions							
Estimated Discharge Rate (Q) (SITE)							
RIVER CHANNEL							
Width of Water Body							
Width / 3							
Depth Edge							
Depth 1							
Depth 2							
Depth 3							
Depth Edge							
Area							
Distance							
Seconds							
Flow Velocity (V) - Approximate							
Friction Comment							
Friction Loss Correction							
Discharge Rate (Q)							
Discharge Rate (Q)							
Field Data - Hydrochemistry							
Clarity							
Colour							
Odour							
pH							
Conductivity							
Temperature							
Laboratory Data - Hydrochemistry							
Alkalinity, Bicarbonate as CaCO3	ND	ND	ND	ND	ND	ND	**ND**
Alkalinity, Total as CaCO3	465	470	470	450	441	464	**460**
Ammoniacal Nitrogen, NH4+							
NH4 to N convert factor							
Ammoniacal Nitrogen as N (low level)	0.345	0.299	0.3	0.313	0.279	0.303	**0.3065**
Fats Oil & Greases	ND	ND	ND	ND	ND	ND	**ND**
Hardness, Total as CaCO3 unfiltered	ND	ND	ND	ND	ND	ND	**ND**
Dissolved Orgniac Carbon	ND	ND	ND	ND	ND	ND	**ND**
BOD, unfiltered	10	2.17	2	22	1	7.11	**7.380**
Chloride	33.9	30.4	34.6	50	31.8	43.3	**37.333**
COD, unfiltered	7	8.48	7	7	7	7	**7.247**
Conductivity @ 20 deg.C	ND	ND	ND	ND	ND	ND	**ND**
TOTAL ANIONS							
TOTAL CATIONS							
Nitrate as NO3							
Nitrates, N	0.07	0.296	0.07	0.07	0.07	0.07	**0.108**
Nitrite as NO2	0.05	0.05	0.05	0.05	0.05	0.05	**0.05**
Nitrogen, Kjeldahl	ND	ND	ND	ND	ND	ND	**ND**
pH							
Phosphate (Ortho as P)	0.02	0.02	0.02	0.02	0.02	0.02	**0.02**
Phosphorus (diss.filt)	ND	ND	ND	ND	ND	ND	**ND**
Phosphorus (tot.unfilt)	ND	ND	ND	ND	ND	ND	**ND**
Sulphate	13.6	28.7	14.7	23.1	17.5	25.5	**20.517**
Suspended solids, Total	2	2	2	3.4	2	2	**2.233**
Turbidity	ND	ND	ND	ND	ND	ND	**ND**
True Colour	1	1	1	1	1	1.7	**1.117**
Temperature							
Apparent Colour	6.9	9.7	6.1	29.6	19.5	70	**23.633**
Filtered (Dissolved) Metals							
Aluminium (diss.filt)	10	10	10	10	10	10	**10**
Arsenic (diss.filt)	0.5	0.5	0.5	0.5	0.5	0.5	**0.5**
Barium (diss.filt)	68.7	70	83.4	84.6	81	92	**79.950**
Cadmium (diss.filt)	0.08	0.08	0.08	0.08	0.08	0.08	**0.08**
Calcium (Dis.Filt)	60.2	76.2	72.6	77.7	83.3	79	**74.833**
Chromium (diss.filt)	1	5.83	1	9.07	1	1	**3.150**
Copper (diss.filt)	0.3	0.585	0.3	0.3	0.398	0.3	**0.364**
Iron (Dis.Filt)	0.019	0.019	0.019	0.019	0.019	0.019	**0.019**
Lead (diss.filt)	0.2	0.2	0.2	0.2	0.595	0.2	**0.266**
Magnesium (Dis.Filt)	43.2	43.6	43.6	41.4	41.6	41.7	**42.517**
Manganese (diss.filt)	3	3	3.02	3	5.33	3.85	**3.533**
Mercury (diss.filt)	0.01	0.01	0.01	0.01	0.01	0.01	**0.01**
Nickel (diss.filt)	0.4	0.4	0.4	0.4	0.4	0.4	**0.4**
Potassium (Dis.Filt)	3.76	3.45	3.34	3.39	2.86	3.13	**3.322**
Selenium (diss.filt)	1	1	1	1	1	1	**1**
Sodium (Dis.Filt)	50.3	41.4	40.7	57.8	36.5	49	**45.950**
Zinc (diss.filt)	1.39	1	1.02	1	1.54	1.1	**1.175**

Sample Details	Sourcewater / Wastewater: B&V Parameter List	Intake	Ultrafilter Backwash	RO Waste	Pretreatment: Projected Discharge To Outfall	Pretreatment: Welfare Discharge (7 Site Staff, c. 26 drivers per day) 1 no. PE = 60g BOD5 / PE d TKN 10g N / PE d Flow 0.1-0.5m3 / PE d	Pretreatment: Projected Combined Discharge To Outfall	Treated: Background Concentrations from CW	Treated: [Conservative] Projected Combined Discharge To Outfall Key Parameters	Firlough Hydrogen Plant Surface Water (SW) BASELINE		
Sample ID										FHP-SW1 (Upstream)	FHP-SW2 (Downstream)	AVERAGE
Site										FHP	FHP	
Event / Date										02/12/2022	02/12/2022	
Reference	B&V	B&V	B&V	B&V	B&V	RSK						
Sample Type		Groundwater	Wastewaster	Wastewaster	**Process Wastewater**	**Welfare Wastewater**				Surface Water	Surface Water	Surface Water
Grid Reference for Sampling Location												
Field Data - Discharge												
Surface Water Feature										Stream/River	Stream/River	
Description of sample location										Alongside	Road bridge	
Total Rain 3 Days Prior										1.0	1.0	
Monitoring Conditions										Dry	Dry	
Estimated Discharge Rate (Q) (SITE)										n/a	n/a	
RIVER CHANNEL												
Width of Water Body										2	0.9	
Width / 3										0.667	0.300	
Depth Edge										0	0.02	
Depth 1										0.50	0.05	
Depth 2										0.30	0.05	
Depth 3										0.15	0.05	
Depth Edge										0	0.02	
Area										0.775	0.198	
Distance										1	2	
Seconds										6	3	
Flow Velocity (V) - Approximate										0.1667	0.6667	
Friction Comment										Very High	Moderate	
Friction Loss Correction										0.25	0.5	
Discharge Rate (Q)										0.032	0.066	0.0490625
Discharge Rate (Q)										32.3	65.8	49.0625
Field Data - Hydrochemistry												
Clarity										Clear	Clear	
Colour										Slight Yellow	Slight Yellow	
Odour										No	No	
pH										7.15	7.48	7.315
Conductivity										0.565	0.594	0.5795
Temperature										10.2	9.6	9.9
Laboratory Data - Hydrochemistry												
Alkalinity, Bicarbonate as CaCO3	M-Alkalinity as CaC	429.0000	429.0000	1716.0000	1581.9375					244	282	263
Alkalinity, Total as CaCO3										244	282	263
Ammoniacal Nitrogen, NH4+	Ammoniacal Nitroge	0.1667	0.1667	0.6668	0.6147			1.0000				
NH4 to N convert factor	NH4 to N convert fa	0.7765	0.7765	0.7765	0.7765			0.7765				
Ammoniacal Nitrogen as N (low level)	Ammoniacal Nitroge	0.1294	0.1294	0.5178	0.4773			0.7765	0.7765	0.03	0.03	0.03
Fats Oil & Greases										4	4	4
Hardness, Total as CaCO3 unfiltered	Hardness, mg/L as C	396.0000	396.0000	1584.0000	1460.2500					2.7	3.7	3.2
Dissolved Orgniac Carbon										4	3	3.5
BOD, unfiltered	BOD, unfiltered	2.5275	2.5275	10.1100	9.3202	84.0000	11.5222	5	5	1	1.1	1.05
Chloride	Chlorides, Cl as CaC	47.2703	47.2703	189.0810	174.3090					23.3	24.2	23.75
COD, unfiltered	COD, unfiltered	7.9000	7.9000	31.6000	29.1313					22	41	31.5
Conductivity @ 20 deg.C										0.577	0.615	0.596
TOTAL ANIONS	TOTAL ANIONS	496.9028	496.9028	1987.6110	1832.3289							
TOTAL CATIONS	TOTAL CATIONS	472.3018	472.3018	1889.2071	1741.6128							
Nitrate as NO3	Nitrates, NO3	0.0405	0.0405	0.1620	0.1493				0.2	4.6	3.6	4.1
Nitrates, N	Nitrates, N	0.0500	0.0500	0.2000	0.1844					1.15	0.9	1.025
Nitrite as NO2	Nitrites, NO2	0.4568	0.4568	1.8270	1.6843	50.0000	3.1089		NO3	0.02	0.02	0.02
Nitrogen, Kjeldahl										0.5	0.5	0.5
pH												
Phosphate (Ortho as P)	Phosphates, P	0.0200	0.0200	0.0800	0.0738			0.3 (TP)	0.3	0.03	0.03	0.03
Phosphorus (diss.filt)										5	8	6.5
Phosphorus (tot.unfilt)										5	11	8
Sulphate	Sulfates, SO4 as CaC	20.5920	20.5920	82.3680	75.9330					328	366	347
Suspended solids, Total	TSS, mg/L	2.0000	71.2000	0.0000	7.4167					10	10	10
Turbidity										4.7	2.7	3.7
True Colour										ND	ND	ND
Temperature												
Apparent Colour										56	68	62
Filtered (Dissolved) Metals												
Aluminium (diss.filt)										20	20	20
Arsenic (diss.filt)										2.5	2.5	2.5
Barium (diss.filt)										24	26	25
Cadmium (diss.filt)										0.5	0.5	0.5
Calcium (Dis.Filt)										96.2	108.1	102.15
Chromium (diss.filt)										1.5	1.5	1.5
Copper (diss.filt)										7	7	7
Iron (Dis.Filt)										37	81	59
Lead (diss.filt)										5	5	5
Magnesium (Dis.Filt)										5.8	6.3	6.05
Manganese (diss.filt)										3	8	5.5
Mercury (diss.filt)										1	1	1
Nickel (diss.filt)										2	2	2
Potassium (Dis.Filt)										6	10	8
Selenium (diss.filt)										3	3	3
Sodium (Dis.Filt)										12.4	12.4	12.4
Zinc (diss.filt)										3	4	3.5

FHP & FWF - Wastewater, Groundwater & Surface Water Database
(RSK File Ref. 603676-Hydro-R01-App05-(00))
(SK, CMc, JS 16/02/2023)

RSK

Sample Details	Units	Environmental Quality Standard (EQS): Combination	Surface Water Regs: SW Regs (River)	Surface Water Regs: Annual Average AA - EQS (Inland surface waters)	Surface Water Regs: AA - EQS (Other surface waters)	Surface Water Regs: Maximum allowable concentration: MAC - EQS Inland surface waters	Surface Water Regs: MAC - EQS Other surface waters	SALMONID REGULATIONS (* FOR COMPARISON…	WQ (Dangerous Substances) Regulations 2001 (applies to all waters other than groundwaters): Standard (ug/l) for fresh water <100 hardness / >100 hardness	WQ (Dangerous Substances) Regulations 2001: Standard (ug/l) For Tidal Waters	EXAMPLE LICENCE: Discharge Licence D0206-01 Unnamed tributary of the Legarhill River GBNI1NW363602097	EXAMPLE LICENCE: Discharge Licence D0437-01 Brogeen SW_18_2121
Sample ID												
Site												
Event / Date												
Reference												
Sample Type	Medum											
Grid Reference for Sampling Location	Irish Grid											
Unfiltered (Total) Metals												
Aluminium (tot.unfilt)	µg/l											
Arsenic (tot.unfilt)	µg/l	25	n/a	25	20	n/a	n/a		25/25	20		
Barium (tot.unfilt)	µg/l											
Cadmium (tot.unfilt)	µg/l											
Calcium (Tot. Unfilt.)	mg/l											
Chromium (tot.unfilt)	µg/l											
Copper (tot.unfilt)	µg/l	5						5 - with water	5/30	5		
Hardness, Total as CaCO3 unfiltered	mg/l											
Iron (Tot. Unfilt.)	µg/l											
Lead (tot.unfilt)	mg/l		n/a	1.2	1.3	14	14					
Magnesium (Tot. Unfilt.)	µg/l											
Manganese (tot.unfilt)	µg/l											
Mercury (tot.unfilt)	µg/l	0.07		n/a	n/a	0.07	0.07					
Nickel (tot.unfilt)	mg/l											
Potassium (Tot. Unfilt.)	µg/l											
Selenium (tot.unfilt)	mg/l											
Sodium (Tot. Unfilt.)	µg/l											
Zinc (tot.unfilt)	µg/l	8	n/a	8 (AA	40	n/a	n/a		8/50/100	40		
Microbiological												
Coliforms, Total*	MPN/100ml	?										
Escherichia Coli (W)*	MPN/100ml	?										

Firlough Hydrogen Plant Groundwater (GW) BASELINE (Minerex File Ref. 3131-043 (Rev1) 28/10/2022)

Sample Details							
Sample ID	3131- BH6A-	3131- BH6B-	3131- BH7A-	3131- BH7B-	3131- BH6C-	3131- BH7C-	**AVERAGE**
Site	FHP	FHP	FHP	FHP	FHP	FHP	**FHP**
Event / Date	11/07/202	2/07/202	1/07/202	2/07/202	2/07/202	2/07/2022	
Reference	3131-028	3131-028	3131-028	3131-028	3131-028	3131-028	**3131-028-COC2**
Sample Type	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	**Groundwater**
Grid Reference for Sampling Location							
Unfiltered (Total) Metals							
Aluminium (tot.unfilt)	10	10.7	18.2	10	10	10	**11.483**
Arsenic (tot.unfilt)	2	2	2	2	2	2	**2**
Barium (tot.unfilt)	68.4	70.5	84.8	83.9	83.8	90.1	**80.250**
Cadmium (tot.unfilt)	0.5	0.5	0.5	0.5	0.5	0.5	**0.5**
Calcium (Tot. Unfilt.)	74	84	81.9	83.8	87.7	79.5	**81.817**
Chromium (tot.unfilt)	3	7.26	3	10.7	3	3	**4.993**
Copper (tot.unfilt)	1	1.35	1	1	1	1	**1.058**
Hardness, Total as CaCO3 unfiltered	385	405	409	400	392	366	**392.833**
Iron (Tot. Unfilt.)	0.024	0.024	0.041	0.024	0.024	0.024	**0.027**
Lead (tot.unfilt)	1	1	1	1	1	1	**1**
Magnesium (Tot. Unfilt.)	48.4	47.4	49.7	46.3	41.8	40.6	**45.700**
Manganese (tot.unfilt)	2.47	3.27	2.65	2.99	4.33	3.79	**3.250**
Mercury (tot.unfilt)	0.02	0.02	0.02	0.02	0.02	0.02	**0.02**
Nickel (tot.unfilt)	1	1	1	1	1	1	**1**
Potassium (Tot. Unfilt.)	4.25	3.89	3.83	3.87	2.89	3.12	**3.642**
Selenium (tot.unfilt)	1	1	1	1	1	1	**1**
Sodium (Tot. Unfilt.)	55.4	44.7	45.1	63.5	37.6	53.1	**49.900**
Zinc (tot.unfilt)	5	5	5	5	5	5	**5**
Microbiological							
Coliforms, Total*	1	13.4	1	1	1	4.1	**3.583**
Escherichia Coli (W)*	1	1	1	1	1	1	1

Sample Details	Sourcewater / Wastewater: B&V Parameter List	Sourcewater / Wastewater: Intake	Sourcewater / Wastewater: Ultrafilter Backwash	Sourcewater / Wastewater: RO Waste	Pretreatment: Projected Discharge To Outfall	Pretreatment: Welfare Discharge (7 Site Staff, c. 26 drivers per day) 1 no. PE = 60g BOD5 / PE d TKN 10g N / PE d Flow 0.1-0.5m3 / PE d	Pretreatment: Projected Combined Discharge To Outfall	Treated: Background Concentrations from CW	Treated: [Conservative] Projected Combined Discharge To Outfall Key Parameters	Firlough Hydrogen Plant Surface Water (SW) BASELINE		
Sample ID										FHP-SW1 (Upstream)	FHP-SW2 (Downstream)	AVERAGE
Site										FHP	FHP	
Event / Date										02/12/2022	02/12/2022	
Reference	B&V	B&V	B&V	B&V	B&V	RSK						
Sample Type		Groundwater	Wastewaster	Wastewaster	**Process Wastewater**	**Welfare Wastewater**				Surface Water	Surface Water	Surface Water
Grid Reference for Sampling Location												
Unfiltered (Total) Metals												
Aluminium (tot.unfilt)	Aluminium, Al	0.0100	0.0100	0.0400	0.0369							
Arsenic (tot.unfilt)	Arsenic, As	0.0005	0.0005	0.0020	0.0018							
Barium (tot.unfilt)	Barium, Ba	0.0674	0.0674	0.2697	0.2486							
Cadmium (tot.unfilt)	Cadmium, Cd	0.0005	0.0005	0.0020	0.0018							
Calcium (Tot. Unfilt.)	Calcium, Ca as CaCO	293.8750	293.8750	1175.5000	1083.6641							
Chromium (tot.unfilt)	Chromium, Cr	0.0030	0.0030	0.0120	0.0111							
Copper (tot.unfilt)										7	7	7
Hardness, Total as CaCO3 unfiltered												
Iron (Tot. Unfilt.)	Iron, Fe	0.0240	0.0240	0.0960	0.0885							
Lead (tot.unfilt)	Lead, Pb	0.0004	0.0004	0.0015	0.0014							
Magnesium (Tot. Unfilt.)	Magnesium, Mg as	103.4179	103.4179	413.6715	381.3534							
Manganese (tot.unfilt)	Manganese, Mn	0.0104	0.0104	0.0415	0.0383							
Mercury (tot.unfilt)	Mercury, Hg	0.0200	0.0200	0.0800	0.0738							
Nickel (tot.unfilt)	Nickel, Ni	0.0037	0.0037	0.0148	0.0137							
Potassium (Tot. Unfilt.)	Potassium, K as CaC	5.8944	5.8944	23.5776	21.7356							
Selenium (tot.unfilt)	Selenium, Se	0.0010	0.0010	0.0040	0.0037							
Sodium (Tot. Unfilt.)	Sodium, Na as CaCO	69.1145	69.1145	276.4580	254.8597							
Zinc (tot.unfilt)	Zinc, Zn	0.0080	0.0080	0.0321	0.0296					3	3	3
Microbiological												
Coliforms, Total*	Coliforms, MPN/10	611.0000	611.0000	2444.0000	2253.0625					ND	ND	ND
Escherichia Coli (W)*	E.coli MPN/100ml	**19.0750**	**19.0750**	**76.3000**	**70.3391**					ND	ND	#DIV/0!

Note/s:
N/A = Not Applicable or Not Analysed. N/R = Not Recorded.
The below diagram presents symbols assigned to values re culvert discharge calculations.

(green)	Green indicates < LOD
(pink)	Formula Driven
(yellow)	Note
(red)	Exceedance of EQS
ND	No Data

APPENDIX C

603676 - Firlough Hydrogen (SK 14/02/2023)	Preliminary Assimilative Capacity Assessment - BOD
	Scenarion A - Using Inferred Constant River HHYDRO Tool Q95%ile and Monthly Average Discharge Rate

		Cat.	Desc.	Units																		
1	Asses	TIME	Period (Month/Annual)	Period	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL	MIN	MAX	AVERAGE		
2	Asses	RAIN	Rainfall LTA (mm/month) (KNOCK AIR)	mm/month	135.400	102.900	118.100	81.600	92.000	91.500	95.700	107.900	111.300	141.300	134.200	141.400	1,353.300	81.600	1,353.300	224.391		Met Eireann
3	Asses	RAIN	Rainfall LTA (cm/month) (Secondary Axis) (KNOCK AIR)	cm/month	13.540	10.290	11.810	8.160	9.200	9.150	9.570	10.790	11.130	14.130	13.420	14.140	135.330	8.160	135.330	22.439		
4	Asses	RAIN	Rainfall LTA (m/month) (KNOCK AIR)	m/month	0.135	0.103	0.118	0.082	0.092	0.092	0.096	0.108	0.111	0.141	0.134	0.141	1.353	0.082	1.353	0.224		Met Eireann / MEL
5	Asses	RAIN	Rainfall LTA (mm/month) (3131-011)	mm/month	134.000	113.000	98.000	77.000	93.000	94.000	110.000	117.000	111.000	131.000	142.000	151.000	1,371.000	77.000	1,371.000	226.818		
6	Asses	RAIN	Rainfall LTA (cm/month) (3131-011)	cm/month	13.400	11.300	9.800	7.700	9.300	9.400	11.000	11.700	11.100	13.100	14.200	15.100	137.100	7.700	137.100	22.682		
7	Asses	RAIN	Rainfall LTA (m/month) (3131-011)	m/month	0.134	0.113	0.098	0.077	0.093	0.094	0.110	0.117	0.111	0.131	0.142	0.151	1.371	0.077	1.371	0.227		
8	Asses	RAIN	Site Area - Roofed (3131-011)	m2	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	n/a	n/a	n/a		
9	Asses	RAIN	Harvested RAIN Volume	m3	2,003.920	1,522.920	1,747.880	1,207.680	1,361.600	1,354.200	1,416.360	1,596.920	1,647.240	2,091.240	1,986.160	2,092.720	20,028.840	1,207.680	20,028.840	3,320.985		
10	Asses	RAIN	Site Area - Not Roofed (3131-011)	m2	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	n/a	n/a	n/a		
11	Asses	RAIN	Harvested STORM Volume	m3	4,447.890	3,380.265	3,879.585	2,680.560	3,022.200	3,005.775	3,143.745	3,544.515	3,656.205	4,641.705	4,408.470	4,644.990	44,455.905	2,680.560	44,455.905	7,371.241		
12	Asses	RAIN	Total Rain & Storm Volume	m3	6,451.810	4,903.185	5,627.465	3,888.240	4,383.800	4,359.975	4,560.105	5,141.435	5,303.445	6,732.945	6,394.630	6,737.710	64,484.745	3,888.240	64,484.745	10,692.227		
13	Asses	RAIN	Rain Storage	m3	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6000	n/a	n/a	n/a		
14	Asses	WELFARE WW	Projected Aerage Wastewater (m3) (Based approximately on 7 site staff and c. 26 vistitors / drivers per day)	m3/day	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500						
15	Asses	WELFARE WW	Projected Aerage Wastewater	m3/hour	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146						
16	Asses	WELFARE WW	Projected Aerage Wastewater	m3/sec	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405						
17	Asses	WELFARE WW	Projected Aerage Wastewater	l/sec	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041						
18		WWT (W)	Constructed Wetland (Welfare) - Retention Time	Days	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904						
19		WWT (W)	Constructed Wetland (Welfare) - Outfall	Method	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage						
20	Asses	PROCESS WW	Projected Aerage Wastewater (m3) (B&V)	m3	1726.890	2029.270	1550.090	1269.430	1281.020	1222.710	880.170	1165.980	1287.650	1707.790	1556.830	1855.960						Provided by B&V
21	Asses	PROCESS WW	Projected Aerage Wastewater (m3/day)	m3/day	57.563	67.642	51.670	42.314	42.701	40.757	29.339	38.866	42.922	56.926	51.894	61.865						
22		COMBINED WW	Projected Combined Aerage Wastewater (m3) (Welfare & Process)		61.063	71.142	55.170	45.814	46.201	44.257	32.839	42.366	46.422	60.426	55.394	65.365						
23	Asses	COMBINED WW	Projected Combined Average Wastewater (m3/hour)	m3/hour	2.544	2.964	2.299	1.909	1.925	1.844	1.368	1.765	1.934	2.518	2.308	2.724						
24	Asses	COMBINED WW	Projected Combined Aerage Wastewater (m3/sec)	m3/sec	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565						
25	Asses	COMBINED WW	Projected Combined Aerage Wastewater (l/sec) (Secondary Axis)	l/sec	0.707	0.823	0.639	0.530	0.535	0.512	0.380	0.490	0.537	0.699	0.641	0.757						
26	Asses	COMBINED WW	Wastewater Storage	m3	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1500.000	n/a	n/a	n/a		
27	**Ass**	**DISCHARGE**	**RESTRICT DISCHARGE RATE Coefficient**	**%**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**						
28	Asses	DISCHARGE	Discharge Rate	m3/hour	2.544	2.964	2.299	1.909	1.925	1.844	1.368	1.765	1.934	2.518	2.308	2.724						
29	Asses	DISCHARGE	Discharge Rate	m3/sec	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565						
30	Asses	DISCHARGE	Discharge Rate	l/sec	0.707	0.823	0.639	0.530	0.535	0.512	0.380	0.490	0.537	0.699	0.641	0.757						
31	Asses	DISCHARGE	Attenuation Rate	m3/hour	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000						
32	Asses	DISCHARGE	Storage Capacity	hours	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						
33	Asses	DISCHARGE	Storage Capacity	days	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!						
34	Asses	HYDROLOGY	HYDROtool Q95 for end of Catchment Node (l/sec)	l/sec	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000						
35	Asses	HYDROLOGY	Approximate catchment area upstream of DP	%	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330						
36	Asses	HYDROLOGY	Inferred Q95%ile [FIXED]at DP (m3/sec)	m3/sec	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620						
37	Asses	HYDROLOGY	Inferred Q95%ile [FIXED] at DP (l/sec)	l/sec	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620						
38	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (m3/sec)	m3/sec	0.015000	0.007500	0.007000	0.004620	0.004620	0.004620	0.004620	0.007000	0.010000	0.015000	0.015000	0.015000						
39	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (l/sec)	l/sec	15.000	7.500	7.000	4.620	4.620	4.620	4.620	7.000	10.000	15.000	15.000	15.000						

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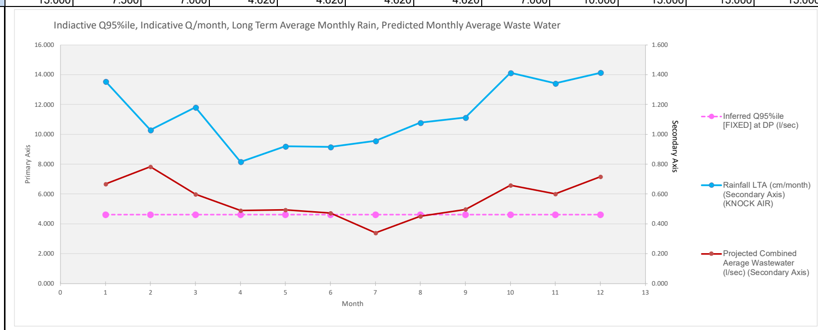

63	Preliminary Assimilative Capacity Assessment																
64	**Guidance**	**Appendix C – Assimilative Capacity and Mass Balance Calculations**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Unit**	**Param**	**Comment**
65																	
66	Assessment	Pollutant	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD			
67	Guidance																
68	Guidance	**Calculation 1 – Assimilative Capacity**															
69	Guidance																
70	Guidance	This calculation is used to determine the capacity of the receiving waters to assimilate the effluent discharge in kg/day															
71	Guidance	Formula 1 below may be used to determine assimilative capacity for the majority of chemical parameters e.g. BOD, suspended solids etc. with the exception of toxic substances e.g. heavy metals in which case Formula 2 must be used															
72	Assessment	Appropriate Formula	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1			Screen heavy metals
73	Guidance																
74	Guidance	**Formula 1**															
75	Guidance																
76	Guidance	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day															
77	Guidance																
78	Guidance	Where:															
79	Guidance	Cmax = maximum permissible concentration (EQS – 95%ile															
80	Guidance	Cback = background upstream concentration (mg/l mean value)															
81	Guidance	F95 = the 95%ile flow in the river (m3/s)															
82	Guidance	Note: (60x60x24)/1000 = 86.4															
83	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants	5	5	5	5	5	5	5	5	5	5	5	5	mg/l	BOD	SW Regs Good Status 95%ile
84	Assessment	95%ile value	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Baseline
85	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)	4	4	4	4	4	4	4	4	4	4	4	4	mg/l	BOD	
86	Assessment	Cback = background upstream concentration (mg/l mean value)	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Assume 95%ile value
87	**Assessment**	**F95 = the 95%ile flow in the river (m3/s)**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**	**m3/sec**		**Assume 95%ile value**
88	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	kg/day	BOD	
89	Guidance																
90	Guidance	**Formula 2**															
91	Guidance																
92	Guidance	Assimilative capacity = (Cmax – Cback) x DWF x 86.4 kg/day															
93	Guidance																
94	Guidance	where:															
95	Guidance	Cmax = maximum permissible concentration (EQS - 95%ile value) (mg/l)															
96	Guidance	Cback = background upstream concentration (mg/l mean value)															
97	Guidance	DWF = dry weather flow in the river (m3/s)															
98	Guidance	Note: (60x60x24)/1000 = 86.4															
99	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants in a receiving water which should not be exceeded in order to protect human health and the environment.													mg/l	BOD	Salmonid Regs
100	Assessment	95%ile value = Assume low e.g. BOD													mg/l	BOD	
101	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0	mg/l	BOD	
102	Assessment	Cback = background upstream concentration (mg/l mean value)	0	0	0	0	0	0	0	0	0	0	0	0	mg/l	BOD	Assume 95%ile value
103	Assessment	F95 = the 95%ile flow in the river (m3/s)													m3/sec		Assume 95%ile value
104	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day	0	0	0	0	0	0	0	0	0	0	0	0	kg/day	BOD	
105	Guidance																
106	Guidance	Once the assimilative capacity of the receiving water has been established, the percentage of the assimilative capacity that will be used by the discharge may be calculated using the effluent load information.															
107	Guidance																
108	Guidance	The effluent load may be determined using the following formula:															
109	Guidance																
110	Guidance	Effluent flow x effluent concentration / 1000 = effluent load (kg/day)															
111	Guidance																
112	Assessment	**Wastewater Loading**															
113	Assessment	Effluent flow (Dicharge Rate)	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565	m3/sec		
114	Assessment	Effluent flow	0.70674769	0.82340664	0.63853781	0.53025849	0.53472994	0.5122338	0.38008102	0.49034722	0.53728781	0.69937886	0.64113812	0.75654321	l/sec		
115	**Assessment**	**Effluent concentration**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**mg/l**	**BOD**	
116	Assessment	Effluent Load	7.06747685	8.23406636	6.38537809	5.30258488	5.34729938	5.12233796	3.80081019	4.90347222	5.37287809	6.99378858	6.41138117	7.5654321	mg/sec	BOD	
117	Assessment	Effluent Load	610,630.00	711,423.33	551,696.67	458,143.33	462,006.67	442,570.00	328,390.00	423,660.00	464,216.67	604,263.33	553,943.33	653,653.33	mg/day	BOD	
118	Assessment	Effluent Load	0.6106300	0.7114233	0.5516967	0.4581433	0.4620067	0.4425700	0.3283900	0.4236600	0.4642167	0.6042633	0.5539433	0.6536533	kg/day	BOD	
119	Guidance																
120	Assessment	**Assimilative Capacity Assessment Result**															
121	Assessment	Assimilative Capacity (AC) = (Cmax – Cback) x F95 x 86.4 kg/day	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	1.197504	kg/day	BOD	
122	Assessment	Effluent Load (EL)	0.6106300	0.7114233	0.5516967	0.4581433	0.4620067	0.4425700	0.3283900	0.4236600	0.4642167	0.6042633	0.5539433	0.6536533	kg/day	BOD	
123	Assessment	AC - EL	0.586874	0.48608067	0.64580733	0.73936067	0.73549733	0.754934	0.869114	0.773844	0.73328733	0.59324067	0.64356067	0.54385067	kg/day	BOD	
124	**Assessment**	**Percentage of the assimilative capacity that will be used by the discharge**	**51.0%**	**59.4%**	**46.1%**	**38.3%**	**38.6%**	**37.0%**	**27.4%**	**35.4%**	**38.8%**	**50.5%**	**46.3%**	**54.6%**			
125	**Assessment**	**ACA Result**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**			
126	**Assessment**																
127	Guidance																
128	Guidance	**Calculation 2 – Mass Balance**															
129	Guidance																
130	Guidance	This formula is used to calculate the concentration of a parameter in the receiving water downstream of the discharge. This downstream concentration may then be compared directly with the water quality standard (EQS) to determine whether the discharge will cause an exceedance of the EQS value.															
131	Guidance																
132	Guidance	**Mass balance Equation:**															
133	Guidance																
134	Guidance	$T = \frac{FC + fc}{F + f}$															
135	Guidance																
136	Guidance	where:															
137	Guidance	• F is the river flow upstream of the discharge (95%ile flow m3/sec);															
138	Guidance	• C is the concentration of pollutant in the river upstream of the discharge (mean concentration in mg/l);															
139	Guidance	• f is the flow of the discharge (maximum flow in m3/sec);															
140	Guidance	• c is the maximum concentration of pollutant in the discharge (mg/l);															
141	Guidance	• T is the concentration of pollutant downstream of the discharge.															
142	Guidance																
143	Assessment	F (95%ile flow m3/sec);	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	0.00462	m3/sec		Linked to abve
144	Assessment	C (mean background concentration in mg/l);	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Linked to abve
145	Assessment	f (maximum discharge flow m3/sec);	0.00070675	0.00082341	0.00063854	0.00053026	0.00053473	0.00051223	0.00038008	0.00049035	0.00053729	0.00069938	0.00064114	0.00075654	m3/sec		3.0 m3/hour
146	Assessment	c (maximum pollutant conc. Discharge mg/l);	10	10	10	10	10	10	10	10	10	10	10	10	mg/l	BOD	Linked to abve
147	Assessment	**T (Resulting concentration downstream)**	**2.194**	**2.361**	**2.093**	**1.927**	**1.934**	**1.898**	**1.684**	**1.864**	**1.938**	**2.183**	**2.097**	**2.266**	**mg/l**	BOD	
148	Assessment	EQS	5	5	5	5	5	5	5	5	5	5	5	5	mg/l	BOD	Linked to abve
149	Assessment	Mass Balance Result	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**			

Preliminary Assimilative Capacity Assessment - BOD

Scenarion B - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and NO Restricted Discharge Rate

		Cat.	Desc.	Units																	Comment
1	Asses	TIME	Period (Month/Annual)	Period	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL	MIN	MAX	AVERAGE	
2	Asses	RAIN	Rainfall LTA (mm/month) (KNOCK AIR)	mm/month	135.400	102.900	118.100	81.600	92.000	91.500	95.700	107.900	111.300	141.300	134.200	141.400	1,353.300	81.600	1,353.300	224.391	Met Eireann
3	Asses	RAIN	Rainfall LTA (cm/month) (Secondary Axis) (KNOCK AIR)	cm/month	13.540	10.290	11.810	8.160	9.200	9.150	9.570	10.790	11.130	14.130	13.420	14.140	135.330	8.160	135.330	22.439	
4	Asses	RAIN	Rainfall LTA (m/month) (KNOCK AIR)	m/month	0.135	0.103	0.118	0.082	0.092	0.092	0.096	0.108	0.111	0.141	0.134	0.141	1.353	0.082	1.353	0.224	Met Eireann / MEL
5	Asses	RAIN	Rainfall LTA (mm/month) (3131-011)	mm/month	134.000	113.000	98.000	77.000	93.000	94.000	110.000	117.000	111.000	131.000	142.000	151.000	1,371.000	77.000	1,371.000	226.818	
6	Asses	RAIN	Rainfall LTA (cm/month) (3131-011)	cm/month	13.400	11.300	9.800	7.700	9.300	9.400	11.000	11.700	11.100	13.100	14.200	15.100	137.100	7.700	137.100	22.682	
7	Asses	RAIN	Rainfall LTA (m/month) (3131-011)	m/month	0.134	0.113	0.098	0.077	0.093	0.094	0.110	0.117	0.111	0.131	0.142	0.151	1.371	0.077	1.371	0.227	
8	Asses	RAIN	Site Area - Roofed (3131-011)	m2	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	n/a	n/a	n/a	
9	Asses	RAIN	Harvested RAIN Volume	m3	2,003.920	1,522.920	1,747.880	1,207.680	1,361.600	1,354.200	1,416.360	1,596.920	1,647.240	2,091.240	1,986.160	2,092.720	20,028.840	1,207.680	20,028.840	3,320.985	
10	Asses	RAIN	Site Area - Not Roofed (3131-011)	m2	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	n/a	n/a	n/a	
11	Asses	RAIN	Harvested STORM Volume	m3	4,447.890	3,380.265	3,879.585	2,680.560	3,022.200	3,005.775	3,143.745	3,544.515	3,656.205	4,641.705	4,408.470	4,644.990	44,455.905	2,680.560	44,455.905	7,371.241	
12	Asses	RAIN	Total Rain & Storm Volume	m3	6,451.810	4,903.185	5,627.465	3,888.240	4,383.800	4,359.975	4,560.105	5,141.435	5,303.445	6,732.945	6,394.630	6,737.710	64,484.745	3,888.240	64,484.745	10,692.227	
13	Asses	RAIN	Rain Storage	m3	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6000	n/a	n/a	n/a	
14	Asses	WELFARE WW	Projected Aerage Wastewater (m3) (Based approximately on 7 site staff and c. 26 vistitors / drivers per day)	m3/day	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500					
15	Asses	WELFARE WW	Projected Aerage Wastewater	m3/hour	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146					
16	Asses	WELFARE WW	Projected Aerage Wastewater	m3/sec	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405					
17	Asses	WELFARE WW	Projected Aerage Wastewater	l/sec	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041					
18		WWT (W)	Constructed Wetland (Welfare) - Retention Time	Days	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904					
19		WWT (W)	Constructed Wetland (Welfare) - Outfall	Method	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage					
20	Asses	PROCESS WW	Projected Aerage Wastewater (m3) (B&V)	m3	1726.890	2029.270	1550.090	1269.430	1281.020	1222.710	880.170	1165.980	1287.650	1707.790	1556.830	1855.960					Provided by B&V
21	Asses	PROCESS WW	Projected Aerage Wastewater (m3/day)	m3/day	57.563	67.642	51.670	42.314	42.701	40.757	29.339	38.866	42.922	56.926	51.894	61.865					
22		COMBINED WW	Projected Combined Aerage Wastewater (m3) (Welfare & Process)		61.063	71.142	55.170	45.814	46.201	44.257	32.839	42.366	46.422	60.426	55.394	65.365					
23	Asses	COMBINED WW	Projected Combined Average Wastewater (m3/hour)	m3/hour	2.544	2.964	2.299	1.909	1.925	1.844	1.368	1.765	1.934	2.518	2.308	2.724					
24	Asses	COMBINED WW	Projected Combined Aerage Wastewater (m3/sec)	m3/sec	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565					
25	Asses	COMBINED WW	Projected Combined Aerage Wastewater (l/sec) (Secondary Axis)	l/sec	0.707	0.823	0.639	0.530	0.535	0.512	0.380	0.490	0.537	0.699	0.641	0.757					
26	Asses	COMBINED WW	Wastewater Storage	m3	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1500.000	n/a	n/a	n/a	
27	**Ass**	**DISCHARGE**	**RESTRICT DISCHARGE RATE Coefficient**	**%**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**					
28	Asses	DISCHARGE	Discharge Rate	m3/hour	2.544	2.964	2.299	1.909	1.925	1.844	1.368	1.765	1.934	2.518	2.308	2.724					
29	Asses	DISCHARGE	Discharge Rate	m3/sec	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565					
30	Asses	DISCHARGE	Discharge Rate	l/sec	0.707	0.823	0.639	0.530	0.535	0.512	0.380	0.490	0.537	0.699	0.641	0.757					
31	Asses	DISCHARGE	Attenuation Rate	m3/hour	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
32	Asses	DISCHARGE	Storage Capacity	hours	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!					
33	Asses	DISCHARGE	Storage Capacity	days	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!					
34	Asses	HYDROLOGY	HYDROtool Q95 for end of Catchment Node (l/sec)	l/sec	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000					
35	Asses	HYDROLOGY	Approximate catchment area upstream of DP	%	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330					
36	Asses	HYDROLOGY	Inferred Q95%ile [FIXED]at DP (m3/sec)	m3/sec	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620					
37	Asses	HYDROLOGY	Inferred Q95%ile [FIXED] at DP (l/sec)	l/sec	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620					
38	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (m3/sec)	m3/sec	0.010000	0.010000	0.007500	0.004620	0.003000	0.002000	0.001000	0.002000	0.004620	0.007500	0.010000	0.010000					
39	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (l/sec)	l/sec	10.000	10.000	7.500	4.620	3.000	2.000	1.000	2.000	4.620	7.500	10.000	10.000					

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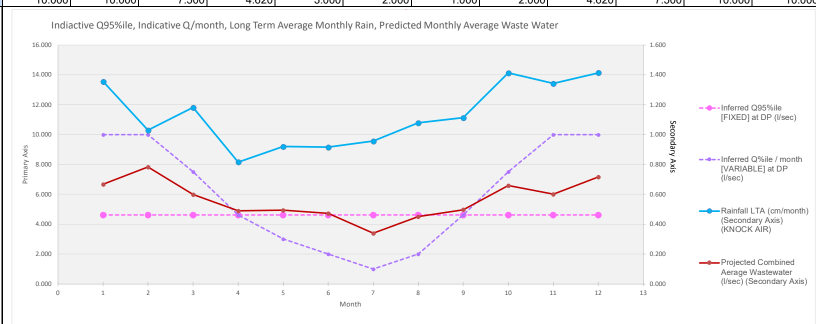
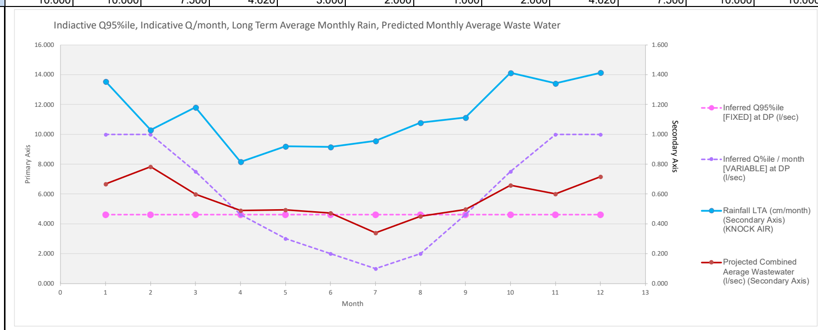


63	**Preliminary Assimilative Capacity Assessment**															
64	**Guidance**	**Appendix C – Assimilative Capacity and Mass Balance Calculations**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Unit**	**Paran**	**Comment**
65																	
66	Assessment	Pollutant	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD			
67	Guidance																
68	Guidance	**Calculation 1 – Assimilative Capacity**															
69	Guidance																
70	Guidance	This calculation is used to determine the capacity of the receiving waters to assimilate the effluent discharge in kg/day															
71	Guidance	Formula 1 below may be used to determine assimilative capacity for the majority of chemical parameters e.g. BOD, suspended solids etc. with the exception of toxic substances e.g. heavy metals in which case Formula 2 must be used															
72	Assessment	Appropriate Formula	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1			Screen heavy metals
73	Guidance																
74	Guidance	**Formula 1**															
75	Guidance																
76	Guidance	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day															
77	Guidance																
78	Guidance	Where:															
79	Guidance	Cmax = maximum permissible concentration (EQS – 95%ile															
80	Guidance	Cback = background upstream concentration (mg/l mean value)															
81	Guidance	F95 = the 95%ile flow in the river (m3/s)															
82	Guidance	Note: (60x60x24)/1000 = 86.4															
83	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants	5	5	5	5	5	5	5	5	5	5	5	5	mg/l	BOD	SW Regs Good Status 95%ile
84	Assessment	95%ile value	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Baseline
85	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)	4	4	4	4	4	4	4	4	4	4	4	4	mg/l	BOD	
86	Assessment	Cback = background upstream concentration (mg/l mean value)	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Assume 95%ile value
87	**Assessment**	**F95 = the 95%ile flow in the river (m3/s)**	**0.010**	**0.010**	**0.008**	**0.005**	**0.003**	**0.002**	**0.001**	**0.002**	**0.005**	**0.008**	**0.010**	**0.010**	**m3/sec**		**Assume 95%ile value**
88	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day	2.592	2.592	1.944	1.197504	0.7776	0.5184	0.2592	0.5184	1.197504	1.944	2.592	2.592	kg/day	BOD	
89	Guidance																
90	Guidance	**Formula 2**															
91	Guidance																
92	Guidance	Assimilative capacity = (Cmax – Cback) x DWF x 86.4 kg/day															
93	Guidance																
94	Guidance	where:															
95	Guidance	Cmax = maximum permissible concentration (EQS - 95%ile value) (mg/l)															
96	Guidance	Cback = background upstream concentration (mg/l mean value)															
97	Guidance	DWF = dry weather flow in the river (m3/s)															
98	Guidance	Note: (60x60x24)/1000 = 86.4															
99	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants in a receiving water which should not be exceeded in order to protect human health and the environment.													mg/l	BOD	Salmonid Regs
100	Assessment	95%ile value = Assume low e.g. BOD													mg/l	BOD	
101	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0	mg/l	BOD	
102	Assessment	Cback = background upstream concentration (mg/l mean value)	0	0	0	0	0	0	0	0	0	0	0	0	mg/l	BOD	Assume 95%ile value
103	Assessment	F95 = the 95%ile flow in the river (m3/s)													m3/sec		Assume 95%ile value
104	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day	0	0	0	0	0	0	0	0	0	0	0	0	kg/day	BOD	
105	Guidance																
106	Guidance	Once the assimilative capacity of the receiving water has been established, the percentage of the assimilative capacity that will be used by the discharge may be calculated using the effluent load information.															
107	Guidance																
108	Guidance	The effluent load may be determined using the following formula:															
109	Guidance																
110	Guidance	Effluent flow x effluent concentration / 1000 = effluent load (kg/day)															
111	Guidance																
112	Assessment	**Wastewater Loading**															
113	Assessment	Effluent flow (Dicharge Rate)	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565	m3/sec		
114	Assessment	Effluent flow	0.70674769	0.82340664	0.63853781	0.53025849	0.53472994	0.5122338	0.38008102	0.49034722	0.53728781	0.69937886	0.64113812	0.75654321	l/sec		
115	**Assessment**	**Effluent concentration**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**mg/l**	**BOD**	
116	Assessment	Effluent Load	7.06747685	8.23406636	6.38537809	5.30258488	5.34729938	5.12233796	3.80081019	4.90347222	5.37287809	6.99378858	6.41138117	7.5654321	mg/sec	BOD	
117	Assessment	Effluent Load	610,630.00	711,423.33	551,696.67	458,143.33	462,006.67	442,570.00	328,390.00	423,660.00	464,216.67	604,263.33	553,943.33	653,653.33	mg/day	BOD	
118	Assessment	Effluent Load	0.6106300	0.7114233	0.5516967	0.4581433	0.4620067	0.4425700	0.3283900	0.4236600	0.4642167	0.6042633	0.5539433	0.6536533	kg/day	BOD	
119	Guidance																
120	Assessment	**Assimilative Capacity Assessment Result**															
121	Assessment	Assimilative Capacity (AC) = (Cmax – Cback) x F95 x 86.4 kg/day	2.592	2.592	1.944	1.197504	0.7776	0.5184	0.2592	0.5184	1.197504	1.944	2.592	2.592	kg/day	BOD	
122	Assessment	Effluent Load (EL)	0.6106300	0.7114233	0.5516967	0.4581433	0.4620067	0.4425700	0.3283900	0.4236600	0.4642167	0.6042633	0.5539433	0.6536533	kg/day	BOD	
123	Assessment	AC - EL	1.98137	1.88057667	1.39230333	0.73936067	0.31559333	0.07583	-0.06919	0.09474	0.73328733	1.33973667	2.03805667	1.93834667	kg/day	BOD	
124	**Assessment**	**Percentage of the assimilative capacity that will be used by the discharge**	**23.6%**	**27.4%**	**28.4%**	**38.3%**	**59.4%**	**85.4%**	**126.7%**	**81.7%**	**38.8%**	**31.1%**	**21.4%**	**25.2%**			
125	**Assessment**	**ACA Result**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**FAIL**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**			
126	**Assessment**																
127	Guidance																
128	Guidance	**Calculation 2 – Mass Balance**															
129	Guidance																
130	Guidance	This formula is used to calculate the concentration of a parameter in the receiving water downstream of the discharge. This downstream concentration may then be compared directly with the water quality standard (EQS) to determine whether the discharge will cause an exceedance of the EQS value.															
131	Guidance																
132	Guidance	**Mass balance Equation:**															
133	Guidance																
134	Guidance	$T = \frac{FC + fc}{F + f}$															
135	Guidance																
136	Guidance	where:															
137	Guidance	• F is the river flow upstream of the discharge (95%ile flow m3/sec);															
138	Guidance	• C is the concentration of pollutant in the river upstream of the discharge (mean concentration in mg/l);															
139	Guidance	• f is the flow of the discharge (maximum flow in m3/sec);															
140	Guidance	• c is the maximum concentration of pollutant in the discharge (mg/l);															
141	Guidance	• T is the concentration of pollutant downstream of the discharge.															
142	Guidance																
143	Assessment	F (95%ile flow m3/sec);	0.01	0.01	0.0075	0.00462	0.003	0.002	0.001	0.002	0.00462	0.0075	0.01	0.01	m3/sec		Linked to abve
144	Assessment	C (mean background concentration in mg/l);	1	1	1	1	1	1	1	1	1	1	1	1	mg/l	BOD	Linked to abve
145	Assessment	f (maximum discharge flow m3/sec);	0.00070675	0.00082341	0.00063854	0.00053026	0.00053473	0.00051223	0.00038008	0.00049035	0.00053729	0.00069938	0.00064114	0.00075654	m3/sec		3.0 m3/hour
146	Assessment	c (maximum pollutant conc. Discharge mg/l);	10	10	10	10	10	10	10	10	10	10	10	10	mg/l	BOD	Linked to abve
147	Assessment	**T (Resulting concentration downstream)**	**1.594**	**1.685**	**1.706**	**1.927**	**2.362**	**2.835**	**3.479**	**2.772**	**1.938**	**1.768**	**1.542**	**1.633**	**mg/l**	BOD	
148	Assessment	EQS	5	5	5	5	5	5	5	5	5	5	5	5	mg/l	BOD	Linked to abve
149	Assessment	Mass Balance Result	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**			

	603676 - Firlough Hydrogen (SK 14/02/2023)				Preliminary Assimilative Capacity Assessment - BOD																
					Scenarion C - Using Inferred Variable River Q95%ile (HHYDRO Tool Derived) and Monthly Average Discharge Rate, combined with Wastewater Storage and WITH Restricted Discharge Rate																
		Cat.	Desc.	Units																	
1	Asses	TIME	Period (Month/Annual)	Period	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL	MIN	MAX	AVERAGE	
2	Asses	RAIN	Rainfall LTA (mm/month) (KNOCK AIR)	mm/month	135.400	102.900	118.100	81.600	92.000	91.500	95.700	107.900	111.300	141.300	134.200	141.400	1,353.300	81.600	1,353.300	224.391		Met Eireann
3	Asses	RAIN	Rainfall LTA (cm/month) (Secondary Axis) (KNOCK AIR)	cm/month	13.540	10.290	11.810	8.160	9.200	9.150	9.570	10.790	11.130	14.130	13.420	14.140	135.330	8.160	135.330	22.439		
4	Asses	RAIN	Rainfall LTA (m/month) (KNOCK AIR)	m/month	0.135	0.103	0.118	0.082	0.092	0.092	0.096	0.108	0.111	0.141	0.134	0.141	1.353	0.082	1.353	0.224		Met Eireann / MEL
5	Asses	RAIN	Rainfall LTA (mm/month) (3131-011)	mm/month	134.000	113.000	98.000	77.000	93.000	94.000	110.000	117.000	111.000	131.000	142.000	151.000	1,371.000	77.000	1,371.000	226.818		
6	Asses	RAIN	Rainfall LTA (cm/month) (3131-011)	cm/month	13.400	11.300	9.800	7.700	9.300	9.400	11.000	11.700	11.100	13.100	14.200	15.100	137.100	7.700	137.100	22.682		
7	Asses	RAIN	Rainfall LTA (m/month) (3131-011)	m/month	0.134	0.113	0.098	0.077	0.093	0.094	0.110	0.117	0.111	0.131	0.142	0.151	1.371	0.077	1.371	0.227		
8	Asses	RAIN	Site Area - Roofed (3131-011)	m2	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	14,800.000	n/a	n/a	n/a		
9	Asses	RAIN	Harvested RAIN Volume	m3	2,003.920	1,522.920	1,747.880	1,207.680	1,361.600	1,354.200	1,416.360	1,596.920	1,647.240	2,091.240	1,986.160	2,092.720	20,028.840	1,207.680	20,028.840	3,320.985		
10	Asses	RAIN	Site Area - Not Roofed (3131-011)	m2	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	32,850.000	n/a	n/a	n/a		
11	Asses	RAIN	Harvested STORM Volume	m3	4,447.890	3,380.265	3,879.585	2,680.560	3,022.200	3,005.775	3,143.745	3,544.515	3,656.205	4,641.705	4,408.470	4,644.990	44,455.905	2,680.560	44,455.905	7,371.241		
12	Asses	RAIN	Total Rain & Storm Volume	m3	6,451.810	4,903.185	5,627.465	3,888.240	4,383.800	4,359.975	4,560.105	5,141.435	5,303.445	6,732.945	6,394.630	6,737.710	64,484.745	3,888.240	64,484.745	10,692.227		
13	Asses	RAIN	Rain Storage	m3	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6,000.000	6000	n/a	n/a	n/a		
14	Asses	WELFARE WW	Projected Aerage Wastewater (m3) (Based approximately on 7 site staff and c. 26 vistitors / drivers per day)	m3/day	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500						
15	Asses	WELFARE WW	Projected Aerage Wastewater	m3/hour	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146						
16	Asses	WELFARE WW	Projected Aerage Wastewater	m3/sec	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405	0.0000405						
17	Asses	WELFARE WW	Projected Aerage Wastewater	l/sec	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041						
18		WWT (W)	Constructed Wetland (Welfare) - Retention Time	Days	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904	11.904						
19		WWT (W)	Constructed Wetland (Welfare) - Outfall	Method	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage	To WW Storage						
20	Asses	PROCESS WW	Projected Aerage Wastewater (m3) (B&V)	m3	1726.890	2029.270	1550.090	1269.430	1281.020	1222.710	880.170	1165.980	1287.650	1707.790	1556.830	1855.960						Provided by B&V
21	Asses	PROCESS WW	Projected Aerage Wastewater (m3/day)	m3/day	57.563	67.642	51.670	42.314	42.701	40.757	29.339	38.866	42.922	56.926	51.894	61.865						
22		COMBINED WW	Projected Combined Aerage Wastewater (m3) (Welfare & Process)		61.063	71.142	55.170	45.814	46.201	44.257	32.839	42.366	46.422	60.426	55.394	65.365						
23	Asses	COMBINED WW	Projected Combined Average Wastewater (m3/hour)	m3/hour	2.544	2.964	2.299	1.909	1.925	1.844	1.368	1.765	1.934	2.518	2.308	2.724						
24	Asses	COMBINED WW	Projected Combined Aerage Wastewater (m3/sec)	m3/sec	0.0007067	0.0008234	0.0006385	0.0005303	0.0005347	0.0005122	0.0003801	0.0004903	0.0005373	0.0006994	0.0006411	0.0007565						
25	Asses	COMBINED WW	Projected Combined Aerage Wastewater (l/sec) (Secondary Axis)	l/sec	0.707	0.823	0.639	0.530	0.535	0.512	0.380	0.490	0.537	0.699	0.641	0.757						
26	Asses	COMBINED WW	Wastewater Storage	m3	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1,500.000	1500.000	n/a	n/a	n/a		
27	**Ass**	**DISCHARGE**	**RESTRICT DISCHARGE RATE Coefficient**	**%**	**1.00**	**1.00**	**1.00**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**1.00**	**1.00**	**1.00**						
28	Asses	DISCHARGE	Discharge Rate	m3/hour	2.544	2.964	2.299	0.954	0.963	0.922	0.684	0.883	0.967	2.518	2.308	2.724						
29	Asses	DISCHARGE	Discharge Rate	m3/sec	0.0007067	0.0008234	0.0006385	0.0002651	0.0002674	0.0002561	0.0001900	0.0002452	0.0002686	0.0006994	0.0006411	0.0007565						
30	Asses	DISCHARGE	Discharge Rate	l/sec	0.707	0.823	0.639	0.265	0.267	0.256	0.190	0.245	0.269	0.699	0.641	0.757						
31	Asses	DISCHARGE	Attenuation Rate	m3/hour	0.000	0.000	0.000	0.954	0.963	0.922	0.684	0.883	0.967	0.000	0.000	0.000						
32	Asses	DISCHARGE	Storage Capacity	hours	#DIV/0!	#DIV/0!	#DIV/0!	1571.561	1558.419	1626.861	2192.515	1699.476	1551.000	#DIV/0!	#DIV/0!	#DIV/0!						
33	Asses	DISCHARGE	Storage Capacity	days	#DIV/0!	#DIV/0!	#DIV/0!	65.482	64.934	67.786	91.355	70.811	64.625	#DIV/0!	#DIV/0!	#DIV/0!						
34	Asses	HYDROLOGY	HYDROtool Q95 for end of Catchment Node (l/sec)	l/sec	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000						
35	Asses	HYDROLOGY	Approximate catchment area upstream of DP	%	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330						
36	Asses	HYDROLOGY	Inferred Q95%ile [FIXED]at DP (m3/sec)	m3/sec	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620	0.004620						
37	Asses	HYDROLOGY	Inferred Q95%ile [FIXED] at DP (l/sec)	l/sec	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620	4.620						
38	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (m3/sec)	m3/sec	0.010000	0.010000	0.007500	0.004620	0.003000	0.002000	0.001000	0.002000	0.004620	0.007500	0.010000	0.010000						
39	Asses	HYDROLOGY	Inferred Q%ile / month [VARIABLE] at DP (l/sec)	l/sec	10.000	10.000	7.500	4.620	3.000	2.000	1.000	2.000	4.620	7.500	10.000	10.000						
40–62																						



63	**Preliminary Assimilative Capacity Assessment**																				
64	**Guidance**	**Appendix C – Assimilative Capacity and Mass Balance Calculations**		**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Unit**				**Paran**	**Comment**
65																					
66	Assessment	Pollutant		BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD	BOD						
67	Guidance																				
68	Guidance	**Calculation 1 – Assimilative Capacity**																			
69	Guidance																				
70	Guidance	This calculation is used to determine the capacity of the receiving waters to assimilate the effluent discharge in kg/day																			
71	Guidance	Formula 1 below may be used to determine assimilative capacity for the majority of chemical parameters e.g. BOD, suspended solids etc. with the exception of toxic substances e.g. heavy metals in which case Formula 2 must be used																			
72	Assessment	Appropriate Formula		Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1	Formula 1						Screen heavy metals
73	Guidance																				
74	Guidance	**Formula 1**																			
75	Guidance																				
76	Guidance	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day																			
77	Guidance																				
78	Guidance	Where:																			
79	Guidance	Cmax = maximum permissible concentration (EQS – 95%ile																			
80	Guidance	Cback = background upstream concentration (mg/l mean value)																			
81	Guidance	F95 = the 95%ile flow in the river (m3/s)																			
82	Guidance	Note: (60x60x24)/1000 = 86.4																			
83	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants		5	5	5	5	5	5	5	5	5	5	5	5	mg/l				BOD	SW Regs Good Status 95%ile
84	Assessment	95%ile value		1	1	1	1	1	1	1	1	1	1	1	1	mg/l				BOD	Baseline
85	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)		4	4	4	4	4	4	4	4	4	4	4	4	mg/l				BOD	
86	Assessment	Cback = background upstream concentration (mg/l mean value)		1	1	1	1	1	1	1	1	1	1	1	1	mg/l				BOD	Assume 95%ile value
87	**Assessment**	**F95 = the 95%ile flow in the river (m3/s)**		**0.010**	**0.010**	**0.008**	**0.005**	**0.003**	**0.002**	**0.001**	**0.002**	**0.005**	**0.008**	**0.010**	**0.010**	**m3/sec**					**Assume 95%ile value**
88	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day		2.592	2.592	1.944	1.197504	0.7776	0.5184	0.2592	0.5184	1.197504	1.944	2.592	2.592	kg/day				BOD	
89	Guidance																				
90	Guidance	**Formula 2**																			
91	Guidance																				
92	Guidance	Assimilative capacity = (Cmax – Cback) x DWF x 86.4 kg/day																			
93	Guidance																				
94	Guidance	where:																			
95	Guidance	Cmax = maximum permissible concentration (EQS - 95%ile value) (mg/l)																			
96	Guidance	Cback = background upstream concentration (mg/l mean value)																			
97	Guidance	DWF = dry weather flow in the river (m3/s)																			
98	Guidance	Note: (60x60x24)/1000 = 86.4																			
99	Assessment	Environmental Quality Standard (EQS) The concentration of a particular pollutant or group of pollutants in a receiving water which should not be exceeded in order to protect human health and the environment.														mg/l				BOD	Salmonid Regs
100	Assessment	95%ile value = Assume low e.g. BOD														mg/l				BOD	
101	Assessment	Cmax = maximum permissible concentration (EQS – 95%ile value) (mg/l)		0	0	0	0	0	0	0	0	0	0	0	0	mg/l				BOD	
102	Assessment	Cback = background upstream concentration (mg/l mean value)		0	0	0	0	0	0	0	0	0	0	0	0	mg/l				BOD	Assume 95%ile value
103	Assessment	F95 = the 95%ile flow in the river (m3/s)														m3/sec					Assume 95%ile value
104	Assessment	Assimilative capacity = (Cmax – Cback) x F95 x 86.4 kg/day		0	0	0	0	0	0	0	0	0	0	0	0	kg/day				BOD	
105	Guidance																				
106	Guidance	Once the assimilative capacity of the receiving water has been established, the percentage of the assimilative capacity that will be used by the discharge may be calculated using the effluent load information.																			
107	Guidance																				
108	Guidance	The effluent load may be determined using the following formula:																			
109	Guidance																				
110	Guidance	Effluent flow x effluent concentration / 1000 = effluent load (kg/day)																			
111	Guidance																				
112	Assessment	**Wastewater Loading**																			
113	Assessment	Effluent flow (Dicharge Rate)		0.0007067	0.0008234	0.0006385	0.0002651	0.0002674	0.0002561	0.0001900	0.0002452	0.0002686	0.0006994	0.0006411	0.0007565	m3/sec					
114	Assessment	Effluent flow		0.70674769	0.82340664	0.63853781	0.26512924	0.26736497	0.2561169	0.19004051	0.24517361	0.2686439	0.69937886	0.64113812	0.75654321	l/sec					
115	**Assessment**	**Effluent concentration**		**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**mg/l**				**BOD**	
116	Assessment	Effluent Load		7.06747685	8.23406636	6.38537809	2.65129244	2.67364969	2.56116898	1.90040509	2.45173611	2.68643904	6.99378858	6.41138117	7.5654321	mg/sec				BOD	
117	Assessment	Effluent Load		610,630.00	711,423.33	551,696.67	229,071.67	231,003.33	221,285.00	164,195.00	211,830.00	232,108.33	604,263.33	553,943.33	653,653.33	mg/day				BOD	
118	Assessment	Effluent Load		0.6106300	0.7114233	0.5516967	0.2290717	0.2310033	0.2212850	0.1641950	0.2118300	0.2321083	0.6042633	0.5539433	0.6536533	kg/day				BOD	
119	Guidance																				
120	Assessment	**Assimilative Capacity Assessment Result**																			
121	Assessment	Assimilative Capacity (AC) = (Cmax – Cback) x F95 x 86.4 kg/day		2.592	2.592	1.944	1.197504	0.7776	0.5184	0.2592	0.5184	1.197504	1.944	2.592	2.592	kg/day				BOD	
122	Assessment	Effluent Load (EL)		0.6106300	0.7114233	0.5516967	0.2290717	0.2310033	0.2212850	0.1641950	0.2118300	0.2321083	0.6042633	0.5539433	0.6536533	kg/day				BOD	
123	Assessment	AC - EL		1.98137	1.88057667	1.39230333	0.96843233	0.54659667	0.297115	0.095005	0.30657	0.96539567	1.33973667	2.03805667	1.93834667	kg/day				BOD	
124	**Assessment**	**Percentage of the assimilative capacity that will be used by the discharge**		**23.6%**	**27.4%**	**28.4%**	**19.1%**	**29.7%**	**42.7%**	**63.3%**	**40.9%**	**19.4%**	**31.1%**	**21.4%**	**25.2%**						
125	**Assessment**	**ACA Result**		**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**						
126	**Assessment**																				
127	Guidance																				
128	Guidance	**Calculation 2 – Mass Balance**																			
129	Guidance																				
130	Guidance	This formula is used to calculate the concentration of a parameter in the receiving water downstream of the discharge. This downstream concentration may then be compared directly with the water quality standard (EQS) to determine whether the discharge will cause an exceedance of the EQS value.																			
131	Guidance																				
132	Guidance	**Mass balance Equation:**																			
133	Guidance																				
134	Guidance	$T = \frac{FC + fc}{F + f}$																			
135	Guidance																				
136	Guidance	where:																			
137	Guidance	• F is the river flow upstream of the discharge (95%ile flow m3/sec);																			
138	Guidance	• C is the concentration of pollutant in the river upstream of the discharge (mean concentration in mg/l);																			
139	Guidance	• f is the flow of the discharge (maximum flow in m3/sec);																			
140	Guidance	• c is the maximum concentration of pollutant in the discharge (mg/l);																			
141	Guidance	• T is the concentration of pollutant downstream of the discharge.																			
142	Guidance																				
143	Assessment	F (95%ile flow m3/sec);		0.01	0.01	0.0075	0.00462	0.003	0.002	0.001	0.002	0.00462	0.0075	0.01	0.01	m3/sec					Linked to abve
144	Assessment	C (mean background concentration in mg/l);		1	1	1	1	1	1	1	1	1	1	1	1	mg/l				BOD	Linked to abve
145	Assessment	f (maximum discharge flow m3/sec);		0.00070675	0.00082341	0.00063854	0.00026513	0.00026736	0.00025612	0.00019004	0.00024517	0.00026864	0.00069938	0.00064114	0.00075654	m3/sec					3.0 m3/hour
146	Assessment	c (maximum pollutant conc. Discharge mg/l);		10	10	10	10	10	10	10	10	10	10	10	10	mg/l				BOD	Linked to abve
147	Assessment	**T (Resulting concentration downstream)**		**1.594**	**1.685**	**1.706**	**1.488**	**1.736**	**2.022**	**2.437**	**1.983**	**1.495**	**1.768**	**1.542**	**1.633**	**mg/l**				BOD	
148	Assessment	EQS		5	5	5	5	5	5	5	5	5	5	5	5	mg/l				BOD	Linked to abve
149	Assessment	Mass Balance Result		**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**	**PASS**						