

Lough Allen Priority Area for Action Desk Study



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Data attribution

The following data sources were consulted in the preparation of this report:

Catchment boundaries, waterbodies and areas for action: EPA (2018)

Bedrock Unit: GSI (2008)

Aquifer Category: GSI (2015)

Groundwater body: EPA Catchments Unit (2018)

Soils & Subsoils Maps: Teagasc (2015)

IFS Soils: EPA (2006)

Susceptibility and Pollution Impact Potential Maps: EPA (2018)

WFD waterbody status: EPA (2018)

SAC and NHA boundaries: NPWS (2018)

Corine Landcover: EPA (2018)

Forestry land use info: Forest Service (2018)

Table of Contents

List of Tables	2
List of Figures	2
1. Background	6
1.1. Protected Areas	12
2. Receptor information and assessment.....	13
2.1. Lough Allen	14
2.1.1. Macrophyte Monitoring Stations – M_1 to M_11 (LS260155a30000100 to LS260155a30000200)	18
2.1.2. Supporting Chemistry Stations (Site 1 to Site 7 (LS260155a30000010 to LS260155a30000070)) and Phytoplankton Monitoring Stations (Site 3 to Site 5 (LS260155a30000030 to LS260155a30000050))	18
2.1.3. Site 7	21
2.2. River waterbodies of Lough Allen PAA	25
2.2.1. Owennayle_020: Monitoring station - Br d/s Owennayle Br (RS260050100)	29
2.2.2. Diffagher_010 and Owengar (Leitrim)_020	32
2.2.3. Shannon (Upper)_030.....	34
2.2.4. Shannon (Upper)_040: Monitoring station – Battle Br (RS26S020500)	35
2.2.5. Stony_010 and Sheskinacurry_010.....	38
2.2.6. Drumshanbo Stream_010.....	39
2.2.7. Tarmo_010.....	50
3. Significant pressures	52
3.1. Drumshanbo Urban Wastewater Treatment.....	53
3.2. Invasive Species	55
3.3. Agriculture	56
3.3.1 Pollution Impact Potential Maps	59
3.4. Forestry.....	62
3.5. Hydromorphology.....	63
3.6 Anthropogenic (Unknown)	64
3.6.1. Landslide 28 th June 2020.....	64
3.7. Extractive Industry	67
3.8. Other pressures	69
3.8.1. Ballinagleragh Urban Wastewater Treatment.....	69
3.8.2. Dowra Urban Wastewater Treatment.....	70

3.8.3. Licensed facilities	71
3.8.4. Domestic Wastewater Treatment units	71
4. Pathway information and analysis.....	72
4.1. Overview of Pathways within the PAA	72
5. Interim ‘story’ of the Priority Area for Action.....	80
5.1. Allen	80
5.2. Shannon (Upper)_040.....	81
5.3. Drumshanbo Stream_010.....	82
5.4. Shannon (Upper)_030.....	84
5.5. Tarmo_010.....	85
5.6. Stony_010	86
5.7. Sheskinacurry_010.....	86
6. Communications Plan	87
7. Work plan.....	87
7.1. Consultation on the desk studies LA, IFI etc/ Further information required	87
7.2. Local Catchment Assessment Work Plan.....	88
8. Review of mitigation options.....	89
Appendix 1_Protected Areas and Groundwater bodies.....	90
Appendix 2_Drumshanbo WWTP Assimilative Capacity Calculations.....	92
Appendix 3_Forestry.....	93
Appendix 4_Initial LCA assessment locations.....	95

List of Tables

Table 1 Summary of waterbodies within the Lough Gill PAA plus the Owennayle_020, Diffagher_010 and Owengar (Leitrim)_020.....	10
Table 2 Receptor information for Lough Allen	14
Table 3 General chemistry information for Lough Allen.	16
Table 4 Receptor information for river water bodies in Lough Allen PAA, where data is available, and the Owennayle_020 and Owengar (Leitrim)_020.	25
Table 5 Significant and non-significant pressures as identified in the Initial Characterisation.....	52
Table 6 Conceptual model information for the pathways.....	78

List of Figures

Figure 1 Flow diagram for the Upper Shannon Catchment (26A), waterbodies are grouped by sub-catchment, with WFD Risk stated and colour coded by Ecological Status (2013-2018), waterbodies included in the Lough Allen PAA at Initial 2 nd cycle Characterisation are identified with a blue tick.	7
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Figure 2 Map of Lough Allen PAA and surrounds showing WFD Risk (2nd cycle) and Ecological Status (2013-2018), waterbodies included in the PAA at desk study stage are shown in blue, (please note the white arrow indicates that the Shannon (Upper)_040 river waterbody enters the lake from the NE and outflows in the south)..... 7

Figure 3 Lough Allen PAA in relation to county boundaries..... 8

Figure 4 Showing lake monitoring stations on Lough Gill and river monitoring stations where data is available in the Lough Allen PAA (and inputting deteriorated waterbodies)..... 13

Figure 5 Total Phosphorous annual average trend for Lough Allen (all sites combined)..... 19

Figure 6 Total Phosphorous temporal data for Lough Allen Sites 1-7 from 2019-2022..... 20

Figure 7 Ammonia annual average trend for Lough Allen (all sites combined). 20

Figure 8 Chlorophyll_a annual average trend for Lough Allen (all sites combined). 21

Figure 9 Taken from EPA Maps, showing the southern section of Lough Allen near Drumshanbo, Site 7 is highlighted with a red cross and river flow direction is shown for the Drumshanbo Stream_010 flowing in from the east coloured orange for Poor Ecological Status. 22

Figure 10 Total Phosphorous trend for Site 7 (LS260155a30000070) on Lough Allen..... 23

Figure 11 Chlorophyll-a results above 9µg/L by time of year sampled at Site 7 (LS260155a30000070) on Lough Allen. 23

Figure 12 Relationship between total phosphorous and chlorophyll-a for Site 7 (LS260155a30000070) on Lough Allen. 24

Figure 13 Correlation between annual average concentrations of Chlorophyll_a and Total Phosphorous at Site 7 on Lough Allen is very weak. 24

Figure 14 Owennayle_010 and Owennayle_020 river waterbodies in relation to the Lough Allen PAA. 30

Figure 15 Q value trend for the Owennayle_020 at *Br d/s Owennayle Br* (RS26O050100). 31

Figure 16 2008-2015 BOD data for monitoring station *Br d/s Owennayle Br* (RS26O050100) on the Owennayle_020. 31

Figure 17 Comparison of temporal BOD data from the Owennayle_010 and the Owennayle_020..... 32

Figure 18 The Diffagher_010 and Owengar (Leitrim)_010 river waterbodies in relation to the Lough Allen PAA. 33

Figure 19 Q value trend for the Diffagher_010 at *Cloonemeone Bridge* (RS26D020200). 34

Figure 20 The Shannon (Upper)_040 in relation to Lough Allen, inflowing and outflowing waterbodies and the Lough Allen Canal are also shown. 36

Figure 21 Connection between Lough Allen Canal and the Shannon (Upper)_040. 36

Figure 22 Q Value trend for the Shannon (Upper)_040 at *Battle Br* (RS26S020500)..... 37

Figure 23 Ammonia data for Shannon (Upper)_040 at *Battle Br* (RS26S020500)..... 38

Figure 24 The Stony_010 and Sheskinacurry_010 in relation to Lough Allen. 39

Figure 25 Drumshanbo Stream_010 in relation to Lough Allen. 40

Figure 26 Ammonia data for monitoring station *U/S Drumshanbo WW* (RS26M800930) on the Drumshanbo Stream_010..... 41

Figure 27 BOD data and trend for monitoring station *U/S Drumshanbo WW* (RS26M800930) on the Drumshanbo Stream_010..... 42

Figure 28 Q Value trend for the Drumshanbo Stream_010 at Monitoring Station *150m d/s STW outfall* (RS26D050300). 43

Figure 29 Ortho-phosphate data for the monitoring station *150m d/s STW outfall* (RS26D050300) on the Drumshanbo Stream_010 (off chart concentrations in red text box)..... 44

Figure 30 Ammonia data for the monitoring station *150m d/s STW outfall* (RS26D050300) on the Drumshanbo Stream_010 (off chart concentrations in red text box). 44

Figure 31 TON data for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010.....	45
Figure 32 BOD data and trend for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010.....	45
Figure 33 Ortho-phosphate (filtered 2012-2015, unspecified 2016-2022) data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010 (off chart concentration in red text box).	47
Figure 34 Comparison of Ortho-phosphate (unspecified 2016-2022) annual averages for the 0300 and 0400 monitoring points.	48
Figure 35 Ammonia data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010 (off chart concentrations in red text box).	48
Figure 36 Comparison of ammonia annual averages for the 0300 and 0400 monitoring points.	49
Figure 37 BOD data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010.....	49
Figure 38 Comparison of BOD annual averages for the 0300 and 0400 monitoring points.	50
Figure 39 Tarmo_010 in relation to Lough Allen.	51
Figure 40 Drumshanbo WWTW and Drumshanbo Mart Section 4 licence in relation to monitoring stations with available data on the Drumshanbo Stream_010.	54
Figure 41 Comparison of the nutrient and BOD concentrations of the mass balance estimation with the actual results at the two d/s monitoring points.....	55
Figure 42 Figure 4 from EPA Macrophyte Survey 2016-2018 for Lough Allen showing trend in annual mean colour.....	56
Figure 43 Corine Land Cover Map (2018) for the Lough Allen PAA region.	58
Figure 44 Pollution Impact Potential (PIP) map for surface water phosphate for northern section of PAA with Corine (2018) map for comparison.	59
Figure 45 Pollution Impact Potential (PIP) map for surface water phosphate for southern section of PAA, areas where soils are well-draining have been indicated, Corine (2018) map included for comparison.	60
Figure 46 Potential Impact Potential map for surface water Nitrate for the Lough Allen PAA area. ...	61
Figure 47 PIP map for groundwater Nitrate for Shannon (Upper)_040 area.....	61
Figure 48 Forestry land-use, both Coillte owned and privately-owned, in the Stony_010, Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basin areas.....	63
Figure 49 Pathway of June 2020 landslide.	65
Figure 50 Showing the levels of nutrients, SS and BOD as percentage above the EQS/threshold at the Dawn of Hope Bridge on the 26/08/2020 (data from Leitrim Co. Co.).	66
Figure 51 Showing the levels of nutrients, SS and BOD as multiples of the EQS/salmonid threshold at four progressively downstream locations between the Dawn of Hope Bridge and Lough Allen, taken at three dates after the landslide (data from Leitrim CoCo).	66
Figure 52 Showing the levels of TP and SS as multiples of the EQS/salmonid threshold at Corry Strand and Spencer Harbour in Lough Allen, taken at three dates after the landslide (data from Leitrim CoCo).....	67
Figure 53 Teagasc Subsoils map showing areas of blanket peat and drained peat in the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010 river basins (left), map of areas on Extractive Industries Register in and around the Tarmo_010 river basin (right).	68
Figure 54 Ballinaglera WWTW and Greaghafarna housing estate Section 4 discharge licence (SS/W/95/01) in relation to the Shannon (Upper)_040.	69
Figure 55 Dowra WWTW in relation to the Shannon (Upper)_030.	70

Figure 56 BOD data for monitoring station *Dowra Br* (RS26S020300) on the Shannon (Upper)_020, upstream of Dowra Wastewater Works..... 71

Figure 57 The aquifer bedrock for the Lough Allen PAA, major faults also shown, recorded karst features shown to lie outside PAA boundaries. 74

Figure 58 The wet and dry soils for the Lough Allen PAA..... 75

Figure 59 The subsoil type for Lough Allen PAA. 75

Figure 60 The groundwater vulnerability for the Lough Allen PAA. 76

Figure 61 The near surface PO4 susceptibility map for the Lough Allen PAA with Corine (2018) map for comparison..... 76

Figure 62 The near surface NO3 susceptibility map for the Lough Allen PAA with map showing moderately-well draining soil type and areas of X groundwater vulnerability for comparison..... 77

Figure 63 Protected Areas for Drinking Water, Natura2000 sites and National Heritage Areas in and around Lough Gill PAA. 90

Figure 64 Groundwater bodies associated with the Lough Allen PAA area 91

Figure 65 Mass balance calculations for Drumshanbo WWTP discharge on Drumshanbo Stream_010. 92

Figure 66 Coillte owned forestry in the Stony_010, Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basins. 93

Figure 67 Privately-owned forestry in the Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basins. 94

Figure 68 Initial LCA assessment locations for the Lough Allen PAA..... 95

1. Background

Lough Allen is 3345 hectares sitting mainly in Co. Leitrim with an area to the SW in Co. Roscommon (Fig. 3), the lake is elongated in a north to south direction with the *Upper Shannon* flowing into the lake from the north and flowing out in the south. The *Yellow River* sub-catchment flows into the lake from the east with the *Owengar River* sub-catchment and *Arigna River* sub-catchment flowing in from the west, the *Feorish River* sub-catchment flows into the *Upper Shannon* downstream of lough Allen (Fig. 1). The town of Drumshanbo lies at the southern tip of the lake.

On Sunday the 28th June 2020 at the end of a week of increased rainfall following a prolonged period of approx. 13 weeks of low rainfall, a landslide occurred in the Diffagher_010 catchment causing significant damage at the Dawn of Hope Bridge, sediment blocking the road approx. 3km downstream at Corcormick Bridge, and sediment impacts being visible approx. 8km downstream of the Dawn of Hope Bridge as far as Corry Strand on Lough Gill. An investigation carried out by Leitrim Co.Co. using drone footage pinpointed the initial failure area to approx. 1km NE of the Dawn of Hope Bridge on the boundary of an area of privately owned forestry and an area of blanket bog/wet heath in the Boleybrack Mountain SAC.

As part of the Initial Characterisation Assessment carried out for the 2nd cycle River Basin Management Plan (RBMP), a total of 7 waterbodies were included in the Lough Allen PAA, **Lough Allen** itself and 6 river waterbodies: the inflowing **Shannon (Upper)_030** and the outflowing and inflowing **Shannon (Upper)_040**; the inflowing **Stony_010**, **Sheskinacurry_010** and **Drumshanbo Stream_010** in the *Yellow River* catchment; and the inflowing **Tarmo_010** in the *Arigna River* catchment (Fig. 1). A further three river waterbodies are discussed here at desk study stage:

1. the Owennayle_020, which flows into the Shannon (Upper)_030, due to a deterioration in ecological status since 2nd cycle characterisation and now classified as *At Risk*. This waterbody has been included in the Lough Allen PAA in the draft 3rd cycle RBMP with LAWPRO as the responsible organisation, however the most recent status (2016-2021) has improved to High. The Owennayle_010 has also been included in the draft plan, but with Leitrim Co.Co. as the responsible organisation.
2. the Diffagher_010 and
3. the Owengar (Leitrim)_010, both due to the impact from the June 2020 landslide discussed above.

These waterbodies will be included in the PAA at local catchment assessment (LCA) stage if found to be impacting the downstream water quality of Lough Allen or the Shannon (Upper)_030.

Lough Allen itself is at a moderate ecological status driven by macrophyte status and morphological status, the Shannon (Upper)_040 is also at a moderate ecological status but driven by fish status alone, the Drumshanbo Stream_010 was at poor 2013-2018 ecological status due to invertebrate status (it also has nutrient issues), but has made a slight recent improvement to moderate for the 2016-2021 status period. The Stony_010, Sheskinacurry_010, Tarmo_010 and Shannon (Upper)_030 have *Review* risk status and low confidence, modelled ecological status assigned for the 3rd Cycle (2nd Cycle unassigned status).

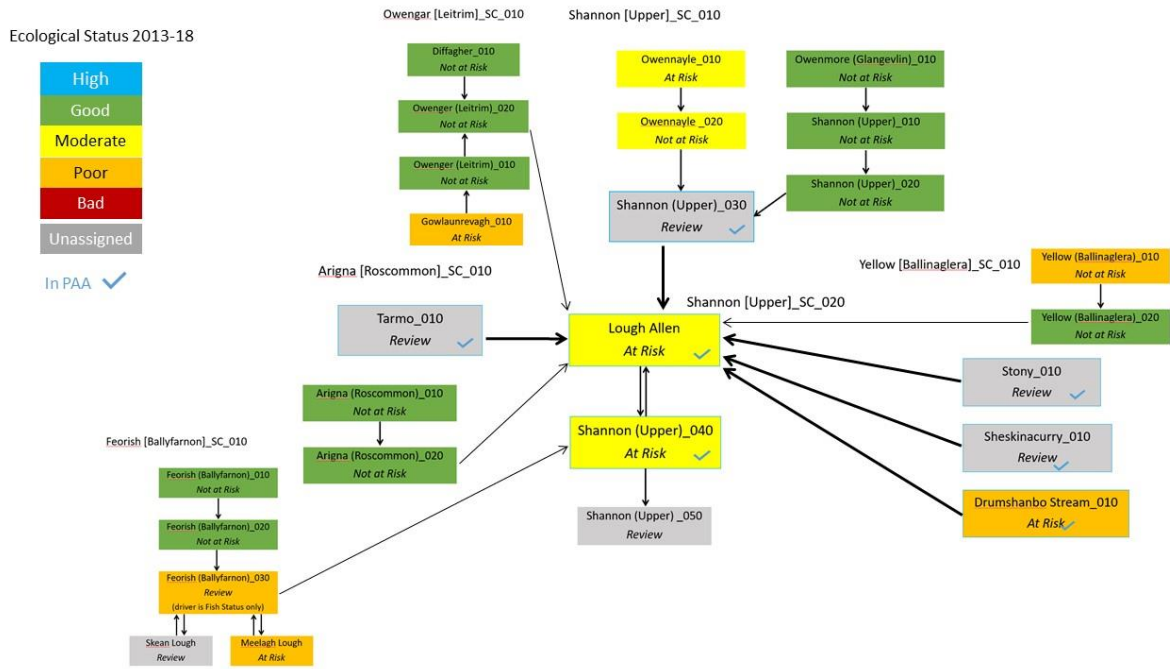


Figure 1 Flow diagram for the Upper Shannon Catchment (26A), waterbodies are grouped by sub-catchment, with WFD Risk stated and colour coded by Ecological Status (2013-2018), waterbodies included in the Lough Allen PAA at Initial 2nd cycle Characterisation are identified with a blue tick.

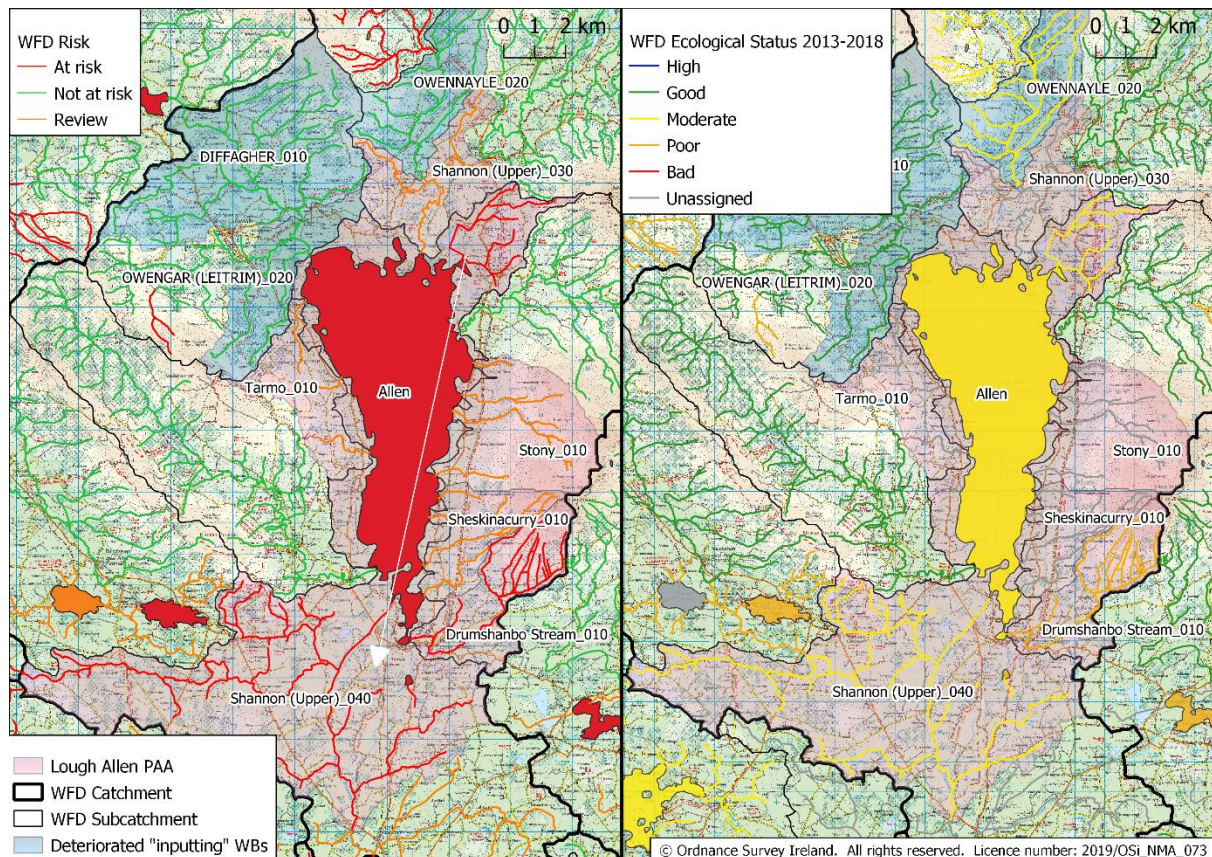


Figure 2 Map of Lough Allen PAA and surrounds showing WFD Risk (2nd cycle) and Ecological Status (2013-2018), waterbodies included in the PAA at desk study stage are shown in blue, (please note the white arrow indicates that the Shannon (Upper)_040 river waterbody enters the lake from the NE and outflows in the south).

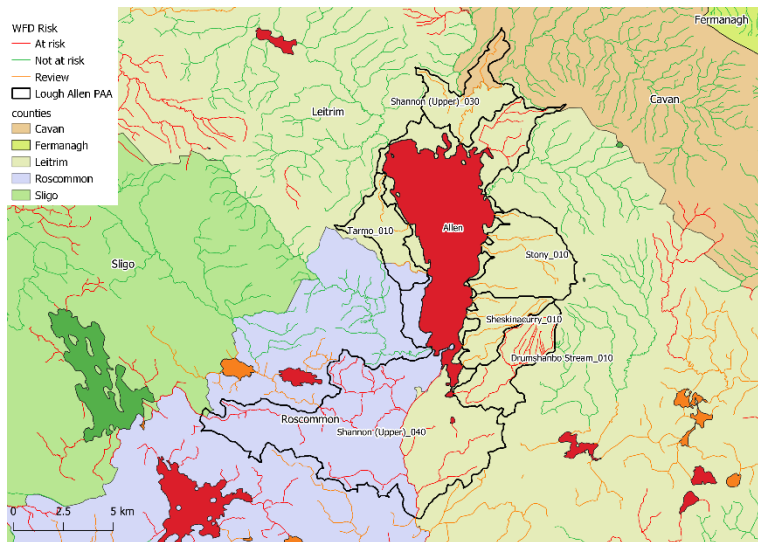


Figure 3 Lough Allen PAA in relation to county boundaries.

Reasons why the Area for Action was chosen:

- *Multiple pressures which can be investigated at the same time*
- *Long term challenge requiring cross agency approach*

EPA characterisation data:

The initial characterisation sub-catchment assessment recommended that the following actions be undertaken:

Allen:

- *IA9 Lake pressures: Local catchment assessment needed with respect to pressures. The lake water body is large and therefore resource allocation will need considered.*

SHANNON (Upper)_040:

- *IA1 Provision of Information: Internal review of fish status needed and update from IFI is required. Currently, the Moderate biology status is driven by coarse fish being present. However, for Salmonid species to travel up to this water, they have to travel long distances, etc and therefore, it needs to be determined if the Moderate fish status is appropriate.*

TARMO_010:

- *IA3 Determination of Water Quality (unassigned waterbody): There is currently no data available, therefore a river walk and samples need to be carried out.*

SHANNON (Upper)_030:

- *IA3 Determination of Water Quality (unassigned waterbody): Local catchment assessment to include water samples and walk.*

Drumshanbo stream_010:

- *IA5 Multiple Sources in defined rural area (1km) or waterbody or rural town: Investigation is needed along the stretch of the water body between monitoring points ending with 0300 and 0400 in order to determine what is causing the increase in Tot am*
- *IA1 Provision of Information: Watching Brief Continue monitoring to determine whether water quality improves after WWTP upgrade.*

STONY_010:

- *IA3 Determination of Water Quality (unassigned waterbody): Local catchment assessment to include water samples and walk.*

SHESKINACURRY_010:

- *IA3 Determination of Water Quality (unassigned waterbody): Local catchment assessment to include water samples and walk.*

Table 1 Summary of waterbodies within the Lough Gill PAA plus the Owennayle_020, Diffagher_010 and Owengar (Leitrim)_020.

WB Code	WB Name (River unless otherwise specified)	In PAA	WFD Risk	Status Obj.	Status					Q (2020)	Driver of Status	Pressure Category	Pressure Subcat.	Impact	Sig. Pressure	IA
					07 - 09	10 - 12	10 - 15	13 - 18	16 - 21							
IE_SH_26O050100	OWENNAYLE_020	Yes	At Risk	Good	G	U	G	M	H	4.5	Inverts.	Agriculture	Agriculture	- Nutrient Pollution - Altered habitat due to Morphological changes - Other: sediment	Yes	No data
												Extractive Industry	Peat	- Acidification - Other: sediment	Yes	
IE_SH_26D020200	DIFFAGHER_010	No	At Risk	Good	G	G	G	G	M	3.6	Inverts. *sediment	Anthro.	Unknown	-landslide June 2020 -impacted trib	Yes	No data
IE_SH_26O020200	OWENGAR (LEITRIM)_020	No	Review	Good	G	G	G	G	G	4.5	Hydro.	Agriculture	Pasture	Nutrient Pollution	Yes	No data
IE_SH_26S020340	SHANNON (Upper)_030	Yes	Review	Good	U	U	U	G	H	Modelled status, low confidence		Agriculture	Pasture	Nutrient Pollution	Yes	3
IE_SH_26S090100	STONY_010	Yes	Review	Good	U	U	U	G	H	Modelled status, low confidence	Agriculture	Pasture		No	3	
											Extractive Industry	Peat		No		
											Forestry	Forestry		No		
IE_SH_26S650770	SHESKINACURRY_010	Yes	Review	Good	U	U	U	G	G	Modelled status, low confidence	Agriculture	Pasture		No	3	
											Extractive Industry	Peat		No		
											Forestry	Forestry		No		
IE_SH_26D050400	Drumshanbo stream_010	Yes	At Risk	Good	P	M	P	P	M	3.5	Inverts.	UWW Drumshanbo	Agglomeration PE of 2,001 to 10,000	Nutrient Pollution	Yes	1
														Organic Pollution		
												Agriculture	Pasture	Nutrient Pollution	Yes	5
												Extractive Industry	Peat		No	
												Forestry	Forestry		No	
Hydro.	Dams, barriers, locks, weirs	- Altered habitat due to Hydrological	Yes													

													and Morphological changes			
IE_SH_26T050840	TARMO_010	Yes	Review	Good	U	U	U	G	G	Modelled status, low confidence	Agriculture	Pasture	Nutrient Pollution	Yes	3	
											Extractive Industry	Quarries		No		
											Forestry	Forestry	Other: sediment	Yes		
IE_SH_26_716	Allen (Lake)	Yes	At Risk	Good	M	P	M	M	M	Macrophytes	Invasive Species	Invasive Species (Zebra Mussel)	Altered habitat due to Morphological changes	Yes	9	
									Hydro.	Agriculture	Pasture	Nutrient Pollution	Yes			
IE_SH_26S020500	SHANNON (Upper)_040	Yes	At Risk	Good	M	M	M	M	M	4	Fish	Anthro.	Unknown	Other: fish status	Yes	1 (IFI)
										Hydro.		Dams, barriers, locks, weirs	Altered habitat due to Morphological changes	Yes		
										Agriculture		Pasture		No		

1.1. Protected Areas

Drinking water:

- Lough Allen Uplands groundwater body
- Glenade Dowra groundwater body
- Curlew Mountains groundwater body
- Geevagh groundwater body which is At Risk
- Carrick-on-Shannon groundwater body

Please note the Owennayle_020 was listed on the September 2016 WFD Register of Protected Areas as a Drinking Water River, but it is not listed on the December 2018 Register.

Special Area of Conservation:

- Cullcagh-Anierin Uplands SAC
- Boleybrack Mountain SAC

National Heritage Areas:

- Corry Mountain Bog NHA
- Kilonan Mountain Bog NHA

(see Appendix 1)

2. Receptor information and assessment

The available receptor information for Lough Gill is discussed first, followed by the available receptor information for the river water bodies in the PAA. The location of the lake monitoring stations and the 6 river operational monitoring stations for which data is available are shown in Figure X below.

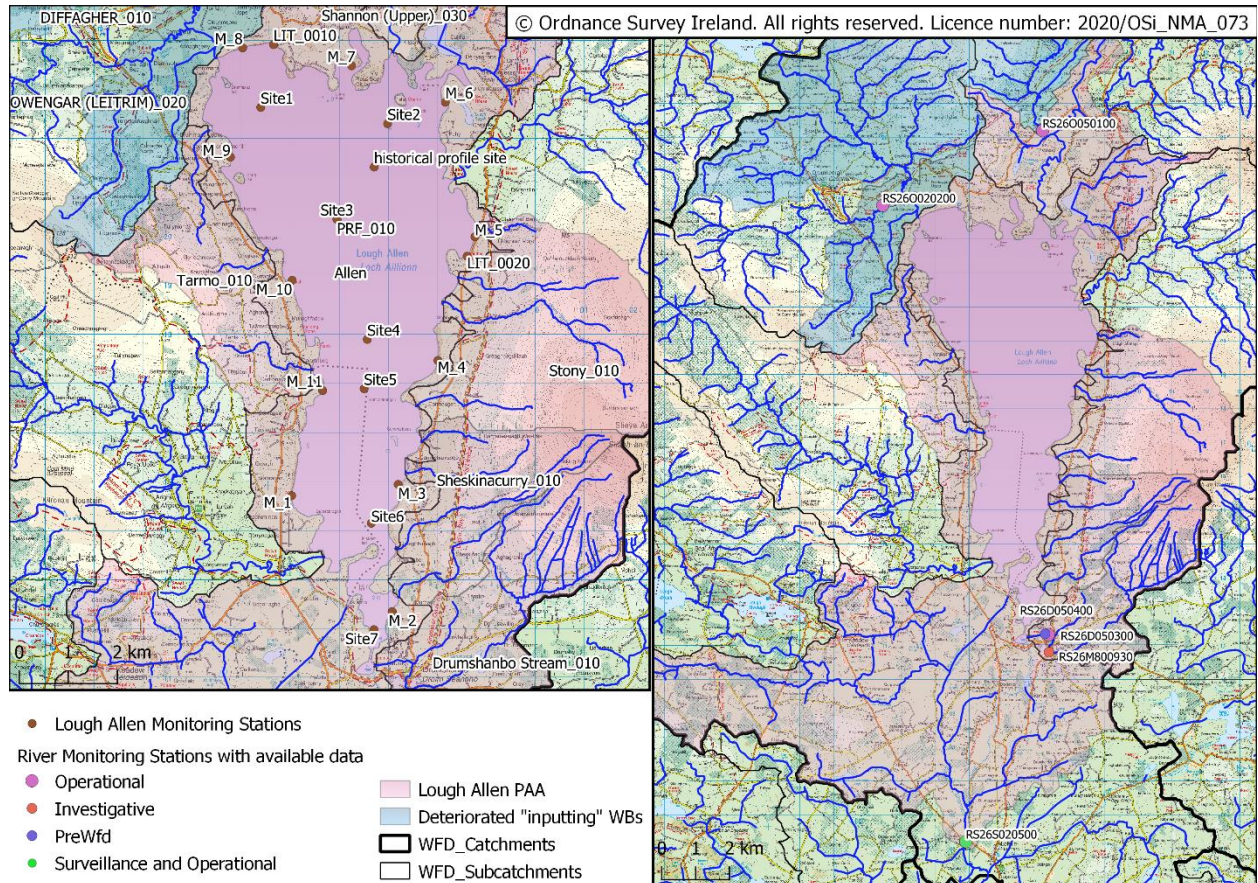


Figure 4 Showing lake monitoring stations on Lough Gill and river monitoring stations where data is available in the Lough Allen PAA (and inputting deteriorated waterbodies).

2.1. Lough Allen

Table 2 Receptor information for Lough Allen

Waterbody		Allen IE_SH_26_716	
Risk Category		At Risk	
Monitoring stations		Macrophyte stations: M_1 (LS260155a30000140) M_2 (0100) M_3 (0110) M_4 (0130) M_5 (0190) M_6 (0120) M_7 (0150) M_8 (0170) M_9 (0200) M_10 (0180) M_11 (0160)	Supporting Chemistry stations: Site 1 (LS260155a30000010) Site 2 (0020) Site 3 (0030) (phytoplankton monitoring) Site 4 (0040) (phytoplankton monitoring) Site 5 (0050) (phytoplankton monitoring) Site 6 (0060) Site 7 (0070)
Monitoring station type		Operational	
Biological Status			
Phytoplankton Status	2007-09	High	
	2010-12	Good	
	2010-15	Good	
	2013-18	Good	
	2016-21	Good	
Macrophyte Status	2007-09	Moderate	
	2010-12	Poor	
	2010-15	Moderate	
	2013-18	Moderate	
	2016-21	Moderate	
Phytobenthos Status		unmonitored	
Fish Status		unmonitored	
HYMO		Moderate in 2013-18 and 2016-21, previously unmonitored. Water level controlled by sluice gates at Bellantra Bridge. Other pressures identified on the lake include plantation forestry in the catchment, soft bank engineering on the shore, recreation pressure and modified shoreline vegetation ¹	
Lake Type		Type 4: Low altitude, low alkalinity (<20 mg/l CaCO ₃), deep (>4m) and large (>50 ha)	
Conceptual model required (Y/N)		Y	
Ecological Status (2016-21)		Moderate	
Macrophyte Survey		<ul style="list-style-type: none"> Between 2008 and 2017 the Trophic Score decreased, % RF Tolerant Taxa increased from 94.4% to 100%, % RF Elodeids decreased from 61% to 25%, Max Depth Colonisation increased by 0.2 m, Average Depth of Presence remained the same. The 2011 Poor status resulted from a decrease from 2008 in the Trophic Score and an increase in % RF Tolerant Taxa due to a loss of one taxa (mosses) which had a count of 1 in 2008. Comparing 2011 to 2017 metrics the difference is in % RF Elodeids; 82% in 2008 and 25% in 2017 comprising one taxon (filamentous algae) from a count of 10 to a count of 2. In 2017 assessment found an impoverished plant community comprised of low counts of two nutrient tolerant plants: <i>Littorella uniflora</i> accounted for 75 % of the plant community, filamentous algae 25%, in total 8 counts of plants from 99 positions sampled. <i>Fontinalis antipyretica</i> accounted for 50% of the plant community with 9 counts in 2014 but was not recorded in 2017. There had been a reasonably wide but sparse distribution of taxa throughout the lake until 2017, when the spread of taxa was confined to three transects. Each survey year up to 2017 had recorded plant taxa in seven of the eleven transects surveyed. <i>There are so few plant taxa and the plant counts are so low that changes in % RF, related metrics and status have little meaning. Indeed, there is little confidence that the macrophyte status is moderate.</i> 	

¹ Info from EPA when queried about specifics of MIMAS classification for Lough Allen

<p>comments</p>	<ul style="list-style-type: none"> • If Zebra Mussel lake, nutrient problem may be masked • Alkalinity range: 7-39 CaCO₃mg/L, average: 17.7 CaCO₃mg/L • Fish: Bream; Brown trout; European eel; Perch; Pike; Pollan; Roach; Roach x Bream hybrid (2006 survey NS SHARE project)²
<p>Significant issues</p>	<p>Macrophytes and hydromorphology driving status, invasive zebra mussel may be present. Total phosphorous issue in lake and chlorophyll issue at site 7 (see Table 3)</p>

² Information taken from IFI National Research Survey Programme Map
<https://ifigis.maps.arcgis.com/apps/webappviewer/index.html?id=9a31fedb077c4fb2991184842b7ef025>

Table 3 General chemistry information for Lough Allen.

Waterbody	Allen IE_SH_26_716								
Risk Category	At risk								
Monitoring station	Site 1 (0010)	Site 2 (0020)	Site 3 (0030)	Site 4 (0040)	Site 5 (0050)	Site 6 (0060)	Site 7 (0070)	All sites	
Monitoring station type	Operational								
Water chemistry ³									
Total Phosphorus	2008	0.017	0.016	0.016	0.016	0.015	0.015	0.037	0.019
	2009	0.008	0.008	0.008	0.008	0.008	0.008	0.025	0.011
	2010	0.008	0.008	0.008	0.008	0.008	0.012	0.028	0.011
	2011	0.016	0.013	0.008	0.008	0.01	0.01	0.031	0.014
	2012	0.018	0.011	0.013	0.009	0.01	0.012	0.025	0.014
	2013	0.019	0.015	0.009	0.013	0.009	0.009	0.033	0.015
	2014	0.014	0.012	0.013	0.012	0.013	0.019	0.026	0.015
	2015	0.016	0.016	0.015	0.015	0.015	0.016	0.035	0.018
	2016	0.017	0.016	0.016	0.016	0.017	0.017	0.036	0.019
	2017	0.018	0.015	0.016	0.016	0.018	0.015	0.031	0.018
	2018	0.017	0.015	0.014	0.014	0.012	0.015	0.032	0.017
	2019	0.015	0.014	0.013	0.012	0.012	0.018	0.033	0.017
	2020	0.022	0.023	0.017	0.017	No data	0.024	0.044	0.025
	2021	0.033	0.027	0.02	0.019		0.052	0.053	0.034
2022	0.026	0.017	0.017	0.019	0.027	0.016	0.047	0.024	
Baseline TP (2020-22)	0.027	0.022	0.018	0.018	NA	0.031	0.048	0.028	
Total Ammonia	2007	0.018	0.016	0.015	0.006	0.005	0.005	0.026	0.013
	2008	0.006	0.008	0.008	0.008	0.008	0.006	0.015	0.008
	2009	0.005	0.007	0.012	0.007	0.008	0.005	0.02	0.009
	2010	0.013	0.013	0.01	0.011	0.01	0.01	0.035	0.014
	2011	0.007	0.007	0.01	0.008	0.01	0.01	0.03	0.012
	2012	0.005	0.005	0.005	0.005	0.005	0.005	0.009	0.006
	2013	0.008	0.008	0.01	0.008	0.008	0.007	0.023	0.01
	2014	0.01	0.01	0.01	0.01	0.01	0.021	0.013	0.012
	2015	0.01	0.01	0.01	0.01	0.01	0.01	0.015	0.012
	2016	0.01	0.014	0.01	0.01	0.01	0.01	0.01	0.011
	2017	0.01	0.01	0.01	0.01	0.01	0.01	0.015	0.012
	2018	0.01	0.01	0.01	0.01	0.01	0.013	0.015	0.011
	2019	0.016	0.017	0.019	0.016	0.018	0.018	0.025	0.018
	2020	0.01	0.01	0.01	0.01	No data	0.01	0.016	0.011
2021	0.01	0.01	0.021	0.01		0.015	0.022	0.015	
2022	0.01	0.01	0.052	0.01	0.01	0.01	0.027	0.019	
Baseline NH ₃ (2020-22)	0.01	0.01	0.028	0.01	NA	0.012	0.022	0.015	
Chlorophyll a ⁴	2008	3.5	3.7	3.1	3.4	3.6*	3.2*	9.45	4.3
	2009	4.1*	7.4*	4.6*	4.4*	4	3.7	9.05	5.4
	2010	3.9	4	3.9	4	3.6	3.9	10.1	4.8
	2011	5.3*	3*	3.4*	3.6*	4.5*	4.9*	15.9*	5.8
	2012	2.3*	2.1*	2.4*	2.7	2.6	2.5	8.9	3.5
	2013	5.1*	5.2*	4.4*	3.8*	4*	3.7*	11.2*	5.3
	2014	4.9	5.3	4.7	4.5	4.5	5.2	16.1	6.4
	2015	5	4.7	4.5	5	5.3	4.8	12.1	5.9
	2016	4.1*	3.9*	4.1*	4.1*	4.8*	4.8*	16.4*	6
	2017	4	3.3	3.2	3.7	3.4	3.4	12.8	4.8
	2018	3.7	4.9	3.4	3.8	4	4.3	16.7	5.8
	2019	4.2	4.5	4	2.9	3.7	4.7	11.7	5.1
	2020	4.9*	8.3*	3*	3.2*	No data	8.4*	3.9*	5.3
	2021	5.4	4*	3	2.8		8.4	12	6
2022	2.9	2.9	2.4	2.4	2.6		2.6	10.1	3.7

³ Please note Limit of Detection can be inconsistent from year to year in available chemistry monitoring data, no. of samples taken per year is also variable (3 or 4)

⁴ Growing season (March to October) mean value. A minimum of 4 samples distributed throughout the growing season is required in any one year, * = year where only 3 samples taken. It should be noted that phytoplankton biomass (chlorophyll) should be used with caution for assessing lake ecological and trophic status when zebra mussels are present (S.I. No. 77 of 2019)

Baseline Chlorophyll a (2020-22)	4.4	4.9	2.8	2.7	NA	6.3	9.1	4.9
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2.1.1. Macrophyte Monitoring Stations – M_1 to M_11 (LS260155a30000100 to LS260155a30000200)

Data summary:

- These 11 stations were on the 2019-2021 Operational Monitoring Programme for macrophyte monitoring. The WFDApp has not published the most recent monitoring programme.
- Both the 2013-2018 and 2016-2021 Moderate ecological status are driven by macrophyte status and hydromorphological conditions both of which are at Moderate status.
- Macrophyte status has been a driver of status for some time; Moderate in the 2010-2015 period, an improvement from Poor in the 2010-2012 period, a deterioration from Moderate in the 2007-2009 period.
- Status details for hydromorphological conditions is only included in the most recent 2013-2018 and 2016-2021 periods. The EPA have advised that the MImAS classification for the lake was largely driven by the sluice gates at Bellantra Bridge which were characterised as having an effect on the water level between 1 and 3 metres, other pressures identified on the lake include plantation forestry in the catchment, soft bank engineering on the shore, recreation pressure and modified shoreline vegetation.

2.1.2. Supporting Chemistry Stations (Site 1 to Site 7 (LS260155a30000010 to LS260155a30000070)) and Phytoplankton Monitoring Stations (Site 3 to Site 5 (LS260155a30000030 to LS260155a30000050))

Data summary:

- Site 1 to Site 7 were on the 2019-2021 Operational Monitoring Programme for supporting chemistry monitoring 4 times annually, while Site 3 to Site 5 were also being monitored for phytoplankton status twice annually. However, there is no chemistry data available for Site 5 from 2020-2021. For 2020 only 3 annual results are available for sites 1-4, 6 and 7. The lake is not monitored for specific pollutants, priority substances, fish status or phytobenthos status. The WFDApp has not published the most recent monitoring programme.
- Phytoplankton status is at Good for the 2016-2021 period and was also at good for the 2013-2018, 2010-2015 and 2010-2012 periods, a deterioration from High in the 2007-2009 period. It should be noted that phytoplankton biomass should be used with caution for assessing lake ecological and trophic status if zebra mussels are present.⁵
- Data available from 2007-2022 for ammonia and from 2008-2022 for chlorophyll_a show annual averages for Lough Allen as a whole (all sites combined) are below their respective Ecological Quality Standards (EQS), shown in Figure 6 & 7 below. Data available from 2008-2022 for total phosphorus (TP) show an upward trend in annual average concentrations over time, with the EQS of 0.025mg/l P being met in 2020 and the threshold being breached in 2021, with an annual average of 0.034 mg/l N, see Table 3 above and Figure 5 below. It should be noted that 2020 and 2021 are the years no data is available for site 5, so the annual average is over 6 sites rather than 7.
- Site 7, located in the southerly section of Lough Allen, south of the Shannon (Upper)_040 outlet (see Fig. 8), is identified as having current and historical TP and chlorophyll_a issues (see Table 3). Ammonia concentrations tend to be higher at site 7 than other sites, albeit still falling below the EQS. Site 7 is discussed further below.

⁵ S.I. No. 77 of 2019 (Table 8 - Biological quality elements)

- A notable jump in the lakes overall annual average TP occurred from 2020-2022. The TP issue at Site 7 worsened while breaches of the EQS were also noted at Site 1, Site 2, Site 5 and Site 6. Excepting Site 7, Site 6 tended to have higher concentrations of TP, followed by Site 1, see Figure 6. Site 6 is in the southern section of the lake, just north of Inisfale Island, where the lake narrows before flowing into the Shannon (Upper)_040 outlet. Site 1 is in the northwest of the lake near the Owengar River inflow which transported sediment to the lake from the June 2020 landslide initiating in the Diffagher_010.

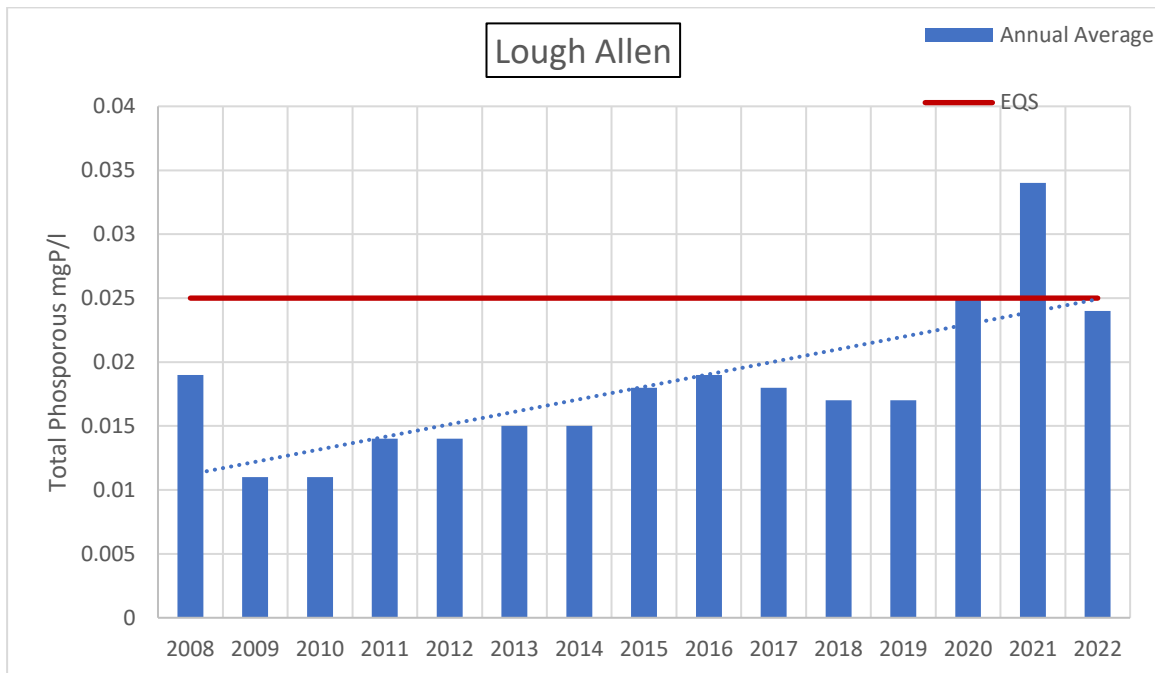


Figure 5 Total Phosphorous annual average trend for Lough Allen (all sites combined).

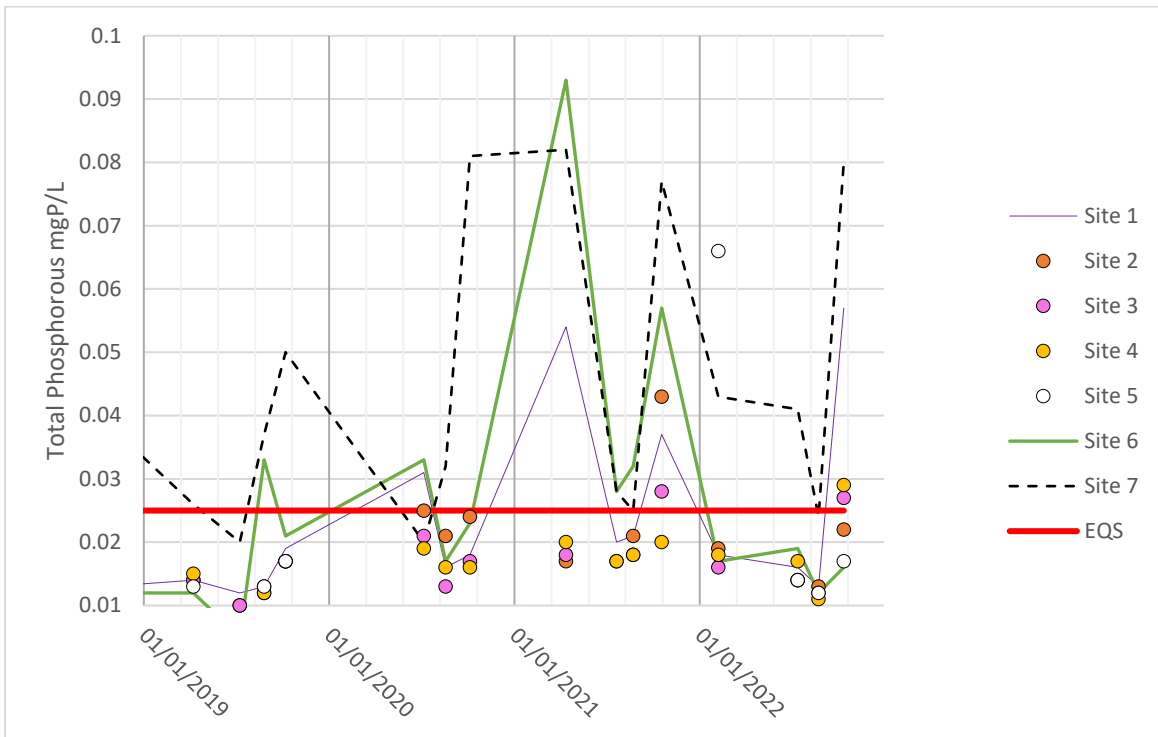


Figure 6 Total Phosphorous temporal data for Lough Allen Sites 1-7 from 2019-2022.

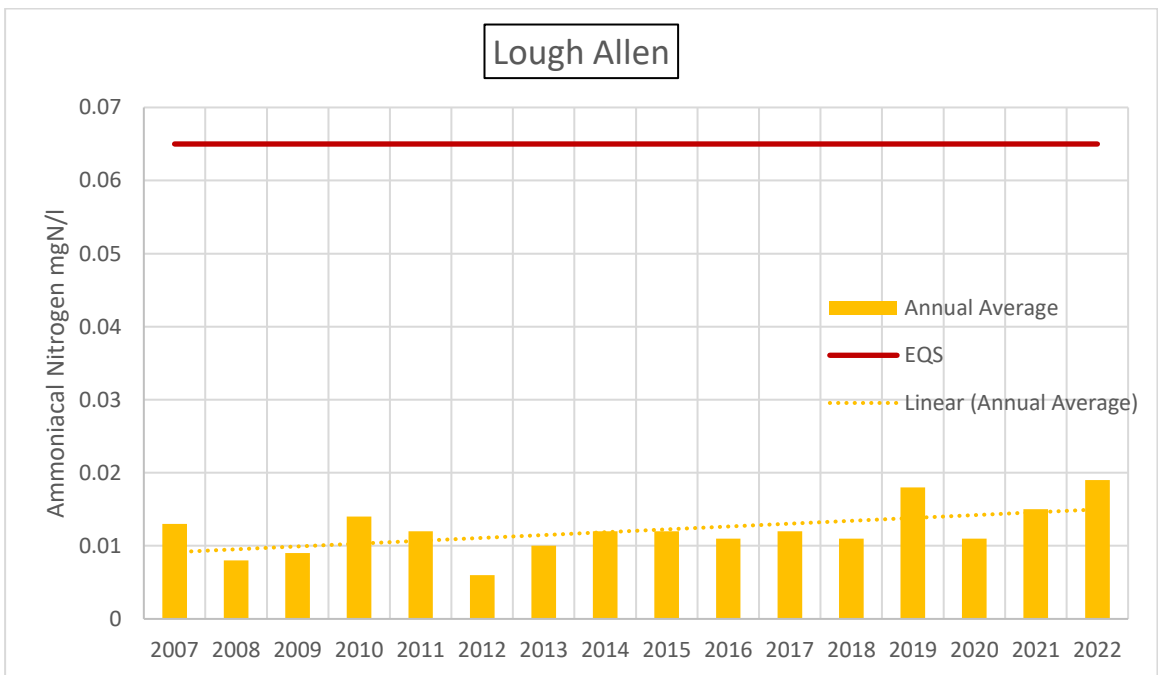


Figure 7 Ammonia annual average trend for Lough Allen (all sites combined).

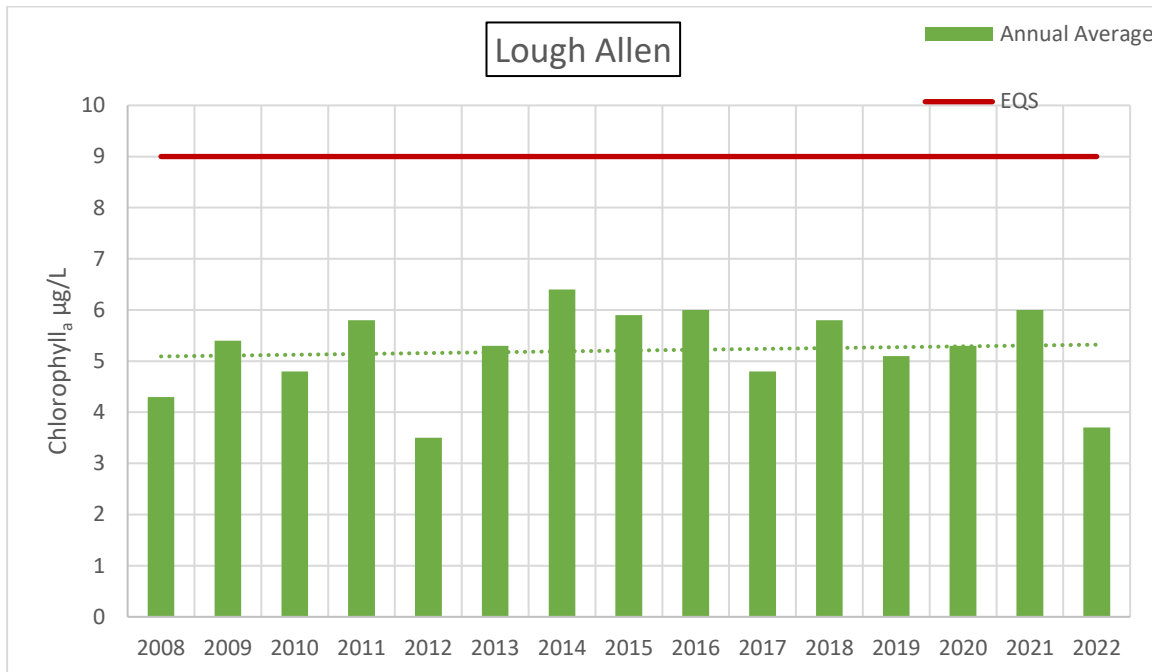


Figure 8 Chlorophyll_a annual average trend for Lough Allen (all sites combined).

2.1.3. Site 7

Figure 9 is a screenshot from EPA Maps, available at <https://gis.epa.ie/EPAMaps/Water>, showing flow arrows indicating that the Drumshanbo Stream, which is at Poor Ecological Status, may be impacting Site 7, this will be investigated as part of the LCA. The possibility of impact from the Lough Allen Canal will also need to be investigated.

Temporal TP results for Site 7 are shown in Figure 10 with an upward trend over time. Roughly 60% of the time the annual peak concentration at Site 7 was sampled in September-November (sampling is 3-4 times annually, typically from April to October, however in 2012 the 4th sample of the year was taken on the 5th of November). Roughly 80% of the time the lowest annual concentration at Site 7 was taken in April-July.

Figure 11 shows that chlorophyll_a spikes at Site 7 tend to be in the first two samples of the year, typically April and July, except for 2014 and 2018 when concentrations were high throughout the growing season, including into September and October. Ireland saw drought conditions throughout the summer of 2018 and late summer drought conditions in 2014 which may account for this extended period of high concentrations of chlorophyll_a in these years. In 2021 and 2022 sample 3 of the year had spikes in chlorophyll_a concentrations, both samples were taken in late August. In 2021 this followed a hot July with both thundery and dry spells and a drier August with above average temperatures also, in 2022 this followed a drier than average and very hot July and August⁶. The available data (Fig. 12) shows no obvious, consistent relationship between TP and chlorophyll_a. Nov-Mar TP concentrations, which are unavailable in this dataset, may provide greater explanation of why and when chlorophyll_a concentrations are at their highest, otherwise, patterns of phosphorous release from the lake bed sediment may be interfering with generally expected seasonal patterns.

⁶ [Annual Climate Statement for 2022 - Met Éireann - The Irish Meteorological Service](#)
[Annual Climate Statement for 2021 - Met Éireann - The Irish Meteorological Service](#)

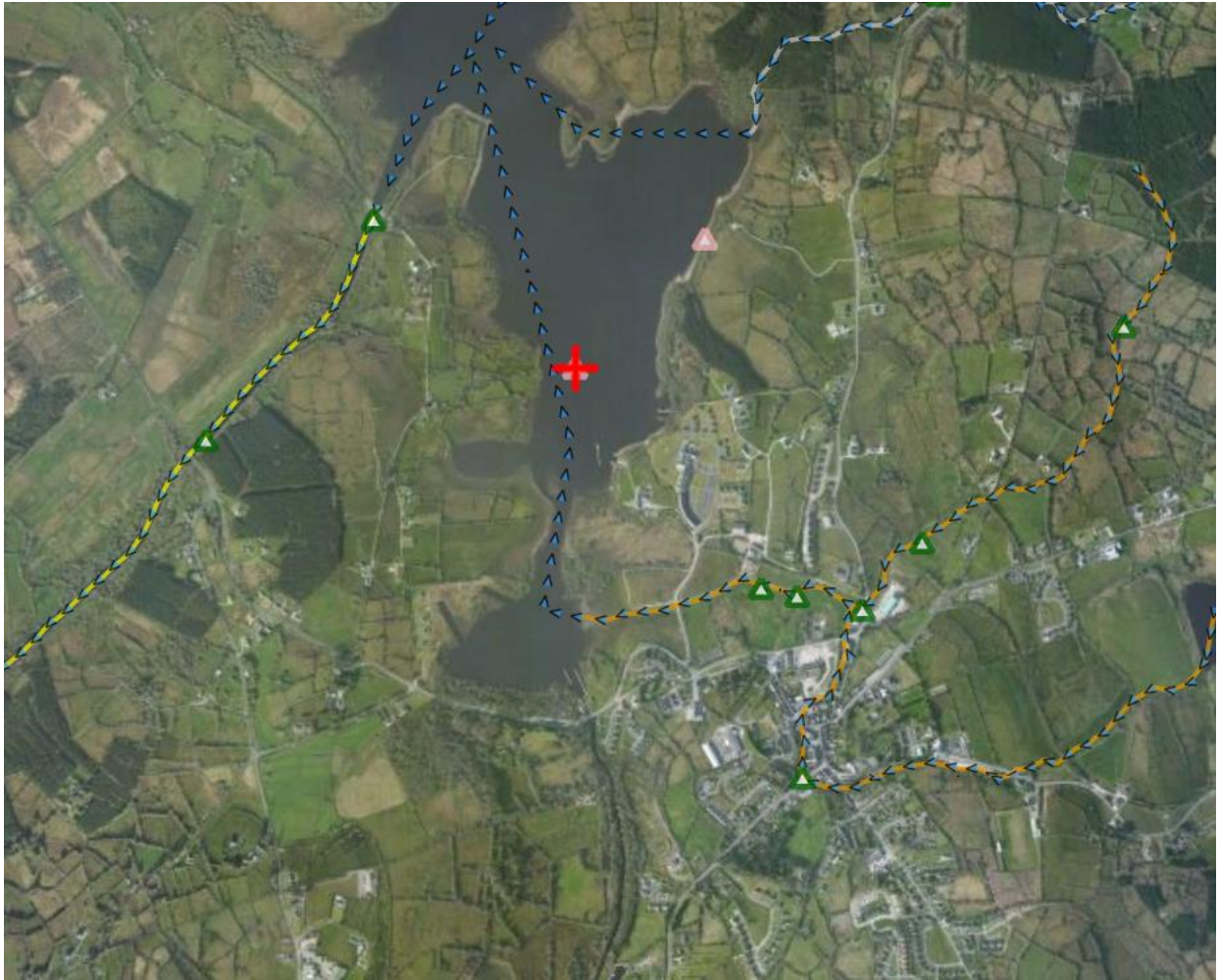


Figure 9 Taken from EPA Maps, showing the southern section of Lough Allen near Drumshanbo, Site 7 is highlighted with a red cross and river flow direction is shown for the Drunshanbo Stream_010 flowing in from the east coloured orange for Poor Ecological Status.

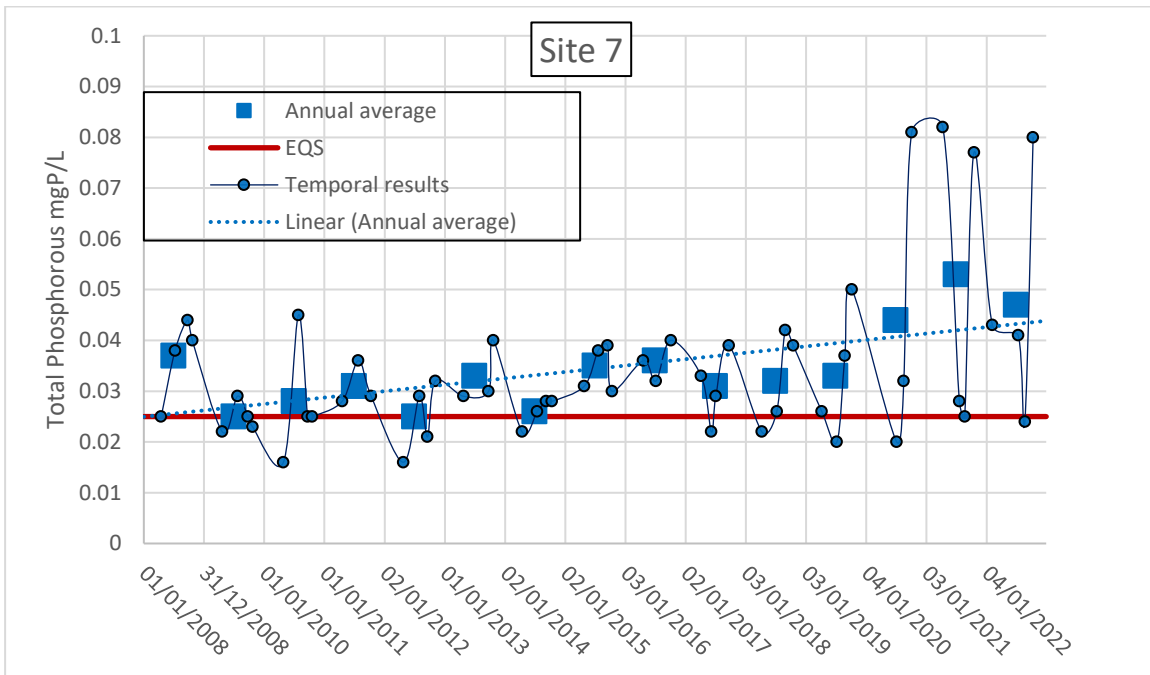


Figure 10 Total Phosphorous trend for Site 7 (LS260155a30000070) on Lough Allen.

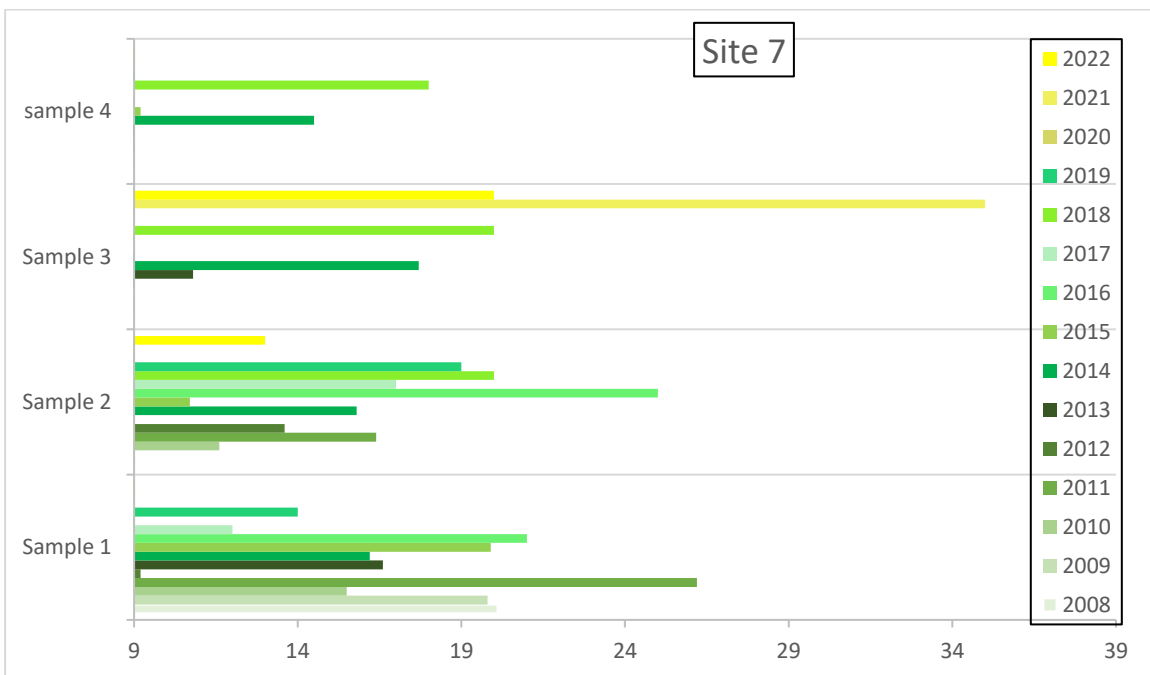


Figure 11 Chlorophyll-a results above 9µg/L by time of year sampled at Site 7 (LS260155a30000070) on Lough Allen.

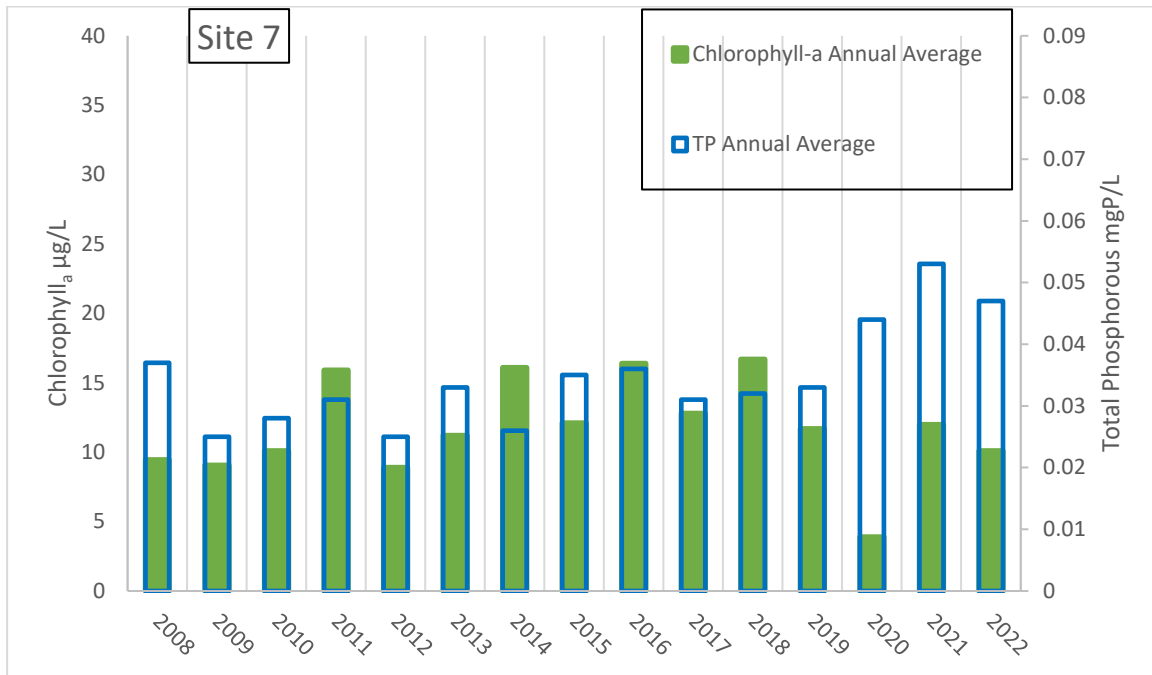


Figure 12 Relationship between total phosphorous and chlorophyll-a for Site 7 (LS260155a30000070) on Lough Allen.

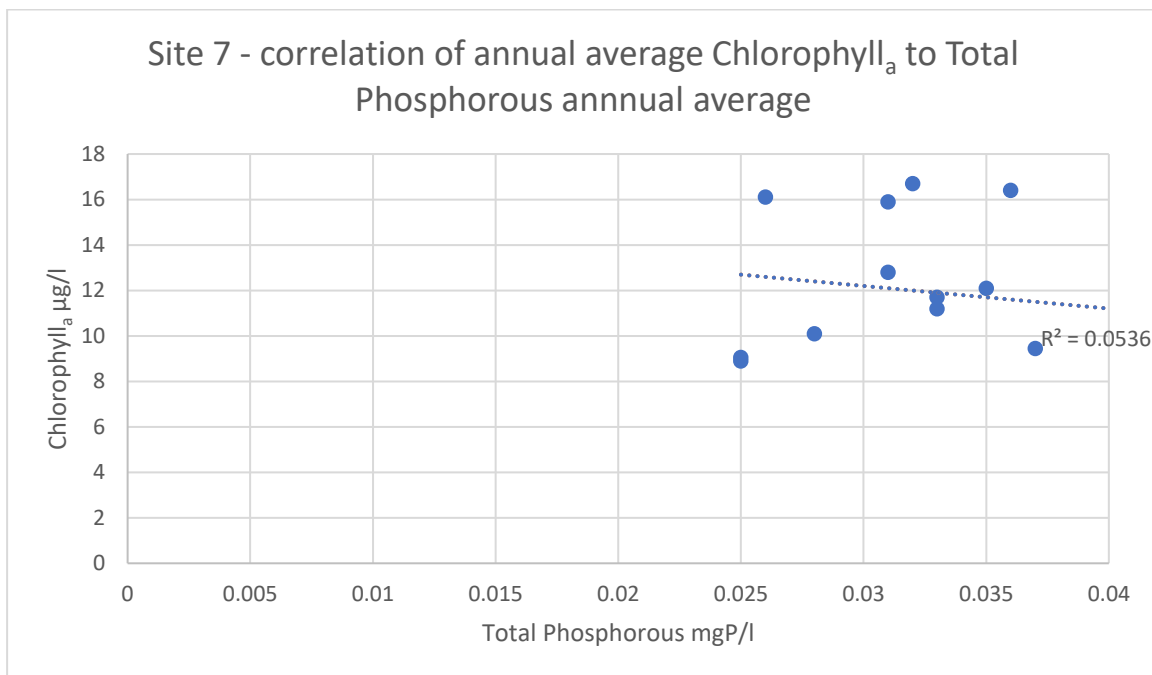


Figure 13 Correlation between annual average concentrations of Chlorophyll_a and Total Phosphorous at Site 7 on Lough Allen is very weak.

2.2. River waterbodies of Lough Allen PAA

Table 4 Receptor information for river water bodies in Lough Allen PAA, where data is available, and the Owennayle_020 and Owengar (Leitrim)_020.

Waterbody		OWENNAYLE_020 IE_SH_26O050100	OWENGAR (LEITRIM)_020 IE_SH_26O020200	Drumshanbo Stream_010 IE_SH_26D050400			SHANNON (Upper)_040 IE_SH_26S020500		
Risk Category		Not at Risk	Not at Risk	At Risk			At Risk		
Monitoring stations		Br d/s Owennayle Br (RS26O050100)	Bridge at Annaghgerry (RS26O020200)	U/S Drumshanbo WW (RS26M800930)	150m d/s STW outfall (RS26D050300)	300 m d/s Sewage Trtmt Works (RS26D050400)	Battle Br (RS26S020500)		
Station type		Operational	Operational	Investigative	Operational	preWFD	Operational/Surveillance		
Location		u/s Lough Allen	u/s Lough Allen	u/s Lough Allen	u/s Lough Allen	u/s Lough Allen	d/s Lough Allen		
Biological Status									
Q values	2008	4	4.1 (Sediment)	-	3.1 (Sediment)	-	4		
	2011	-	4		3.5		4		
	2014	4	4.5		3		4		
	2017	3.5	4		3		4		
	2020	4.5	4.5		3.5		4		
Water chemistry⁷									
PO ₄ ⁸	2007	-	0.029 (June: 0.145)	-	0.087 (Apr, May, Jun)	-	-		
	2008	0.036 (Aug: 0.13)	0.015		0.069 (Jun, Jul)		0.012		
	2009	0.007	0.019		0.053 (Jan, Apr, Oct)		0.01		
	2010	0.005	0.017		0.068 (Jun: 0.202)		0.012		
	2011	0.014	0.013		0.041 (Jun: 0.08)		0.011		
	2012	0.007	0.013		0.016*		0.029	0.046* (Jul: 0.225)	0.013 (May: 0.117)
	2013	0.005	0.01		0.024*		0.019	0.032* (Oct: 0.11)	0.008
	2014	0.008	0.014		0.014*		0.015	0.026*	0.007
	2015	0.008	0.008		0.018*		0.023	0.026*	0.007
	2016	-	0.043 (Mar: 0.16)		0.023		0.113 (May, Aug)	0.05 (Jun: 0.28)	0.009
	2017	-	0.015		0.025		0.074 (Jun: 0.27)	0.043 (May: 0.135)	0.01
	2018	-	0.014		0.019		0.075 (Jun, Oct)	0.121 (Jun-Jul)	0.008
	2019	-	0.017		0.018		0.072 (May-Jun)	0.04 (Jul, Sep)	0.009
2020	-	0.012	0.023	0.318 (Jun, Sep)	0.2 (May, Jun)	0.006			
2021	0.012	0.011	0.018	0.023	0.023	0.008			
2022	0.008	0.011	0.027 (May: 0.092)	0.079 (Mar: 0.25)	0.027	0.008			

⁷ Please note Limit of Detection can be inconsistent from year to year in available chemistry monitoring data and number of samples taken per year can vary from 3-36. Months where temporal results at or above 95%ile are noted in brackets beside annual average figure.

⁸ Ortho-phosphate (unspecified), *=ortho-phosphate (filtered)

Baseline PO ⁴⁺		0.01 (21-22)	0.011 (20-22)	0.023 (20-22)	0.127 (20-22)	0.085 (20-22)	0.007 (20-22)
NH ₃	2007	-	0.042 (June: 0.144, , July: 0.15)	-	0.066 (May: 0.171)	-	-
	2008	0.01	0.035	-	0.091 (Jun, Jul)	-	0.022
	2009	0.005	0.042 (Jan: 0.223)	-	0.144 (Jan, Oct)	-	0.02
	2010	0.022	0.007	-	5.728 (Mar, Jun(22.7))	-	0.014
	2011	0.037	0.012	-	0.034	-	0.014
	2012	0.014	0.023	-	0.054	0.088 (Jun, Jul, Oct)	0.017
	2013	0.01	0.018	-	0.049	0.114 (Oct-Nov)	0.022
	2014	0.01	0.027	-	0.031	0.398 (Jun-Jul)	0.022 (Jun: 0.153)
	2015	0.015	0.028	-	0.029	0.085 (Apr, Aug)	0.03
	2016	-	0.37 (Mar: 1.8)	-	0.038	0.761 (May: 3.6)	0.032 (Mar: 0.173)
	2017	-	0.018	-	0.061	0.036	0.015
	2018	-	0.018	-	0.03	0.108 (Oct: 0.44)	0.021 (Aug: 0.163)
	2019	-	0.016	-	0.051 (Jan:0.14)	0.088 (Jun: 0.32)	0.389 (Jan-Feb, Jul)
	2020	-	0.02	-	0.041	0.073 (Sep: 0.18)	0.052
2021	0.013	0.013	-	0.037	0.022	0.137 (Apr, Jun, Oct)	
2022	0.013	0.012	-	0.061 (May: 0.183)	0.057 (Mar: 0.15)	0.049 (Aug)	
Ecological Threshold	0.065	-	-	-	-	-	-
Baseline NH ₃		0.013 (21-22)	0.015 (20-22)	0.046 (20-22)	0.049 (20-22)	0.079 (20-22)	0.019 (20-22)
TON ⁹	2007	-	0.13	-	1.85 (Jun: 8)	-	-
	2008	0.03	0.08	-	0.43	-	0.21
	2009	0.05	0.1	-	0.74	-	0.17
	2010	0.04	0.24	-	0.49	-	0.18
	2011	0.09	0.03	-	1.1	-	0.14
	2012	0.07	0.12	-	1.06	-	0.18
	2013	0.06	0.05	-	0.31	-	0.19
	2014	0.04	0.06	-	0.27	-	0.19
	2015	0.03	0.31	-	0.47	-	0.13
	2016	-	0.18	-	0.18	-	0.14
	2017	-	0.12	-	1.53 (Jun: 6)	-	0.15
	2018	-	0.19	-	0.66	-	0.11
	2019	-	0.25	-	1.73 (May: 5.9)	-	0.21
	2020	-	0.1	-	2.27 (Jun: 7.5)	-	0.12
2021	0.1	0.13	-	0.46	-	0.13	
2022	0.15	0.14	-	2.95 (Mar (5), Sep(7.1))	-	0.48	
Ecological Threshold	3.5	-	-	-	-	-	-
Baseline TON		0.12 (21-22)	0.12 (20-22)	-	1.87 (20-22)	-	0.24 (20-22)
-	2007	-	1.7	-	2.4 (Apr-Jun, Aug, Nov)	-	-
	2008	1.7	1.6 (Oct: 3.2)	-	2.2 (Jun-Jul, Oct)	-	1

⁹ Months where temporal results at or above 3.5 mgN/L are noted in brackets.

BOD ¹⁰	2009	1.7	1.2		2.2 (Jan, May-Jul, Oct)	0.7	
	2010	1.8 (Jun: 3)	1.8 (Mar: 2.9)		5.5 (Mar, Jun(15.25))	1 (Sep, Dec)	
	2011	2.2 (Nov: 4)	1.7		2.5 (Sep, Nov)	1.2 (Jan: 6.3)	
	2012	1.4	1.6			0.8	
	2013	1.9 (Mar: 3)	1.5		1.5 (Oct: 2.91)	2.9 (Apr, Oct)	2.1 (Jun, Jul, Oct)
	2014	2.3 (Sep: 3)	1.6		1.6 (Oct: 4.34)	2 (Jul: 3.21)	2.1 (Sep-Nov)
	2015	1.2	1.6		1.6 (Aug: 3.72)	1.6	1.8 (Aug, Nov)
	2016		1.6		2.2 (Jun-Sep)	2.6 (Jan, Jul)	2 (Jul-Aug, Sep)
	2017		2.5 (Mar: 8.2)		2 (Jun: 4.2)	3.3 (Mar, May-Jun)	1.9 (Feb: 2.61)
	2018	-	0.5		1.4	1.7	1.5
	2019		0.7		1.2	1.4 (May: 2.8)	1.3
	2020		0.8		1	1.7 (Sep: 2.6)	1.7 (Jul: 6.2)
2021	0.8	0.5		1.7 (Oct, Nov)	2	1.9 (Oct, Nov)	
2022	0.7	0.8		1.4	2 (Jul: 3.9)	1.6 (May: 2.8)	
Baseline BOD	0.7 (21-22)	0.7		1.7 (Jul, Sep)	1.5	1.3 (Jul: 3.9)	
		0.6 (20-22)		1.6 (20-22)	1.8 (20-22)	1.6 (20-22)	
HYMO	MQI V2 Good	WB: Hydromorphological conditions Good 2016-2021 At MP: MQI V2 Good		MQI V2 Moderate	MQI V2 Poor	MQI V2 Poor	
Comments	Monitoring station at d/s limit of rwb as it flows into Shannon (Upper)_030	This MP is not located in stretch impacted by 2020 landslide, it is u/s of the confluence with the Diffagher channel		u/s Drumshanbo Mart Section 4 and all UWW emission points	<50m d/s of UWW primary effluent emission point	Approx. 100m d/s UWW primary effluent emission point	
Conceptual model required (Y/N)	Y	Y		Y			
Ecological Status (2016-21)	High	Good		Moderate			
						Moderate (Benzo(a)pyrene Failure for Chemical Status)	

¹⁰ Please note BOD detection limit varies but can be higher than or at the EQS (<2, <1.6, <1.5), therefore annual average figures should be interpreted with caution. Temporal results at or above 2.6 mgO₂/L (95%ile) are noted in brackets.

<p>EPA Biologist comments 2017</p>	<p><i>“A decline to moderate conditions was noted in the lower section [of Owennayle] (0100) where cattle access may lead to unnecessary nutrient loadings. This is the lowest condition this formally high ecological condition site has been in since monitoring started in 1976.”</i></p>	<p><i>“Good ecological conditions were present at all sites on the Owengar in 2017, despite upper tributaries being affected by severe scouring due to a major flood and a landslide/bog burst that occurred in mid-August 2008, on the watershed between the Owengar and Arigna catchments. Extensive fishery enhancement was carried out in 2014 on the upper station (0075). The lower site (0200) declined from high to good conditions with numerous individuals of pollution tolerant taxa noted.”</i></p>		<p>“The lack of pollution sensitive macroinvertebrate species continues to indicate poor quality in 2017”</p>		<p>“The Upper Shannon was satisfactory and unchanged since last surveyed from station 0100 to 0500 i.e. from the Shannon Pot to Battle Bridge.”</p>
<p>EPA Biologist comments 2020</p>	<p><i>“A welcome return to satisfactory condition was noted on the Owennayle river in 2020. The upper site (0050) was dominated by stonefly which are a sensitive taxon and the site was at Q4 good ecological condition. Acidic condition and agricultural pressures in the catchment are still a concern here. Further downstream at 0100 the site was at Q4-5 high ecological condition with both stonefly and mayfly occurring in good numbers”</i></p>	<p><i>“The three sites on the Owengar (0075, 0100 and 0200) remained at satisfactory condition in 2020 with two of the sites (0100) and (0200) achieving high ecological condition.”</i></p>		<p>“The site 0300 downstream of the STW on the Drumshambo stream showed signs of improvement this year from Q3 to Q3-4. Good numbers of Heptageniidae were present but the occurrence of tolerant taxa in high numbers prevented the stream from achieving satisfactory condition.”</p>		<p>“Satisfactory conditions remained in the uppermost sites on the Upper Shannon in 2020.”</p>
<p>Significant issue</p>	<p>t.b.d. -Historic data (2008-15) indicates BOD issue</p>	<p>-June 2020 issues d/s of MP due to landslide -Historic BOD issue (2007-16) -Historic (March 2016) pollution incident with high phosphate, ammonia and BOD</p>	<p>-Occasional elevated ammonia concentrations - high phosphate and ammonia 17th May 2022 -BOD issue</p>	<p>-Phosphate -Ammonia -TON -BOD -Historic (2008) Q records sediment</p>	<p>-Phosphate (improvement 2021-2022) -Ammonia -BOD</p>	<p>-Fish -Occasional elevated ammonia concentrations -Benzo(a)pyrene Failure for Chemical Status</p>

2.2.1. Owennayle_020: Monitoring station - Br d/s Owennayle Br (RS26O050100)

The Owennayle_020 is upstream of the Shannon (Upper)_030 and although it was not included in the PAA at 2nd Cycle Initial Characterisation Assessment stage it has been considered here at desk study stage as it deteriorated to moderate ecological status in the 2013-2018 period, driven by a 2017 Q assessment, from previously meeting its good status objective (subsequent Q assessment in 2014). The main channel of the *Owennayle* river is the boundary between Co. Cavan to the east and Co. Leitrim to the west in this area (see Fig. 14 & Fig. 3). The EPA ecologist noted the following in 2017:

A decline to moderate conditions was noted in the lower section [of Owennayle] (0100) where cattle access may lead to unnecessary nutrient loadings. This is the lowest condition this formally high ecological condition site has been in since monitoring started in 1976.

The 2020 Q assessment showed a recovery, driving the 2016-2021 Ecological Status up to High. The EPA ecologist noted the following:

A welcome return to satisfactory condition was noted on the Owennayle river in 2020. The upper site (0050) was dominated by stonefly which are a sensitive taxon and the site was at Q4 good ecological condition. Acidic condition and agricultural pressures in the catchment are still a concern here. Further downstream at 0100 the site was at Q4-5 high ecological condition with both stonefly and mayfly occurring in good numbers.

It has one monitoring station, *Br d/s Owennayle Br* (RS26O050100), which is at the downstream limit of the waterbody as it flows into the Shannon (Upper)_030 (a waterbody with no currently monitored stations). Despite the 2020 recovery the waterbody is still listed as *At Risk*, with two significant pressures being added at 3rd Cycle Initial Characterisation Assessment (See Significant Pressures below). Approx. 5.5km upstream, in the headwaters, is the *Br NE of Aughrim* (RS26O050050) monitoring point at the downstream limit of the Owennayle_010, which is *At Risk* and had 2013-2018 moderate ecological status, driven by invertebrate status which had been at moderate since 2005. The 2020 Q assessment showed a recovery, driving the 2016-2021 ecological status up to good. There is an IA7 (multiple sources in multiple areas) on this waterbody, the description reads: *local catchment assessment needed to be carried out, with emphasis on forestry and possible sources of sediment*, with the responsible organisation being listed as Leitrim Co. Co.

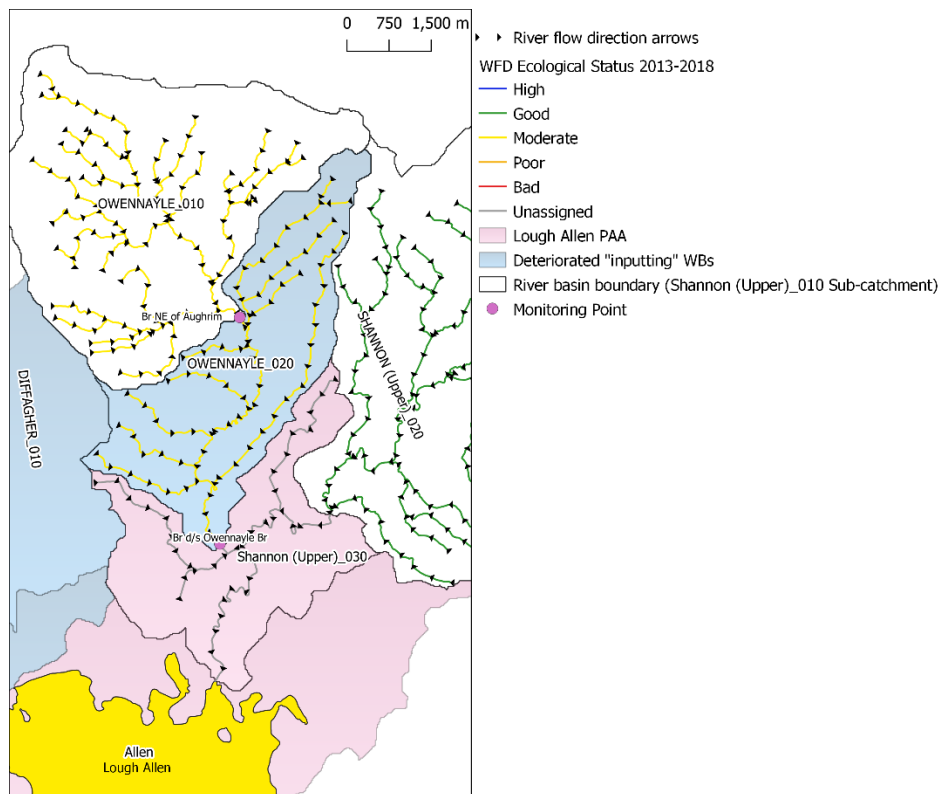


Figure 14 Owenayle_010 and Owenayle_020 river waterbodies in relation to the Lough Allen PAA.

Data summary:

- The Owenayle_020 is an *At Risk* waterbody.
- It had been included on the 2019-2021 Operational Monitoring Programme for Q value assessment alone.
- The latest Q assessment carried out in 2020 scored 4.5 (see Fig. 15), driving the 2016-2021 Ecological Status up to High
- Supporting chemistry data is available from 2008-2015 and from 2021-2022. Ortho-phosphate, ammonia and TON annual average results are below their respective EQS/ecological threshold, however, BOD annual averages breach the EQS from 2008-2011 and from 2013-2014 (Fig. 16). Chemistry results from upstream in the Owenayle_010, available from 2007-2015, also show BOD temporal results either matched the result downstream in Owenayle_020 or are lower (Fig. 17), suggesting BOD issues were being carried downstream from Owenayle_010, but there is also an additional source in the Owenayle_020, otherwise BOD concentrations would be expected to be diminished at the Owenayle_020 monitoring point, approx. 5.5km downstream from the Owenayle_010 monitoring point, due to dilution from tributaries and oxygenation of the stream waters from the atmosphere.

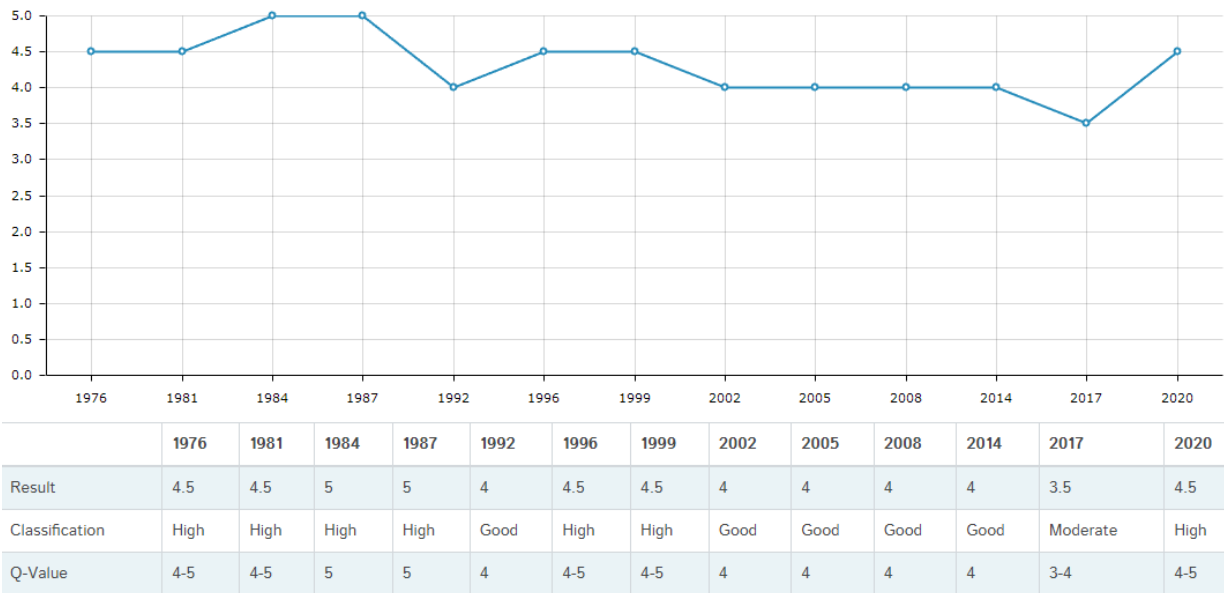


Figure 15 Q value trend for the Owennayle_020 at Br d/s Owennayle Br (RS26O050100).

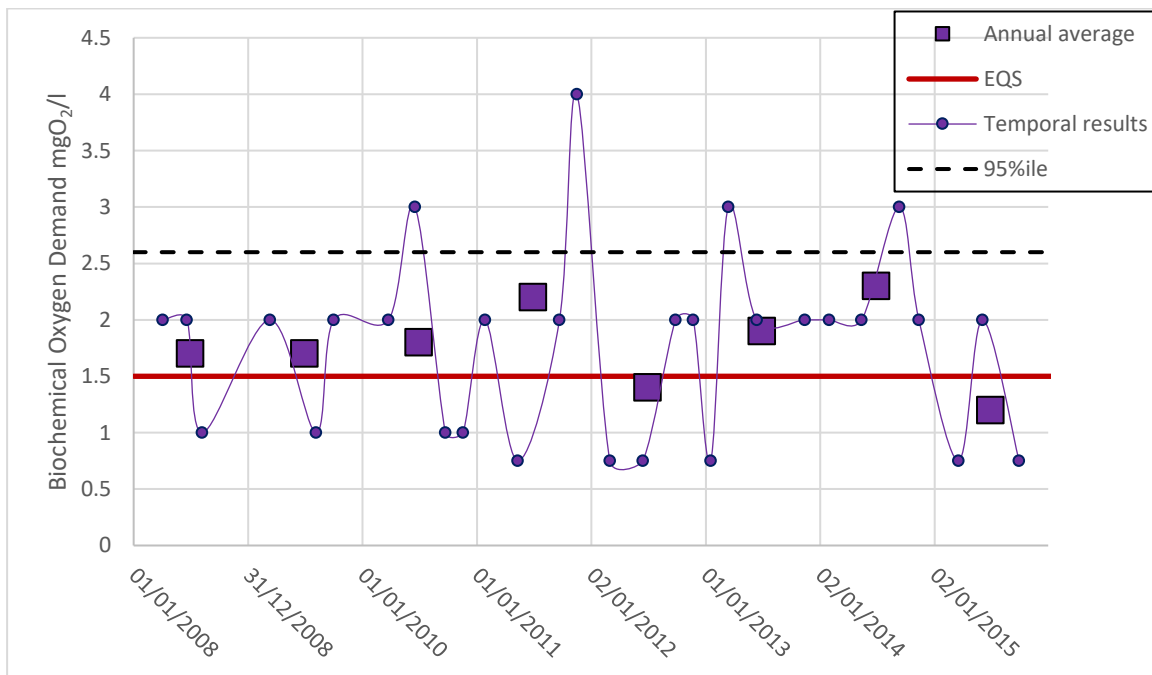


Figure 16 2008-2015 BOD data for monitoring station Br d/s Owennayle Br (RS26O050100) on the Owennayle_020.

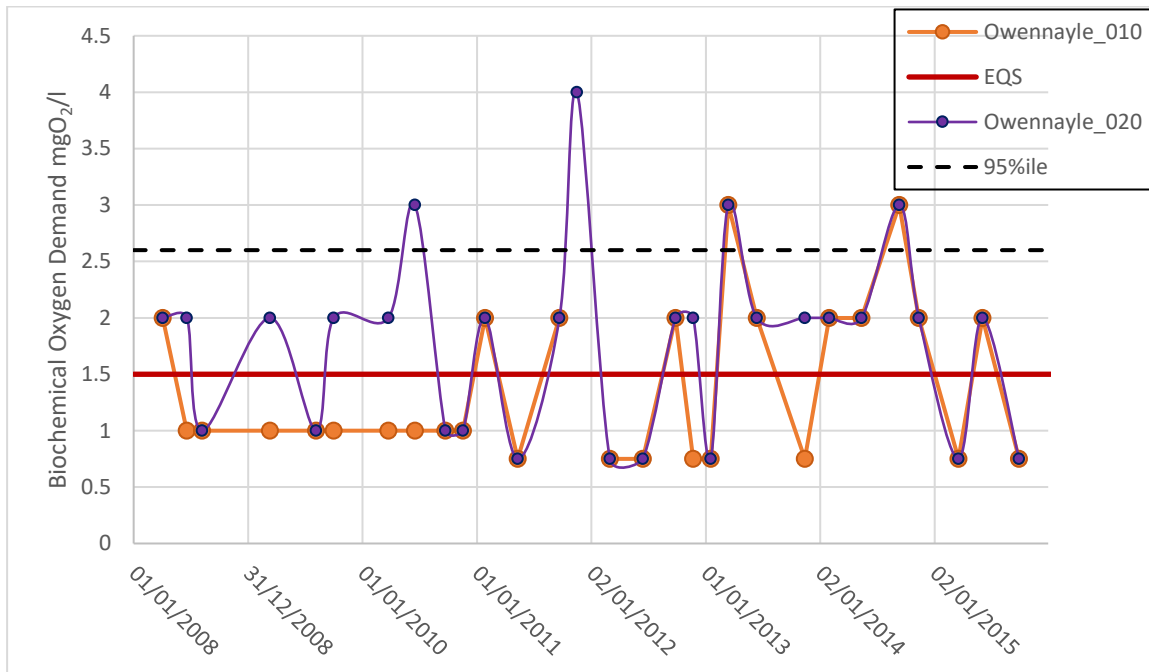


Figure 17 Comparison of temporal BOD data from the Owennayle_010 and the Owennayle_020.

2.2.2. Diffagher_010 and Owengar (Leitrim)_020

The Diffagher_010 has no inflowing waterbodies and flows into the Owengar (Leitrim)_020 before it discharges to Lough Allen at Corry Bay in the NW corner of the lake (Fig. 18). The Owengar (Leitrim)_020 is downstream of the Owengar (Leitrim)_010 which has the Gowlaunrevagh_010 as an inflowing stream. Both river waterbodies are in Co. Leitrim and have been added to the PAA at desk study stage as they were impacted by the 2020 June 28th landslide, discussed below under section 3.6.1 *landslide 28th June 2020*. Ecological status in the 2013-2018 period for both waterbodies was good, driven by 2017 Q assessments and both waterbodies were considered *Not at Risk* having met their good status objective since the 2007-2009 reporting period. Ecological Status deteriorated to Moderate in the Diffagher_010 in the 2019-2021 period and it is now considered *At Risk*. The Owengar (Leitrim)_020 remains at Good Ecological Status but WFD risk is now *Review*.

The Diffagher_010 has three operational monitoring stations, *Br 2 km u/s Main Chan confl* (RS26B300400), *Br u/s Confl with main Diffagher* (RS26K160600) and *Cloonemeone Bridge* (RS26D020200). All three are on the Operational Monitoring Programme 2019-2021 for Q assessment alone, they are not currently, nor have they previously been, monitored for chemistry or supporting chemistry. All three stations had good 2017 Q classifications and Q assessments since the commencement of the WFD Monitoring Programme had been in the range of good-high, however, the 2020 Q assessment at *Cloonemeone Bridge*, conducted after the landslide, showed a deterioration to moderate with sediment noted. Q assessment at *Br u/s Confl with main Diffagher* in 2020 also showed a decline to moderate conditions, this station is located on a tributary of the main channel, it is not along the pathway of the landslide, however where the tributary rises to the north is in close proximity (<200m) from the pathway of the landslide and may be connected via drainage channels, alternatively, this tributary is impacted by a pressure unrelated to the landslide. An improvement was recorded at *Cloonemeone Bridge* in 2021, with a Q assessment of good, the EPA ecologist noted the following:

This site has continued to improve since it was impacted by a landslide which occurred in the upper catchment in July 2020. There was a welcome return of Group A sensitive taxa and the site is in good ecological condition

The *Br u/s Confl with main Diffagher* station was not assessed in 2021.

The Owengar (Leitrim)_020 has one operational monitoring station, *Br at Annaghgerry* (RS26O020200). This monitoring station is located on the *Owengar River* channel upstream of the confluence with the *Diffagher River* channel, it therefore should not be impacted by the 2020 June 28th landslide which initiated in the Diffagher_010 watershed. The 2020 Q assessment recorded high invertebrate status and the ecologist noted the following:

The three sites on the Owengar (0075, 0100 and 0200) remained at satisfactory condition in 2020 with two of the sites (0100) and (0200) achieving high ecological condition.

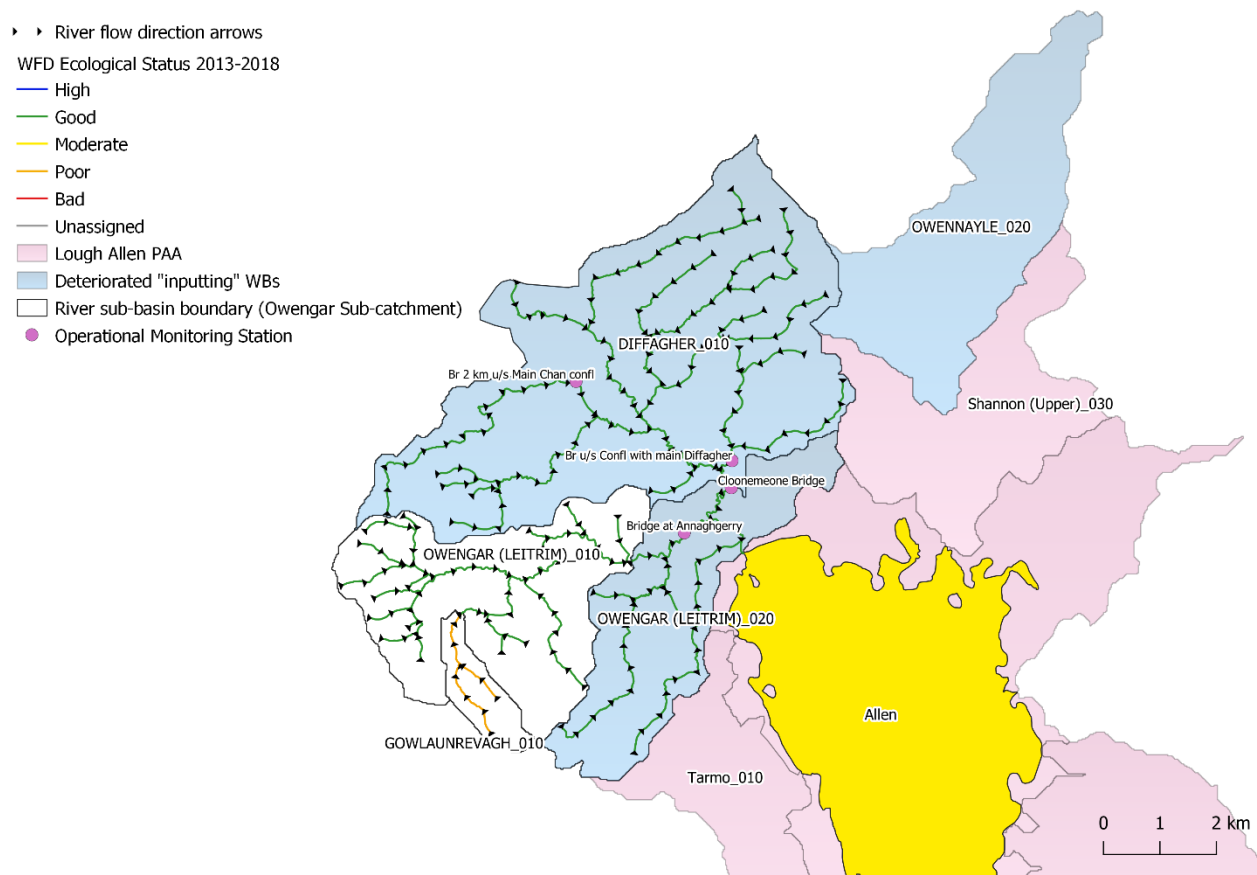


Figure 18 The Diffagher_010 and Owengar (Leitrim)_010 river waterbodies in relation to the Lough Allen PAA.

Chemistry data for *Br at Annaghgerry* (RS26O020200), on the Owengar (Leitrim)_020, is available from 2007-2022 for ortho-phosphate, ammonia, TON and BOD. Ortho-phosphate and ammonia annual averages are below their respective EQS except for 2016 when the annual average EQS values are breached due to high concentrations on the 8th March of 0.16mgP/l ortho-phosphate and 1.8mgN/l total ammonia, a BOD concentration of 8.2mgO₂/l was also recorded for the 8th March 2016, all three

concentrations are the highest recorded temporal values for each parameter in the available dataset. TON annual averages are all below the ecological threshold. BOD annual average values breach the EQS in 2007, 2008, 2010-2012 and 2014-2016 but more recent annual averages from 2017-2019 are well below the EQS.

Data summary:

- The three Operational Monitoring Stations in the Diffagher_010 are on the Operational Monitoring Programme 2019-2021 for Q assessment alone. 2021 Q assessment at the downstream station, *Cloonemeone Bridge* (RS26D020200), showed an improvement to High Status. This station is located along the channel affected by the landslide in 2020, after which a 2020 Q assessment recorded deteriorated moderate conditions with sediment noted (Fig. 19).
- The Owengar (Leitrim)_020 Operational Monitoring Station, *Br at Annaghgerry* (RS26O020200), is located upstream of the confluence with the *Diffagher River* channel, it is therefore not along the pathway of channel affected by the June 28th, 2020, landslide which initiated in the Diffagher_010 watershed. The most recent Q assessment in 2020 recorded high invertebrate status.

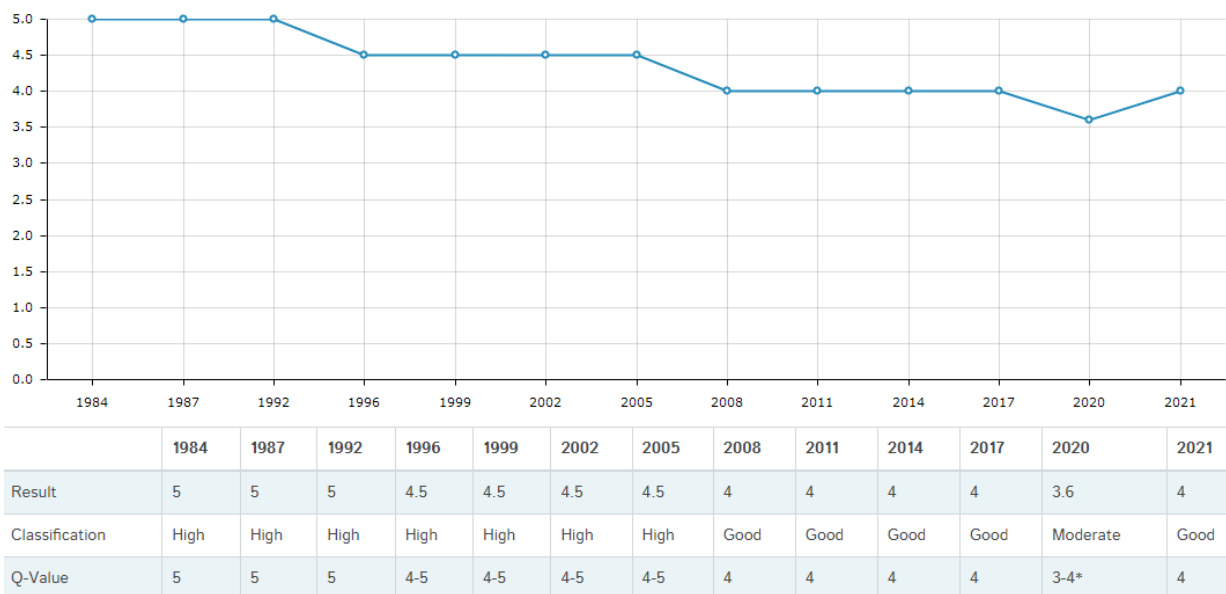


Figure 19 Q value trend for the Diffagher_010 at *Cloonemeone Bridge* (RS26D020200).

2.2.3. Shannon (Upper)_030

The Owennayle_020 and the Shannon (Upper)_020 flow into the Shannon (Upper)_030, from the north and east, respectively, the Shannon (Upper)_030 then flows into Lough Allen (Fig. 14). The Owennayle_020 is the boundary between Co. Cavan to the east and Co. Leitrim to the west, the Shannon (Upper)_020 is in Co. Cavan and the upstream section of the Shannon (Upper)_030 acts as the boundary between Co. Cavan to the north and Co. Leitrim to the south, with the downstream approx. 3.5km section of the waterbody being in Co. Leitrim (see Fig. 3). The Shannon (Upper)_020 is currently meeting its WFD objectives and is considered *Not at Risk*, it is not included in the Lough Allen PAA.

Data summary:

- Shannon (Upper)_030 has a low confidence modelled High 2016-2021 Ecological Status (previously listed as unassigned ecological status) and is a *Review* waterbody for risk status.
- The water body is not on a published monitoring programme and there is no available data on the WFDApp.
- The Dowra Wastewater works (COA) discharges to the Shannon (Upper)_030 and is discussed below under the heading 3.8. *Other pressures*.
- Just north of Dowra village there is a historic waste facility with its own delineated groundwater body, Historic Waste Facility (S22-02567), lying just outside the eastern boundary of the Shannon (Upper)_030 watershed but hydrologically connected via the Glenade Dowra groundwater body. Status is listed as Good and it is considered *Not at Risk*.

2.2.4. Shannon (Upper)_040: Monitoring station – Battle Br (RS26S020500)

The Shannon (Upper)_040 flows into and out of Lough Allen (Fig. 20). The inputting flow to Lough Allen is in Co. Leitrim while the outputting main channel acts as the boundary between Co. Roscommon to the west and Co. Leitrim to the east (see Fig. 3). There is no monitoring point or available data for the inputting section of the river, monitoring is conducted on the outflowing section of the river only, at *Battle Br* (RS26S020500). Moderate ecological status (2013-2018) is driven by fish status alone, in 2017 the EPA ecologist noted:

The Upper Shannon was satisfactory and unchanged since last surveyed from station 0100 to 0500 i.e. from the Shannon Pot [Shannon (Upper)_010] to Battle Bridge.

2020 Q assessment also recorded good status invertebrate conditions.

The description included with the IA1 (responsible organisation is IFI) for this waterbody notes:

Internal review of fish status needed and update from IFI is required. Currently, the Moderate biology status is driven by coarse fish being present. However, for Salmonid species to travel up to this water, they have to travel long distances, etc and therefore, it needs to be determined if the Moderate fish status is appropriate.

The inputting Feorish (Ballyfarnon)_030 is at 2016-2018 Moderate ecological status driven by invertebrate status at a monitoring station upstream of Lough Skean.

A small independent stream in the Shannon (Upper)_040 flows into Acres Lake (Fig. 20) which is at poor ecological status (2013-2018 and 2016-2021) due to macrophyte status, with moderate phytoplankton status, hydromorphological status and supporting chemistry status. The lake sits along the Lough Allen Canal which connects Lough Allen to the Shannon (Upper)_050 approx. 200m downstream of the *Battle Bridge* monitoring point but also with a connection to the Shannon (Upper)_040 approx. 600m upstream of *Battle Bridge* (Fig. 21). Acres is not included in the PAA, the waterbody has an IA9 Further Characterisation Action, the description reads: *Local catchment assessment needed, with a focus on impact of forestry*, with Leitrim Co.Co. being the responsible organisation.

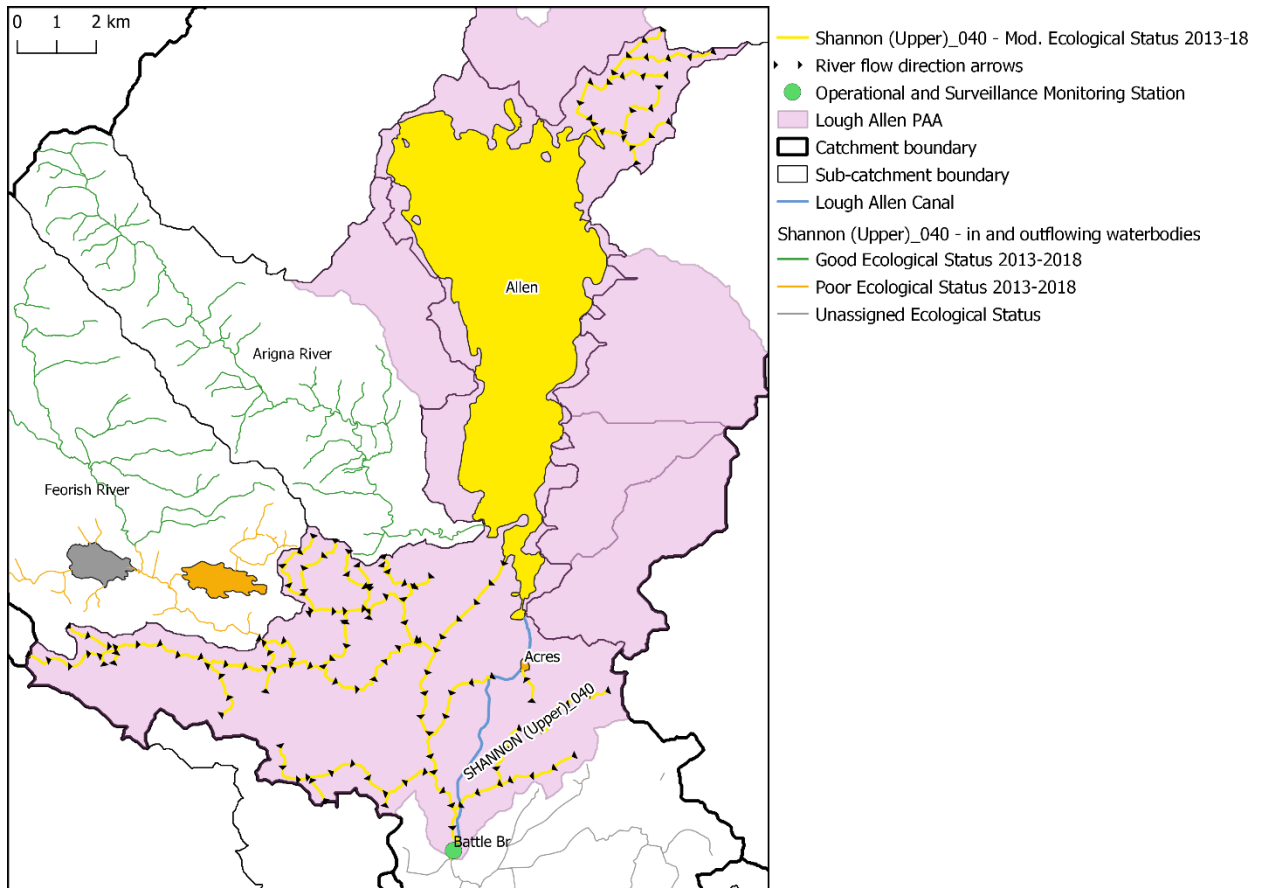


Figure 20 The Shannon (Upper)_040 in relation to Lough Allen, inflowing and outflowing waterbodies and the Lough Allen Canal are also shown.

Map taken from Waterways Ireland Shannon Navigation Guide
<http://wwi.maps.arcgis.com/apps/webappviewer/index.html?id=637dbe0c3ec64403b6e1d8dcf7ed78fa>

Area outside marked navigation



Navigation Channel

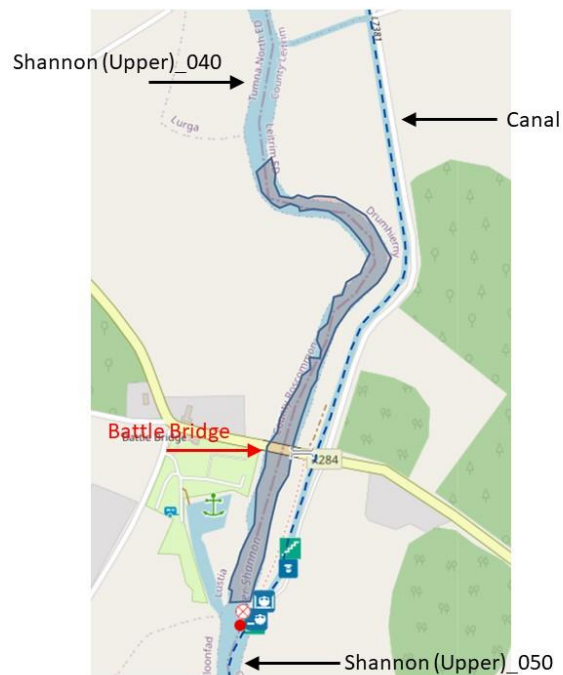
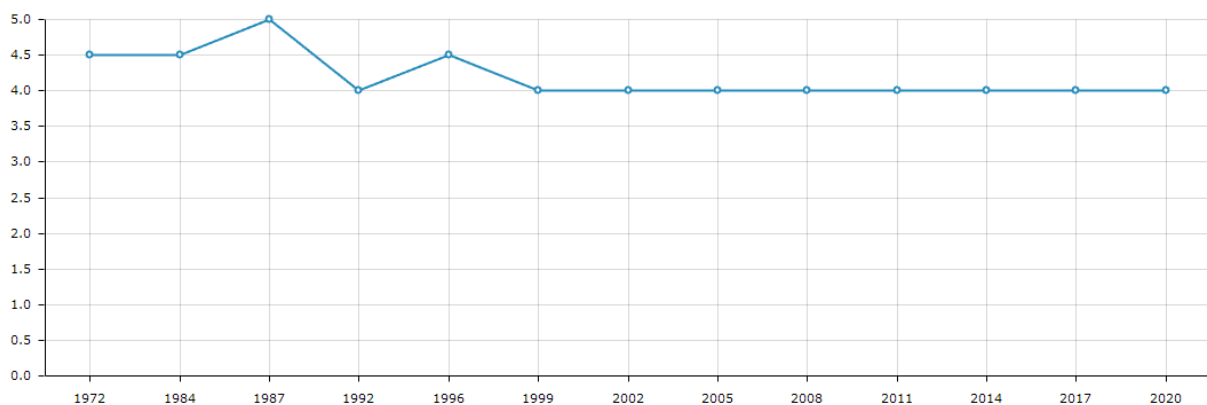


Figure 21 Connection between Lough Allen Canal and the Shannon (Upper)_040.

Data summary:

- The Shannon (Upper)_040 moderate ecological status (2013-2018 and 2016-2021) is driven by fish status alone, invertebrate status is at good with a 2017 and 2020 Q score of 4.
- The Operational and Surveillance monitoring point is at the downstream limit of the waterbody, *Battle Br* (RS26S020500) and is the only station with available chemistry data or Q data after 2007. It was on the 2019-2021 Operational and Surveillance Monitoring Programme for biological monitoring (fish, invertebrates, phytobenthos and macrophytes), supporting chemistry monitoring, chemical monitoring and for assessing hydromorphological conditions.
- Chemistry data available from 2008-2022 show ortho-phosphate, ammonia, TON and BOD annual average results are below their respective EQS/ecological threshold, however, there have been elevated temporal ammonia concentrations above the 95%ile value of 0.14mgN/l as recently as 2020, shown below in Figure 23. The 2016-2021 status details on the WFD App list a Chemical Surface Water Status Fail due to levels of benzo(a)pyrene above the EQS set out in Table 12, Priority Hazardous Substances, of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019¹¹. Benzo(a)pyrene is a carcinogenic polycyclic aromatic hydrocarbon (PAH) found in oil, coal and tar. Exceedances in surface waters may suggest pollution from carbon-based fossil fuels or tar from activities such as road-tarring or burning of oil-based fuels¹².
- There is no available data for the section of the Shannon (Upper)_040 inputting to Lough Allen, however the Ballinagleragh Wastewater works (COA) is located on this section of the waterbody and is discussed below under the heading 3.8. *Other pressures*.



	1972	1984	1987	1992	1996	1999	2002	2005	2008	2011	2014	2017	2020
Result	4.5	4.5	5	4	4.5	4	4	4	4	4	4	4	4
Classification	High	High	High	Good	High	Good	Good	Good	Good	Good	Good	Good	Good
Q-Value	4-5	4-5	5	4	4-5	4	4	4	4	4	4	4	4

Figure 22 Q Value trend for the Shannon (Upper)_040 at *Battle Br* (RS26S020500).

¹¹ [S.I. No. 77/2019 - European Union Environmental Objectives \(Surface Waters\) \(Amendment\) Regulations 2019 \(irishstatutebook.ie\)](https://www.irishstatutebook.ie/eli/2019/si/77/2019-07-26)

¹² National federation of Group Water Schemes, 2011. What's in your Water? A GWS guide to the drinking water parameters. [What's in your water? - National Federation of Group Water Schemes \(nfgws.ie\)](https://www.nfgws.ie/)

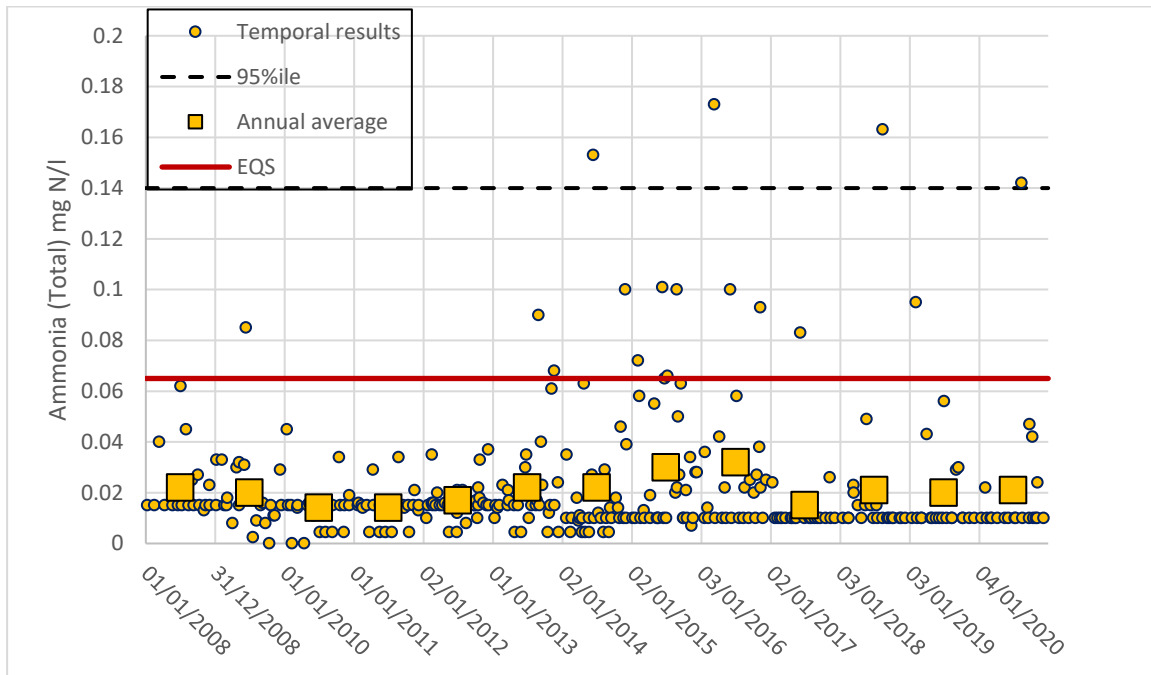


Figure 23 Ammonia data for Shannon (Upper)_040 at Battle Br (RS26S020500).

2.2.5. Stony_010 and Sheskinacurry_010

The Stony_010 and Sheskinacurry_010 river waterbodies are both *Review* waterbodies. They have both previously been classed as unassigned ecological status, the Stony_010 now has a low confidence, modelled High Status, and the Sheskinacurry_010 has a low confidence, modelled Good Status. Neither waterbody has any inputting surface waterbodies and both waterbodies flow into Lough Allen from the west as four independent streams (Fig. 24).

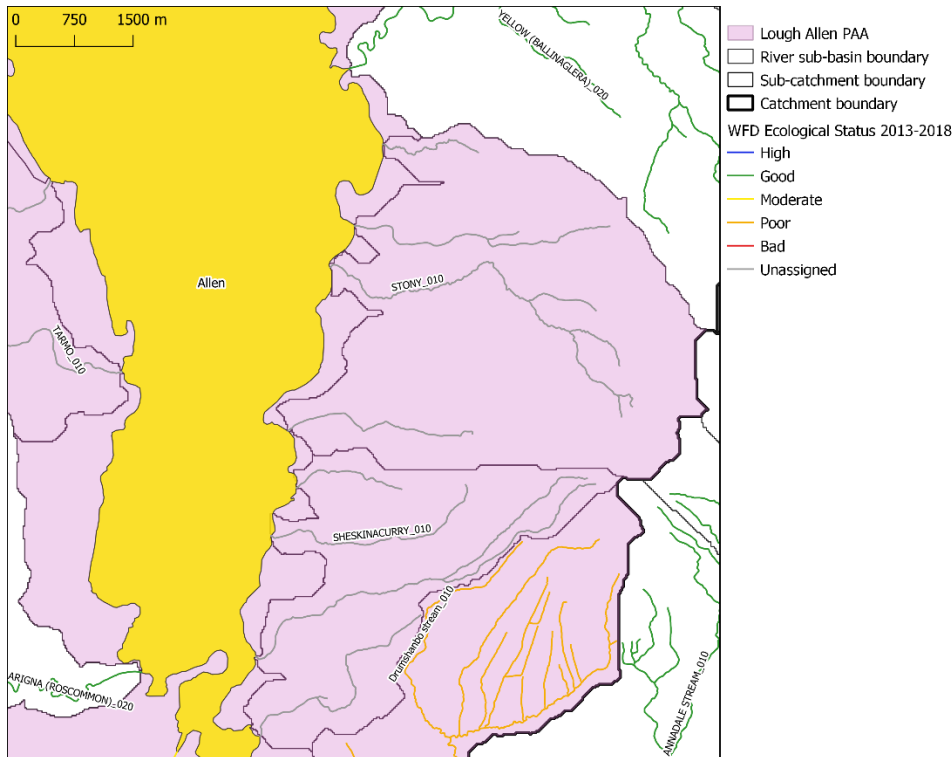


Figure 24 The Stony_010 and Sheskinacurry_010 in relation to Lough Allen.

Data summary:

- The Stony_010 and Sheskinacurry_010 river waterbodies are both *Review* waterbodies with low confidence, modelled ecological status of High and Good, respectively.
- Neither the Stony_010 nor the Sheskinacurry_010 are on a published monitoring programme and there is no available data on the WFDApp.

2.2.6. Drumshanbo Stream_010

Drumshanbo Stream_010, also known as the *Aghagrana*, is an *At Risk* waterbody with a poor 2013-2018 ecological status driven by invertebrate status. 2016-2021 ecological status showed some improvement, rising to moderate. It has no inputting surface waterbodies and flows into the very southern section of Lough Allen, known as *South Pond*, from the west (Fig. 25).

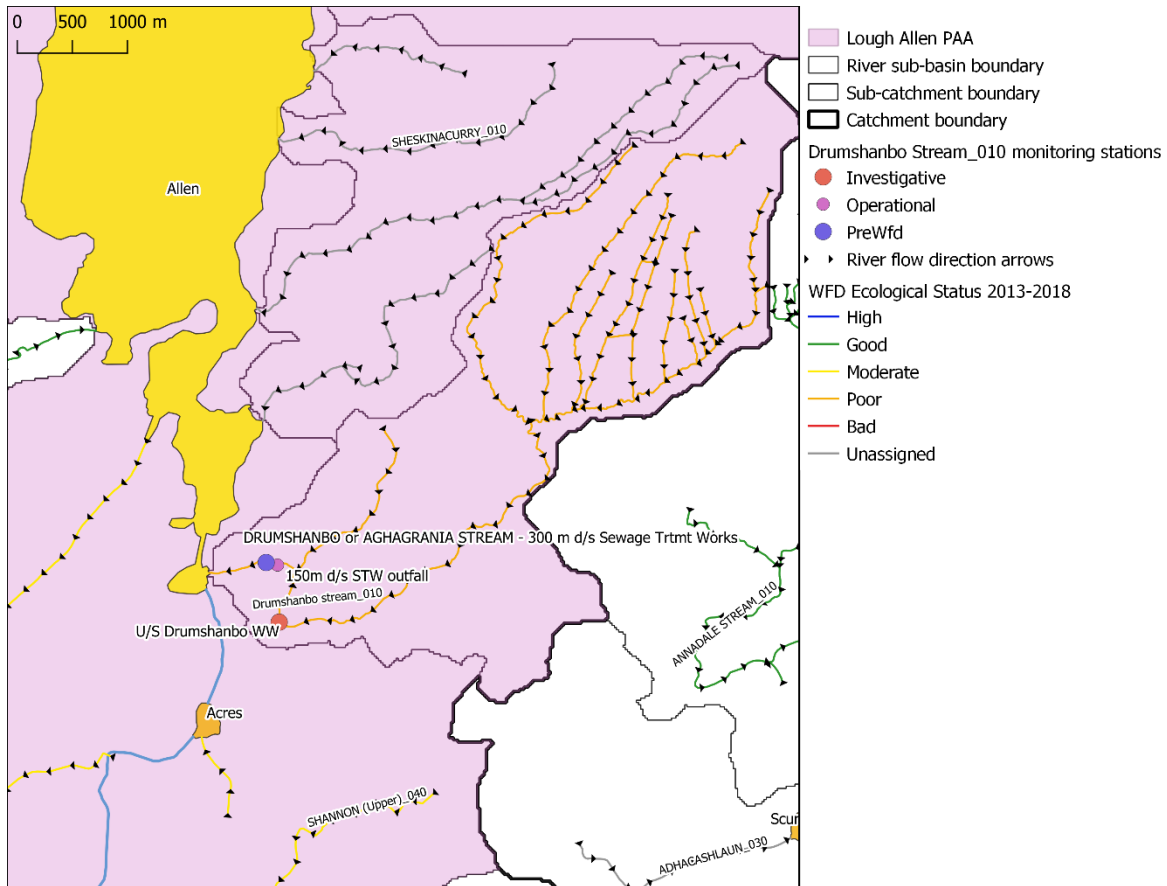


Figure 25 Drumshanbo Stream_010 in relation to Lough Allen.

Data summary for Drumshanbo Stream_010:

- An underlying groundwater body, the Geevagh, comprising pure bedded limestones, is At Risk with the initial characterisation pressure listed as agriculture and the impact assessment stating: *Groundwater contribution of phosphate to associated surface water bodies (At Risk) - - - Anthropogenic Pressures (Diffuse phosphate) (At Risk) - -*, DRUMSHANBO or AGHAGRANIA STREAM_010. Anthropogenic Pressures were added as a significant pressure for Cycle 3. Impacts listed for both pressures are:
 - Nutrient Pollution and
 - Diminution of quality of associated surface waters for chemical reasons
- Upstream of Drumshanbo town and Drumshanbo WWTW there may be a critical source area (CSA) occasionally contributing ammonia to the river (see *Monitoring Station: U/S Drumshanbo WW (RS26M800930)*)
- Downstream of the WWTW there are ortho-phosphate, ammonia, TON and BOD issues, Q assessment is also carried out downstream of the WWTW at the operational monitoring station (300) and is moderate with a 2020 Q Value of 3.5, (see *Monitoring Station: 150m d/s STW outfall (RS26D050300)* and *Monitoring Station: DRUMSHANBO or AGHAGRANIA STREAM - 300 m d/s Sewage Trtmt Works (RS26D050400)* below).
- Ammonia and ortho-phosphate concentrations tend to be higher at the preWFD station downstream of the operational monitoring station suggesting an additional CSA downstream of the Drumshanbo WWTP primary discharge (see *Monitoring Station: DRUMSHANBO or*

AGHAGRANIA STREAM - 300 m d/s Sewage Trtmt Works (RS26D050400) below), this will be investigated as part of the LCA.

Monitoring Station: U/S Drumshanbo WW (RS26M800930)

This investigative monitoring station is in Drumshanbo town, upstream of all Drumshanbo UWW emission points and Drumshanbo Mart (discussed under 3. *Significant pressures, 3.3. Agriculture*)

Data summary:

- This station was not on the Operational Monitoring Programme for 2019-2021.
- This is the upstream ambient monitoring point for the Drumshanbo WWTP as listed in the 2019 AER.
- Chemistry data is available from 2012-2022 for ortho-phosphate, ammonia and BOD. Ortho-phosphate annual averages are all below the EQS, one temporal result on the 17/05/2022, of 0.092 mgP/l, breached the 95%ile of 0.075 mgP/l. The ammonia annual average breached the EQS in 2015, driven by a temporal concentration of 0.22 mgN/l on the 26/08/2015, which breached the 95%ile of 0.14 mgN/l (Fig. 26). A temporal concentration of 0.183 mgN/l Total Ammonia, on the 17/05/2022, also breached the 95%ile, this date corresponds with the breach in ortho-phosphate. BOD annual averages from 2012-2016, 2020 and 2022 breach the EQS (Fig. 27).
- There seems to be a CSA upstream of this station which causes occasional spikes of ammonia loss to the river and BOD issues, perhaps due to nitrification of this ammonia to nitrate and/or the breakdown of “carbonaceous” organic material from the same source or a separate one.

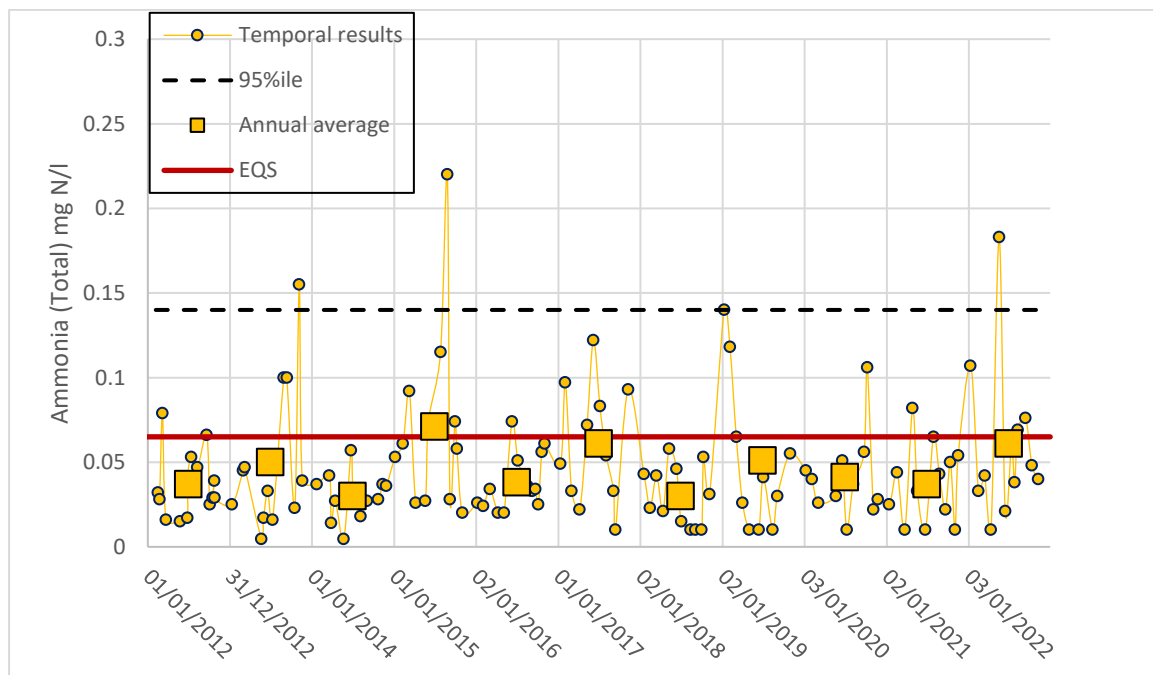


Figure 26 Ammonia data for monitoring station U/S Drumshanbo WW (RS26M800930) on the Drumshanbo Stream_010.

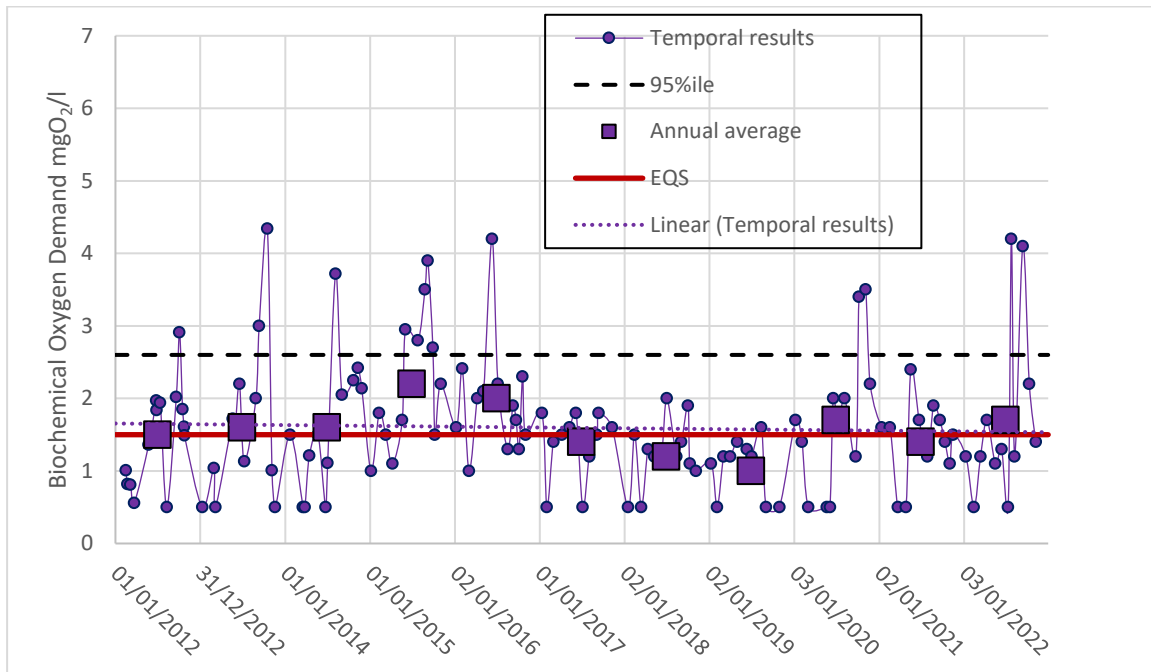


Figure 27 BOD data and trend for monitoring station U/S Drumshanbo WW (RS26M800930) on the Drumshanbo Stream_010.

Monitoring Station: 150m d/s STW outfall (RS26D050300)

This Operational monitoring station is <50m downstream of the Drumshanbo UWW primary effluent emission point and upstream of an emergency SWO on the agglomeration (see *Significant pressures*) according to the co-ordinates listed on the WFDapp, this will be confirmed during LCA.

Data summary:

- This station was on the Operational Monitoring Programme for 2019-2021 for Q assessment in 2020 and supporting chemistry monitoring 5 times per year.
- The 2020 Q Value of 3.5 is the current driver of moderate ecological status. Historical Q data (Fig. 28) show a sustained trend of unsatisfactory quality which has improved somewhat in the 2000s compared to the 1980s. The 2008 Q Value was 3* indicating sediment issues, this issue has not been associated with Q Values since.
- Chemistry data is available from 2007-2022 showing issues with ortho-phosphate, ammonia, TON and BOD (Fig. 29-32). Temporal spikes tend to be in or around the summer months, when flows would be expected to be lower.
 - Ortho-phosphate annual averages fell below the EQS from 2012-2015 and in 2021, otherwise they breach the EQS. Annual averages have breached the 95%ile in 2007, 2016, 2020 and 2022. The breach in 2020, occurring on the 15th June, was particularly high, at 1.1mgP/l, over 14 times the 95%ile of 0.075mgP/l. Temporal spikes in ortho-phosphate tend to occur in May or June, except for 2009 when temporal spikes were in January and October, and 2022 when the highest concentration was recorded in March.
 - Ammonia annual averages fell below the EQS from 2011-2015, in 2017, and recently from 2021-2022, otherwise they breach the EQS, with significant breaches in 2010 and 2016 of 5.728 mgN/l and 0.761 mgN/l, respectively. A temporal concentration on the 08/06/2010 was 22.7 mgN/l (22.56 mgN/l above the 95%ile concentration of 0.14 mgN/l), on the 12/05/2016 a concentration of 3.6 mgN/l was recorded. Ammonia

temporal spikes tend to occur in May, June or July except for 2009 when the highest concentration was recorded in January (0.704 mgN/l) with further spikes in June and October. In 2018 a temporal spike was recorded on the 23rd of October, this date corresponds with a spike in ortho-phosphate. A spike in 2022 is on the 29th of March, corresponding with a spike in ortho-phosphate.

- TON annual averages are below the ecological threshold of 3.5 mgN/l and are at their lowest in 2008, 2010, between 2013-2015, in 2018 and in 2021. Temporal concentrations breach the 3.5 mgN/l in 2007, 2017, 2019, 2020 and 2022. The breach in 2020, on the 15th of June, corresponds with a significant spike in ortho-phosphate. Temporal spikes tend to be between April and July. 2009 is the exception with spikes in January and October, and 2022 with spikes in March and September.
- BOD annual averages consistently breach the EQS except for in 2018, temporal concentrations show a slight downward trend over time. Temporal spikes tend to be in or around the summer months but 2009 and 2015 have a spike in January and there are spikes in October/November from 2007-2009 and 2011-2012. In 2022 the spike is in March.

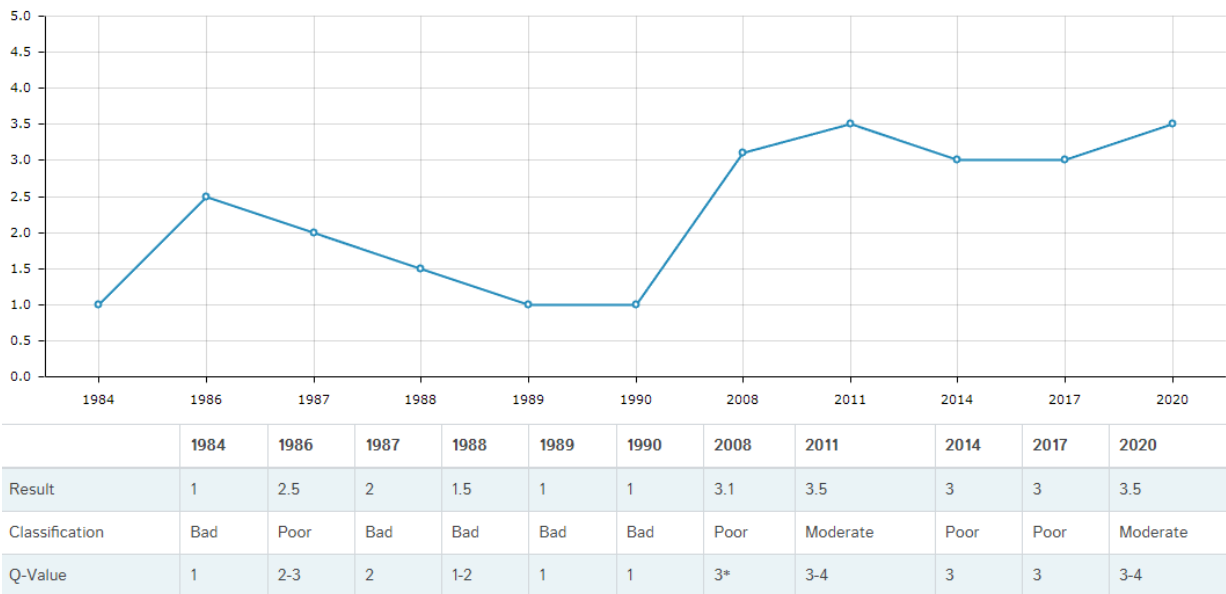


Figure 28 Q Value trend for the Drumshanbo Stream_010 at Monitoring Station 150m d/s STW outfall (RS26D050300).

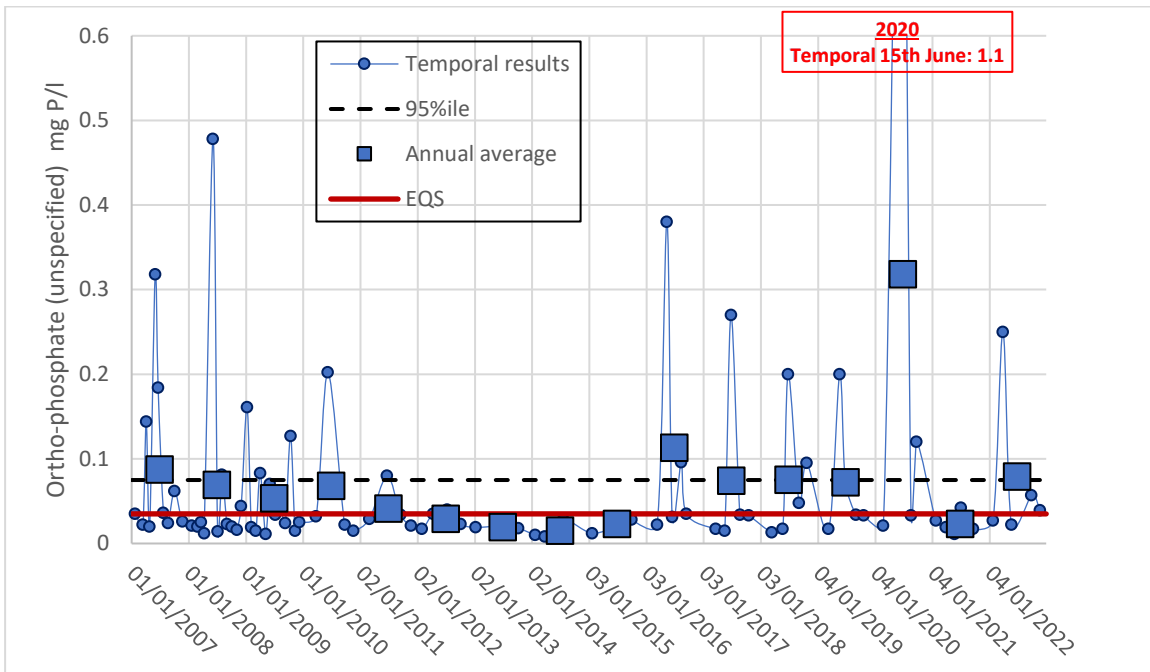


Figure 29 Ortho-phosphate data for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010 (off chart concentrations in red text box).

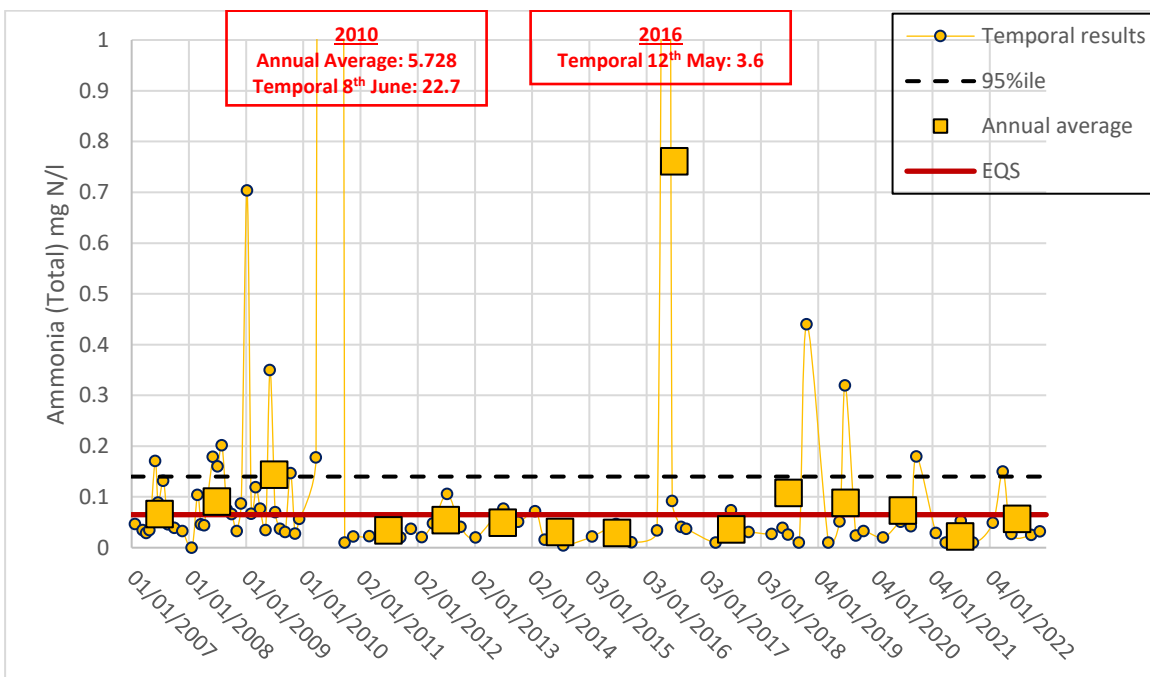


Figure 30 Ammonia data for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010 (off chart concentrations in red text box).

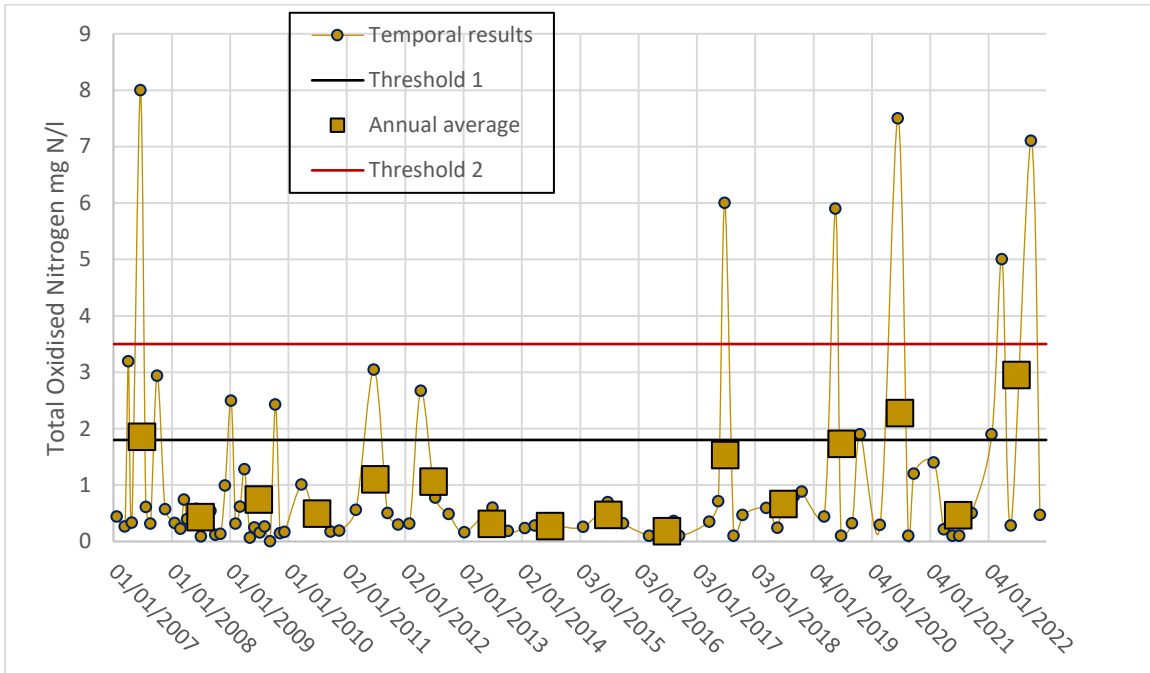


Figure 31 TON data for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010.

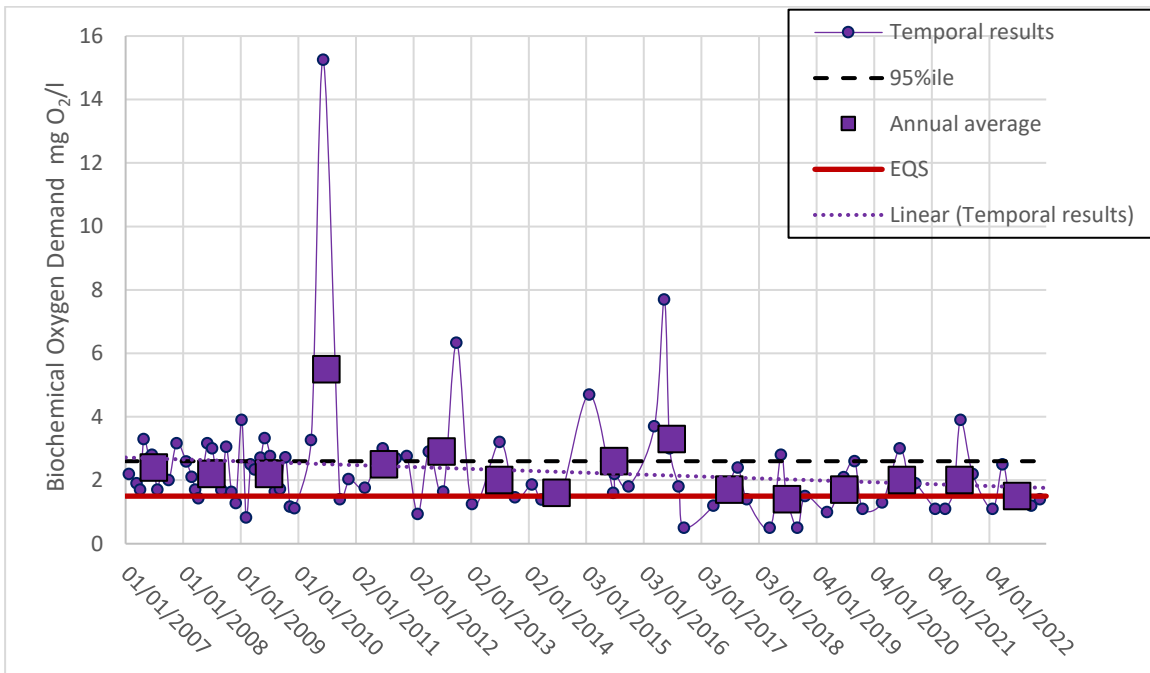


Figure 32 BOD data and trend for the monitoring station 150m d/s STW outfall (RS26D050300) on the Drumshanbo Stream_010.

Monitoring Station: DRUMSHANBO or AGHAGRANIA STREAM - 300 m d/s Sewage Trtmt Works (RS26D050400)

This preWFD monitoring station is approx. 100m downstream of Drumshanbo UWW primary effluent emission point and approx. 90m downstream of an EO (see *Significant pressures*) according to the coordinates listed on the WFDapp, this will be confirmed during LCA.

Data summary:

- This station was not on the Operational Monitoring Programme for 2019-2021.
- This is the downstream ambient monitoring point for the Drumshanbo WWTP as listed in the 2019 AER.
- Chemistry data is available for 2012-2022 for ortho-phosphate, ammonia and BOD showing issues for each parameter. Temporal concentrations are not sampled on the same day as the upstream operational monitoring station *150m d/s STW outfall (RS26D050300)*, this station is also sampled more regularly throughout the year (8-11 months per year) than 0300 (3-5 months per year over comparable period).
 - Ortho-phosphate annual averages breach the EQS in 2012 and 2016-2020 with a reprieve from 2013-2015 and most recently in 2021-2022. Temporal spikes above the 95%ile of 0.075 mgP/l occur from 2012-2013 and 2016-2020 with an extremely high concentration of 0.99 mgP/l on the 02/07/2018 and 1.25mgP/l on the 04/06/2020. At the upstream 0300 station in 2018 no July samples were taken but a sample from June 26th had a high ortho-phosphate concentration of 0.2mgP/l. In 2020 the 0300 station had an extremely high ortho-phosphate concentration on the 15th of June of 1.1mgP/l. Spikes tend to be in the summer months except in 2013 when the spike occurs in October. In 2018 annual averages tend to be higher at this station than the upstream operational monitoring station *150m d/s STW outfall (RS26D050300)*, suggesting an additional CSA for ortho-phosphate downstream of Drumshanbo WWTP and the operational monitoring station, however it should be noted that sampling of the stations does not occur on the same dates or at the same frequency per year and one or two high temporal concentrations can skew annual averages significantly. The lowest annual averages occur from 2013-2015 like the upstream station and annual average trends are similar, downward trend from 2012-2014 with a ramp back up from 2016-2020, followed by a decline in 2021.
 - Ammonia annual averages breach the EQS from 2012-2015, 2018-2019 and in 2021, with a reprieve in 2016-2017, in 2020 and in 2022. Temporal spikes above the 95%ile of 0.14 mgN/l tend to occur in the summer months and/or October. Extremely high temporal concentrations were recorded on 24/06/2014 and 03/07/2014 of 3.383 mgN/l and 1.111 mgN/l, respectively, also on the 02/07/2019 of 3.4 mgN/l. No sample was taken at the upstream 0300 station around the same time in 2014 for comparison, the 0930 station did not have elevated ammonia on the same dates. In 2019 the 0930 station did not have elevated ammonia on the 3rd of July, however, the 0300 station had been sampled 8 days previously on the 25th of June and an elevated concentration above the 95%ile recorded. Annual averages do not follow the same trend as the 0300 station and tend to be higher at this downstream station (Figure 36), suggesting an additional CSA for ammonia downstream of Drumshanbo WWTP and the operational monitoring station, however it should be noted that sampling of the stations does not

occur on the same dates or at the same frequency per year and one or two high temporal concentrations can skew annual averages significantly.

- BOD annual averages breach the EQS from 2012-2016 and from 2019-2021, in 2017 the annual average is at the EQS of 1.5 mgO₂/l, in 2018 and 2022 the annual average is below the EQS. Temporal spikes breach the 95%ile of 2.6 mgO₂/l from 2012-2016 and from 2019-2022. The 2018 reprieve correlates with the dip in 2018 BOD results at the upstream 0300 station. BOD annual averages tend to be lower at this station than the upstream 0300 station (Fig. 38), suggesting a source upstream of the 0300 station. In 2013 and 2014 annual average concentrations were higher at this downstream station, suggesting an additional CSA for organic matter downstream of Drumshanbo WWTP and the operational monitoring station, however it should be noted that sampling of the stations does not occur on the same dates or at the same frequency per year and one or two high temporal concentrations can skew annual averages significantly.

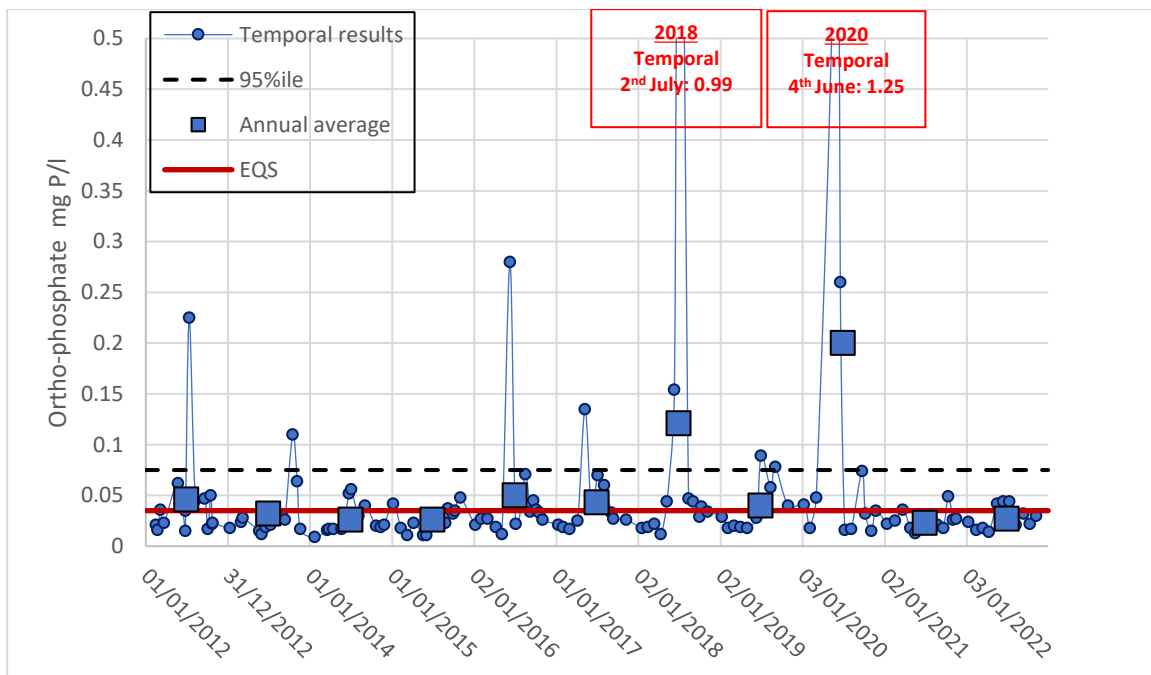


Figure 33 Ortho-phosphate (filtered 2012-2015, unspecified 2016-2022) data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010 (off chart concentration in red text box).

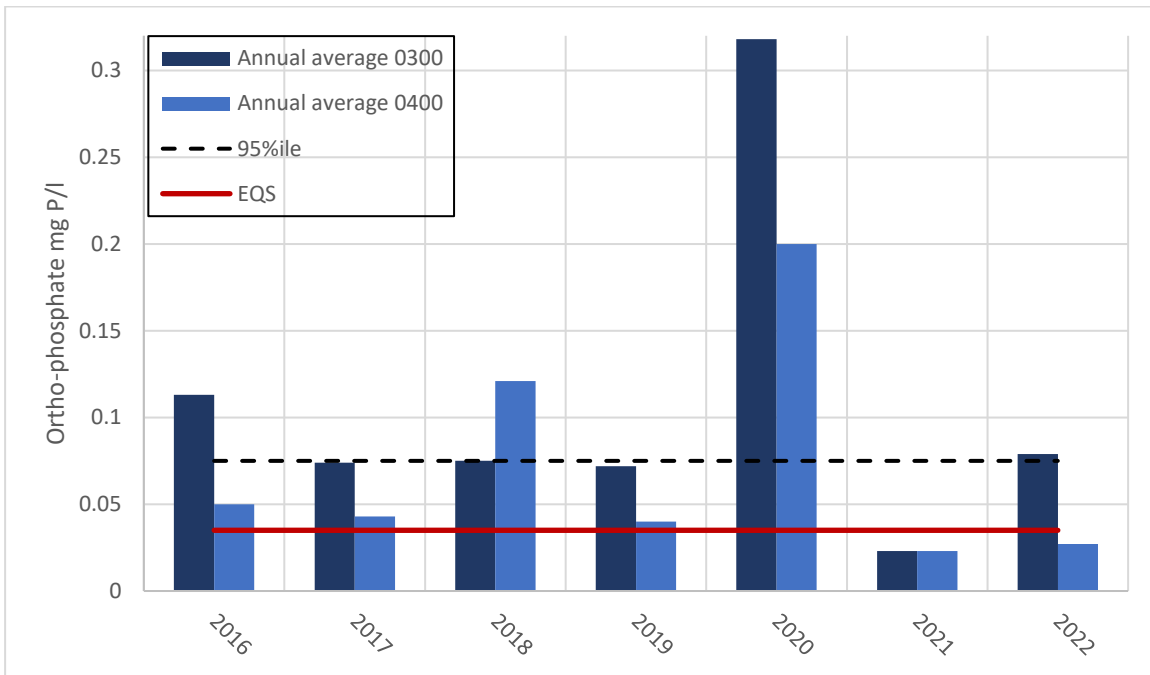


Figure 34 Comparison of Ortho-phosphate (unspecified 2016-2022) annual averages for the 0300 and 0400 monitoring points.

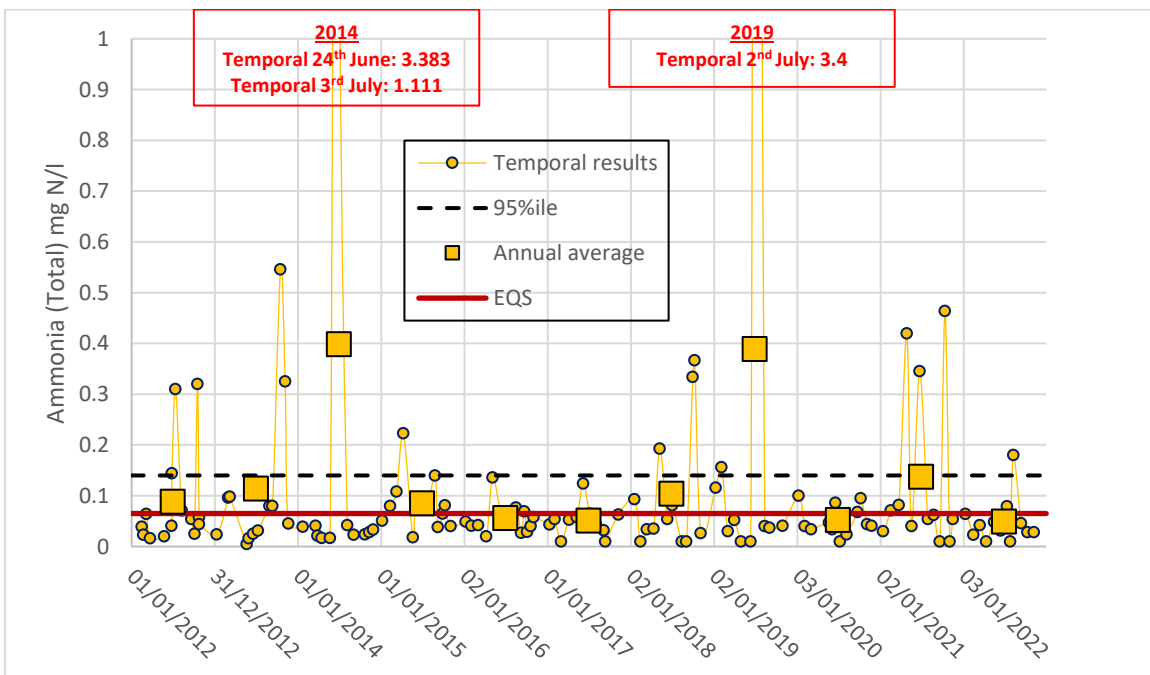


Figure 35 Ammonia data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010 (off chart concentrations in red text box).

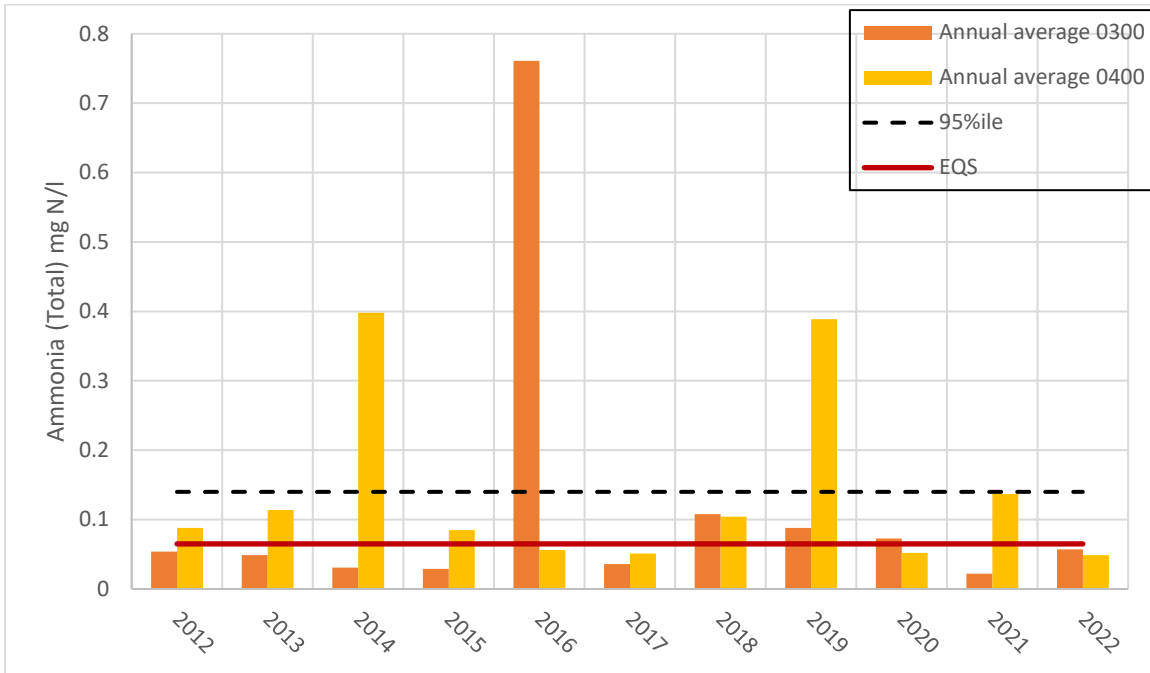


Figure 36 Comparison of ammonia annual averages for the 0300 and 0400 monitoring points.

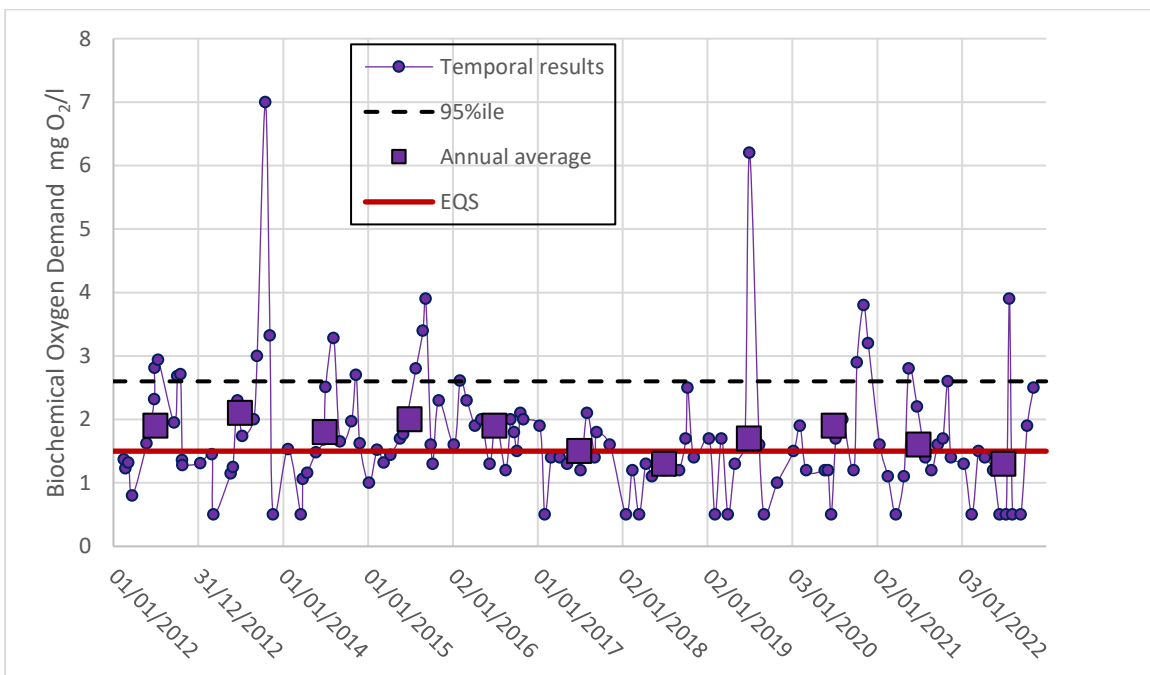


Figure 37 BOD data for 300 m d/s Sewage Trtmt Works (RS26D050400) on the Drumshanbo Stream_010.

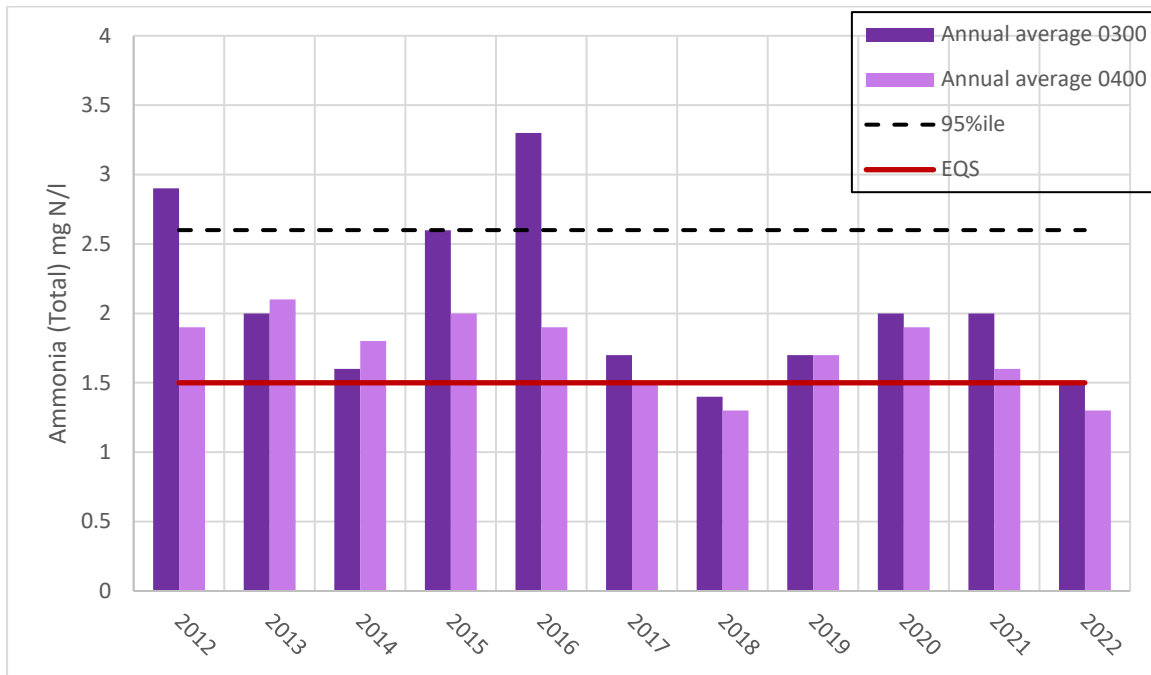


Figure 38 Comparison of BOD annual averages for the 0300 and 0400 monitoring points.

2.2.7. Tarmo_010

The Tarmo_010 is a *Review* waterbody, previously it has been classed as unassigned ecological status, it now has a low confidence, modelled Good Status (2016-2021). It has no inputting surface waterbodies and flows into Lough Allen from the east as three independent streams (Fig. 39). It is mainly in Co. Leitrim but the furthest south stream acts as the boundary with Co. Roscommon to the south (see Fig. 3).

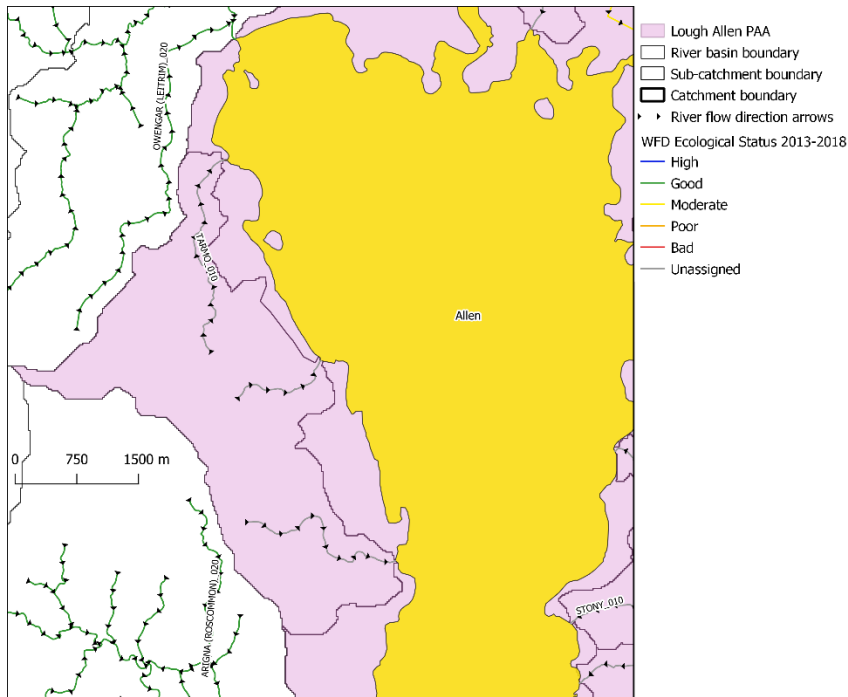


Figure 39 Tarmo_010 in relation to Lough Allen.

Data summary:

- The Tarmo_010 river waterbody is a *Review* waterbody with a low confidence, modelled Good Status.
- It is not on a published monitoring programme and there is no available data on the WFDApp.

3. Significant pressures

Significant pressures and non-significant pressures for each waterbody in the Lough Allen PAA, as identified in the Initial Characterisation Assessment for the 2nd cycle and ongoing 3rd cycle characterisation, as listed in the WFDApp, are summarised in Table 5 and discussed below.

Table 5 Significant and non-significant pressures as identified in the Initial Characterisation.

WB Name	Pressure Category	Pressure Sub-category	Impact	Sig. Pressure
OWENNAYLE_020	Agriculture	Agriculture	Nutrient Pollution Altered habitat due to Morphological changes Other: sediment	Yes
	Extractive Industry	Peat	Acidification Other: sediment	Yes
DIFFAGHER_010	Anthropogenic	Unknown		Yes
OWENGAR (LEITRIM)_020	Agriculture	Pasture	Nutrient Pollution	Yes
SHANNON (Upper)_030	Agriculture	Pasture	Nutrient Pollution	Yes
STONY_010	Agriculture	Pasture		No
	Extractive Industry	Peat		No
	Forestry	Forestry		No
SHESKINACURRY_010	Agriculture	Pasture		No
	Extractive Industry	Peat		No
	Forestry	Forestry		No
Drumshanbo Stream_010	Urban Waste Water (Drumshanbo)	Agglomeration PE of 2,001 to 10,000	Nutrient Pollution Organic Pollution	Yes
	Agriculture	Pasture	Nutrient Pollution	Yes
	Extractive Industry	Peat		No
	Forestry	Forestry		No
	Hydromorphology	Dams, barriers, locks, weirs	Altered habitat due to Hydrological changes Altered habitat due to Morphological changes	Yes
TARMO_010	Agriculture	Pasture	Nutrient Pollution	Yes
	Extractive Industry	Quarries		No
	Forestry	Forestry	Other: sediment	Yes
Allen (Lake)	Invasive Species	Invasive Species (Zebra Mussel)	Altered habitat due to Morphological changes	Yes
	Agriculture	Pasture	Nutrient Pollution	Yes
SHANNON (Upper)_040	Anthropogenic	Unknown	Other significant impacts (<i>fish status</i>)	Yes
	Hydromorphology	Dams, barriers, locks, weirs	Altered habitat due to Morphological changes	Yes
	Agriculture	Pasture		No

3.1. Drumshanbo Urban Wastewater Treatment

The Drumshanbo WWTP is listed as a significant pressure in the Drumshanbo Stream_010, it has a wastewater discharge license (D0144-01) which was granted on the 30/09/2010. It has a capacity PE of 4000 with an agglomeration PE of 1654 for 2019. Available supporting chemistry data for downstream monitoring stations show issues with ortho-phosphate, ammonia, TON and BOD (see Section 2.2.6.), however the georeferencing given for the downstream monitoring points, *150m d/s STW outfall (RS26D050300)* and *300 m d/s Sewage Trtmt Works (RS26D050400)*, put them at <50m and approx. 100m downstream of the WWTP primary discharge, respectively. From satellite imagery the river appears to be no more than 5m in width which would place the 0300 monitoring point within the mixing zone. It should also be noted that 0300 is also located just upstream of an EO (referred to as SW6 in the licensing application) and the 2019 AER referred to an EO incident of uncontrolled release (see below). IW will be consulted as to whether the 2019 EO incident occurred at the SW6 EO located on Drumshanbo Stream and if so, on what date.

The 2019 AER states:

- treatment type is 3P - Tertiary P removal
- The WWTP is not compliant with the ELV's for Suspended Solids, BOD, Ortho-phosphate and Ammonia set in the wastewater discharge license.
- Exceedance was caused by inadequate infrastructure and equipment breakdown
- The ambient monitoring results do not meet the required EQS
- 2 incidents of uncontrolled release were reported to the EPA; causes were due to *SWO Lack of tank storage capacity and EO caused by pump failure.*
- *there is inadequate assimilative capacity in the discharge river/stream during the summer period*

The 2017 AER states:

- The final effluent from the Primary Discharge Point was non-compliant with the Emission Limit Values in 2017 for BOD and Ortho-phosphate.
- The annual maximum hydraulic loading of influent was greater than the peak treatment plant capacity
- 6 incidents of ELV breaches were reported to the EPA: 1 ammonia breach, 2 cBOD breaches and 3 Ortho-P breaches.
- The non-compliance is due to inadequate WWTP infrastructure requiring upgrade

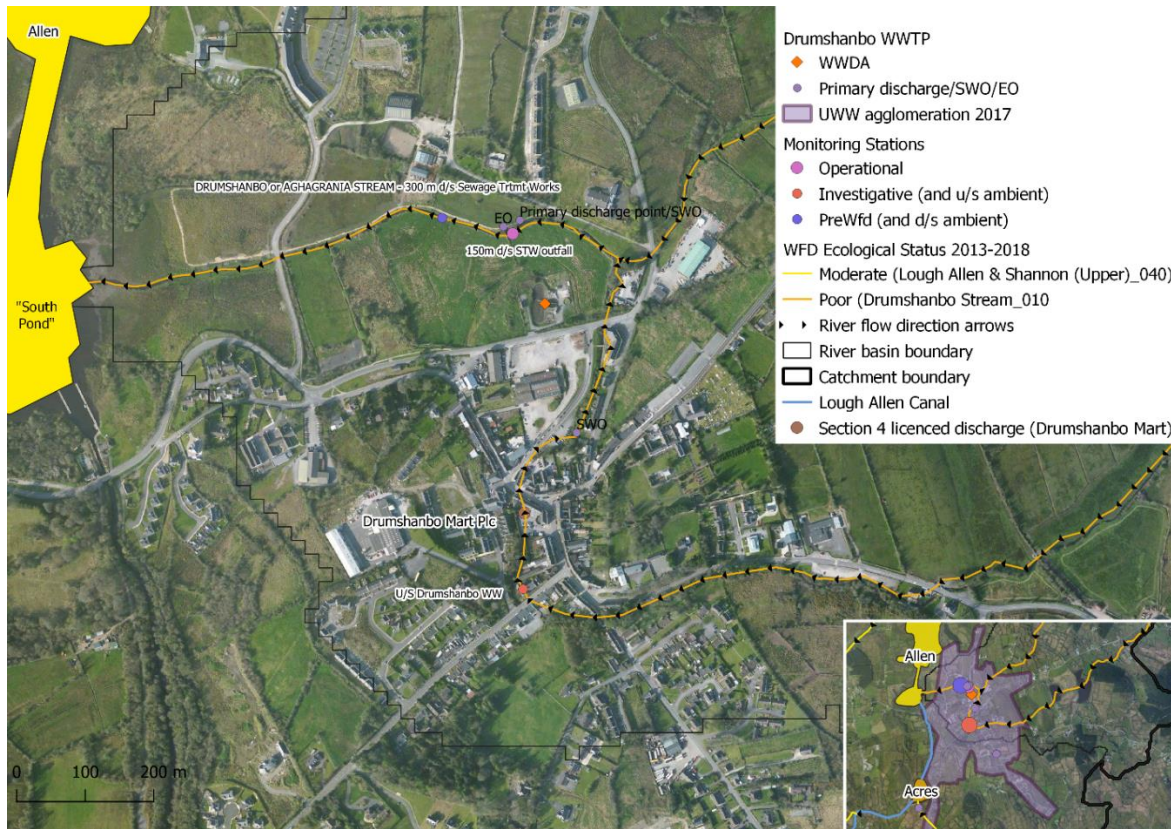


Figure 40 Drumshanbo WWTW and Drumshanbo Mart Section 4 licence in relation to monitoring stations with available data on the Drumshanbo Stream_010.

An estimation of the pollution risk of the WWTW were carried out using assimilative capacity calculations (see Appendix 2)

- Mass balance calculations were carried out using a Q95 flow estimate from the EPA Hydrotool (26_3589) upscaled to the preWFD 0400 monitoring point, as it lies outside of the mixing zone. Hydraulic loading and nutrient loading were taken from the 2019 AER; DWF to the Treatment Plant (m^3/day), BOD (as cBOD), Total Ammonia and MRP from annual mean figures.
- Background concentrations were the 2019 annual average concentrations at the RS26M800930 investigative monitoring point (u/s ambient MP for WWDA).
- These calculations indicate that predicted resultant concentration downstream of the discharge from Drumshanbo WWTW for ammonia-N is $0.357mg/l$ N, this is in excess of the 95%ile standard of $0.14mg/l$ N and it is noted that this discharge will use an estimated 344% of the ammonia headroom at the downstream WFD monitoring station. The predicted resultant concentration downstream of the discharge for molybdate reactive phosphate (MRP) is $0.088mg/l$ P, this is also in excess of the 95%ile standard of $0.075mg/l$ P and will use an estimated 123% of the MRP headroom at the downstream WFD monitoring station.
- A calculation using notional clean background concentrations was also carried out to estimate the contribution solely from this discharge and this indicated that the discharge uses up 241% of the available ammonia headroom and 106% of the available MRP headroom.
- The pollution risk from the Drumshanbo Urban Wastewater Treatment Plant discharge is considered significant.

2019 annual average concentrations from the two downstream monitoring stations (0300 and 0400) suggest an additional source of ammonia downstream of the WWTP discharge and 0300, this is not however reflected in the baseline figures for each monitoring station (Figure 41). It should again be noted that sampling of the stations does not occur on the same dates or at the same frequency per year and one or two high temporal concentrations can skew annual averages significantly. Further information will be sought from IW on the EO (SW6) and it will be investigated as part of the LCA, furthermore, an equine centre located near 0400 and discussed below under *Agriculture* will be assessed as part of the LCA as a potential source of nutrients.

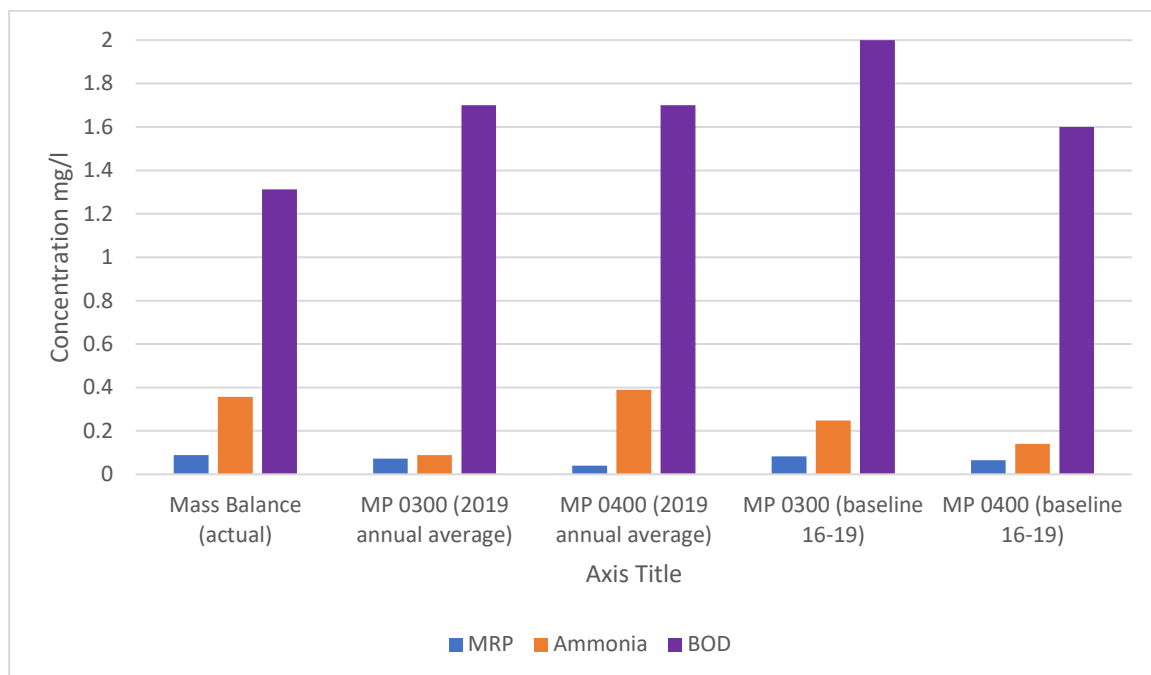


Figure 41 Comparison of the nutrient and BOD concentrations of the mass balance estimation with the actual results at the two d/s monitoring points.

3.2. Invasive Species

Invasive species is listed as a significant pressure for Lough Allen, specifically zebra mussels (*Dreissena polymorpha*) with an impact of *Altered habitat due to Morphological changes*. Neither the EPA biologists nor the online Biodiversity Maps¹³ of the National Biodiversity Data Centre have records of zebra mussel on Lough Allen, zebra mussel are recorded further downstream on the Shannon catchment in Carrick-on-Shannon and on Lough Key therefore they may have been introduced to Lough Allen by boat movement up the Shannon catchment via the Lough Allen Canal. It should be noted that the pH levels in Lough Allen tend to be approx. 7.3, with recordings as low as 6.1, zebra mussels thrive in more alkaline waters as they need calcium for shell growth.

The high filtration rate of the zebra mussel is associated with a loss of plankton and nutrients from the water column to the substrate and increased water clarity¹⁴. If zebra mussel are present in Lough Allen the Max Depth Colonisation increase of 0.2 m between 2008 and 2017 stated in the EPA Macrophyte

¹³ <https://maps.biodiversityireland.ie/Map/Terrestrial/Species/123415>

¹⁴ <https://invasivespeciesireland.com/species-accounts/established/freshwater/zebra-mussel>,
<https://species.biodiversityireland.ie/profile.php?taxonId=123415&taxonName=dreissena>

Survey 2016-2018 could potentially be due to an increase in water clarity due to the presence of the filter feeding Zebra Mussel, Lough Allen is a coloured lake with generally an annual average greater than 60 hazens but there has been a decreasing trend more recently with 2007-2012 annual average colour levels being greater than 80 hazens (Figure 42). The presence of the Zebra Mussel can mask nutrient impacts as sampling of the water column may not be representative of nutrient input, this may offer an explanation for why the lake plant community is mainly comprised of two nutrient tolerant taxa while total phosphorous and chlorophyll levels are in the good indicative quality class and ammonia annual averages in the high indicative quality class. The LCA will focus on nutrient levels in the river waterbodies feeding Lough Allen and high PIP areas around the lake shore. At the time of writing this report there is no method to eradicate Zebra Mussels from lake habitats into which they have become established.

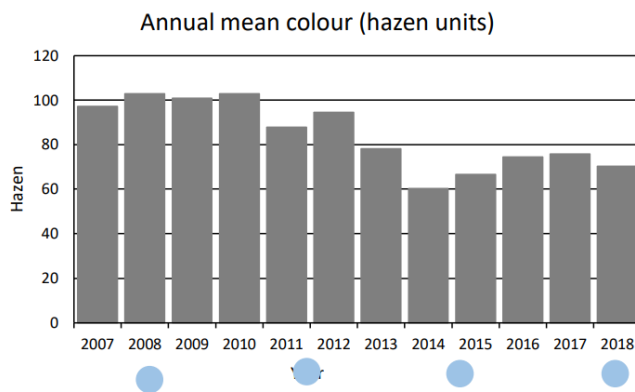


Figure 4: Annual mean colour 2007-2018 for Lough Allen with macrophyte survey years indicated.

Figure 42 Figure 4 from EPA Macrophyte Survey 2016-2018 for Lough Allen showing trend in annual mean colour.

3.3. Agriculture

Agriculture (Pasture) is listed as a significant pressure for Lough Allen, for the Drumshanbo Stream_010, the Shannon (Upper)_030, the Tarmo_010 and the Owengar (Leitrim)_020, with an impact of nutrient pollution listed for all waterbodies.

The associated impact assessment details for Lough Allen states:

Agriculture noted in both CoCo workshops as potential pressure. High PIP SW-P around most of the banks of the lakes.

Nutrient issues in Lough Allen appear, from the chemistry data (see Table 3), to be at their worst to the southern tip of the lake, south of the Shannon (Upper)_040 outlet, around the lake monitoring Site 7, therefore LCA will initially focus on investigation of activities on the banks of the lake in this area.

The impact assessment details for Drumshanbo Stream_010 states:

PIP SW-P high in most of sub-basin, sediment issues with animal access. Also equine centre present along stretch where appears to have increase in Am 2013-2018 Cycle 3 Update: Leitrim CoCo - Note: it is uncertain if there is a discharge from the cattle mart to the public sewer or to surface waters. A full investigation is required. No information regarding the discharge from the equestrian centre.

An Equestrian Centre is located near the preWFD monitoring point (300 m d/s Sewage Trtmt Works (RS26D050400)) where ammonia concentrations tend to be higher than the operational monitoring point upstream (150m d/s STW outfall (RS26D050300)) and this reach of the river will be assessed as part of the LCA. Assessment and mapping of animal access points will be carried out as part of the LCA to ascertain if a cumulative impact is significant. Leitrim Co. Co. have advised that the Drumshanbo Mart discharge, if to surface waters, is unlicensed, the presence of a discharge will be investigated as part of LCA.

It should also be noted that an underlying groundwater body, the Geevagh (See Appendix 1), comprising pure bedded limestones, is At Risk with the initial characterisation listing Agriculture as a pressure, Anthropogenic Pressures were added as a significant pressure for Cycle 3. Impacts listed for both pressures are:

- Nutrient Pollution and
- Diminution of quality of associated surface waters for chemical reasons

The impact assessment states:

Groundwater contribution of phosphate to associated surface water bodies (At Risk) - - - Anthropogenic Pressures (Diffuse phosphate) (At Risk) - -, DRUMSHANBO or AGHAGRANIA STREAM_010

The associated impact details for the Shannon (Upper)_030 state:

High PIP SW-P 2013-2018 Cycle 3 Update: Deemed significant for Cycle 3. High to Very High PIP for SW-P. Limited forestry activity compared to agriculture. Leitrim CoCo - Unaware of any historic or current licensing in the area for forestry activities. No monitoring carried out by LCC.

Agriculture has also been added as a Cycle 3 pressure for the inputting Owennayle_020. Impacts listed are:

- Nutrient Pollution
- Altered habitat due to Morphological changes
- Other: sediment

The associated impact details state:

No chemistry data for 2016-18. Chemistry from 2013, 2014 and 2015 indicated Good/High indicative quality for ortho-P, TON and total ammonia. EPA Q-value Viewer: decline to Moderate conditions (-0100) where cattle access may lead to unnecessary nutrient loadings. This is the lowest condition this formally High ecological condition site has been in since monitoring started in 1976. Corine land cover change (2012-18) mapping indicates potentially 233 ha area of change from peat bog to burnt area. Cavan CoCo - Farm surveys 2013 and 2017. No information regarding peat burning. No complaints recorded for this area.

The 2020 Q assessment showed a recovery, driving the 2016-2021 Ecological Status up to High. LCA will initially be focused on determining if the Shannon (Upper)_030 is impacted and the significance of any impact on Lough Allen. If it is determined there is significant impact, LCA will expand to incorporate the Owennayle_020.

The associated impact assessment details for Tarmo_010 state:

High SW and NS P PIP, no chemistry or biology data available. 2013-2018 Cycle 3 Update: Deemed a significant pressure for Cycle 3 with nutrients checked. High SW/NS P PIP: Rank 2 in the east and south of the sub-basin. Leitrim CoCo - No new information. From satellite imagery - most probable pressures is forestry and agriculture. Possible nutrient losses from the spread of slurries on land and fertiliser.

LCA will initially be focused on determining if the Tarmo_010 is impacted.

Agriculture (Pasture) is listed a 2nd cycle non-significant pressure in a further 3 river waterbodies; Shannon (Upper)_040, Stony_010, and Sheskinacurry_010.

LCA will initially be focused on determining if the Stony_010 and Sheskinacurry_010 are impacted. LCA in the Shannon (Upper)_040 will focus on determining if the section inputting to Lough Allen is impacted.

Figure 43 below, showing the Corine Land Cover Map for the PAA area, illustrates agriculture (mainly of the Corine designation - *land principally occupied by agriculture, but with significant areas of natural vegetation*) as the dominant land-use.

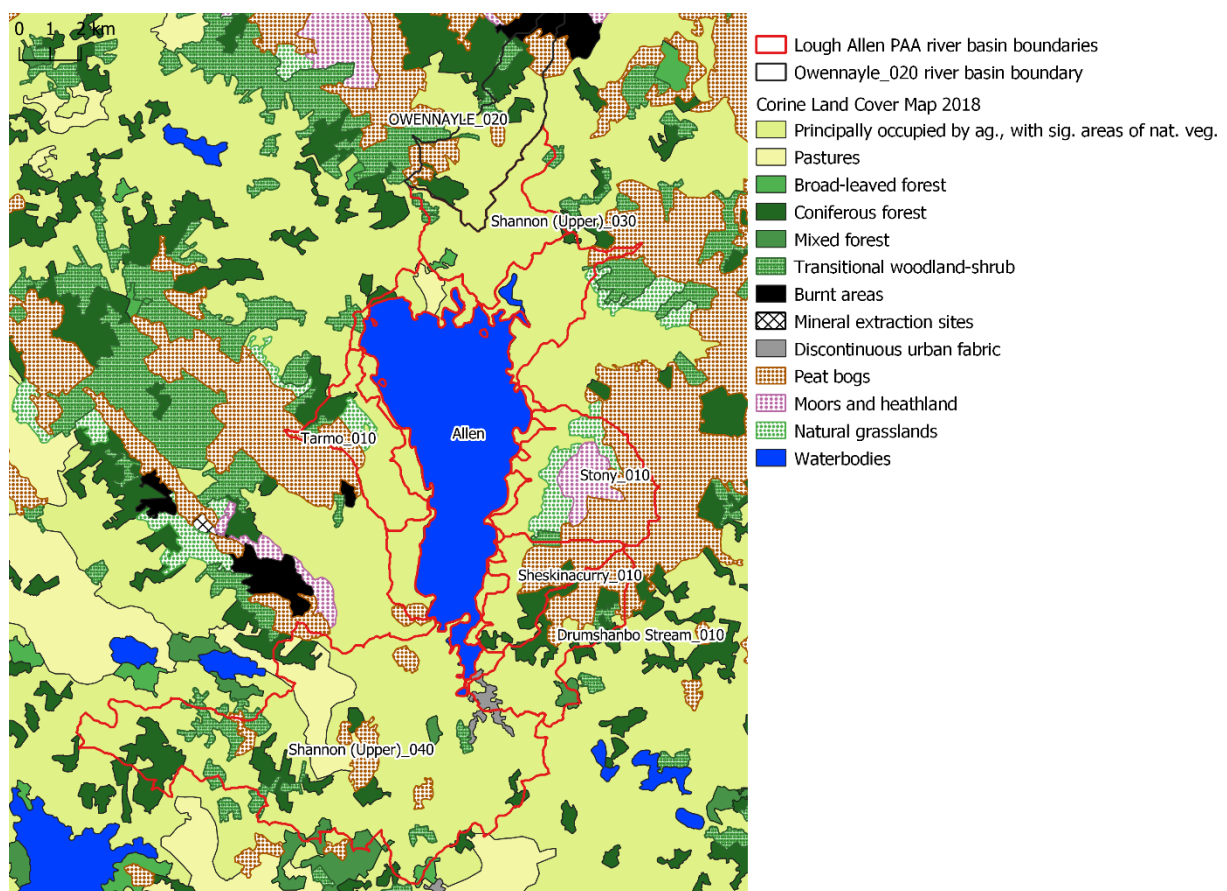


Figure 43 Corine Land Cover Map (2018) for the Lough Allen PAA region.

3.3.1 Pollution Impact Potential Maps

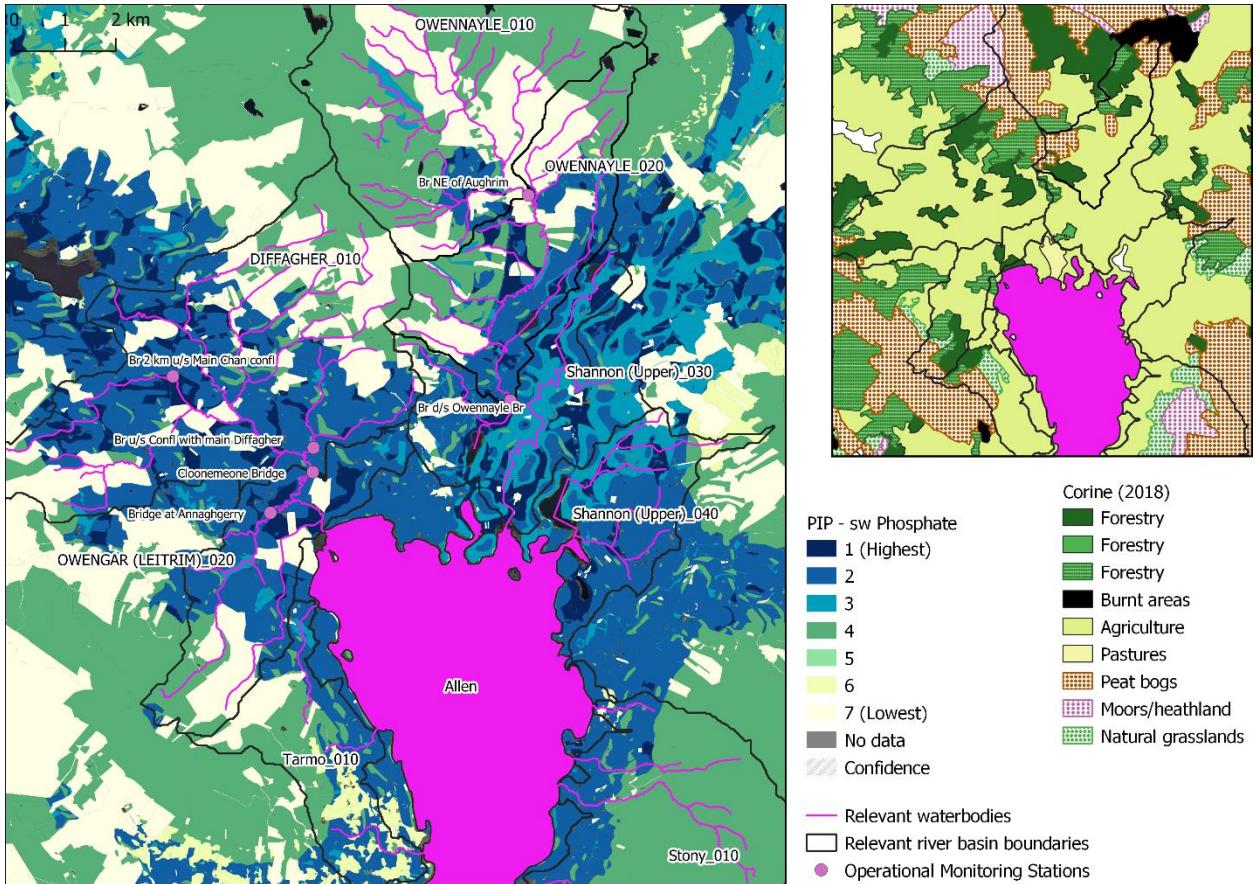


Figure 44 Pollution Impact Potential (PIP) map for surface water phosphate for northern section of PAA with Corine (2018) map for comparison.

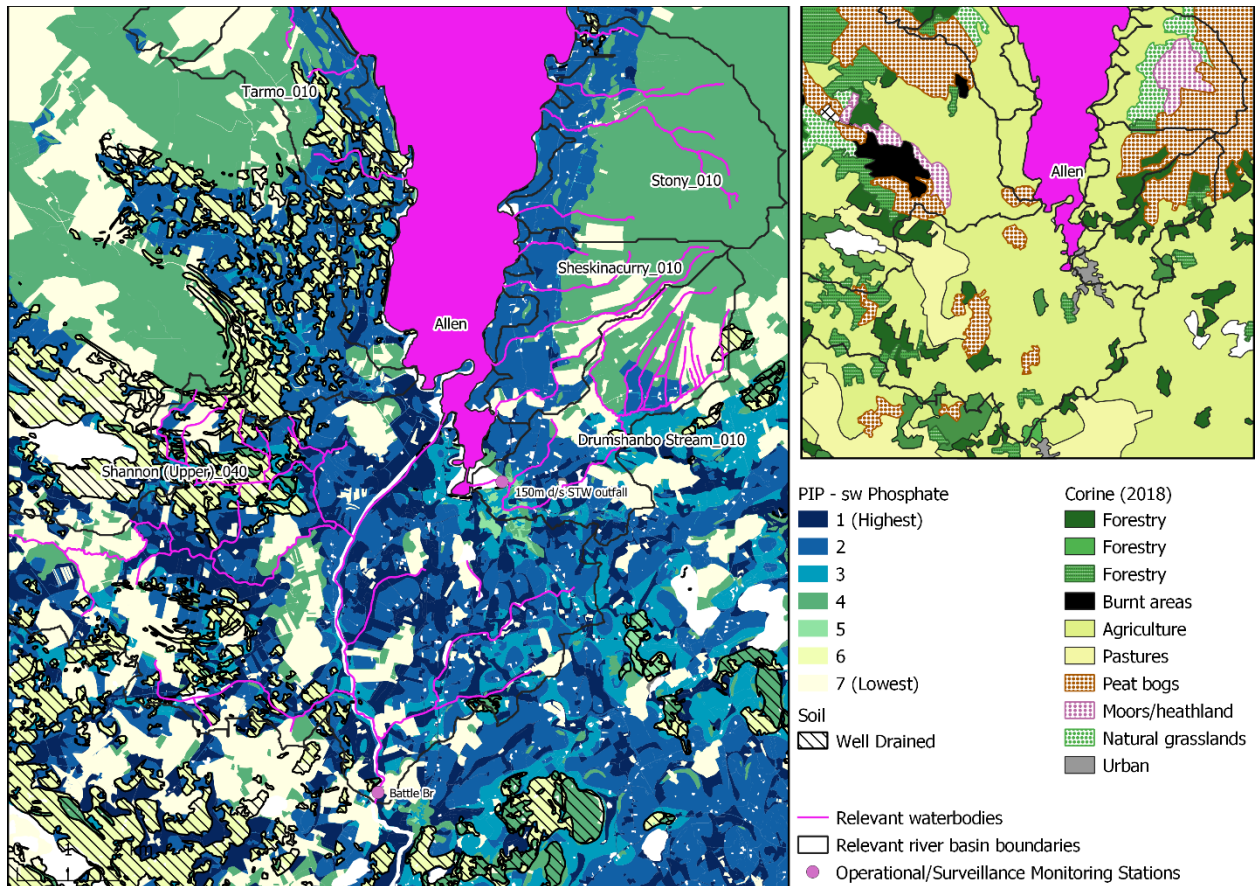


Figure 45 Pollution Impact Potential (PIP) map for surface water phosphate for southern section of PAA, areas where soils are well-draining have been indicated, Corine (2018) map included for comparison.

The predominant soil type in the PAA is poorly draining (Fig. 58), Figure 44 and 45 show that surface flow phosphate loss potential is largely predicted by land-use where soils are poorly draining; areas of peat and natural habitat tend to have a moderate potential while the PIP model picks out forestry as having the lowest potential, agricultural areas and urban areas of made ground have the highest potential for surface water phosphate loss. Where soils are well-draining within the PAA (mainly found in the Tarmo_010 waterbody and the section of the Shannon (Upper)_040 downstream of Lough Allen) phosphate loss potential tends to be low.

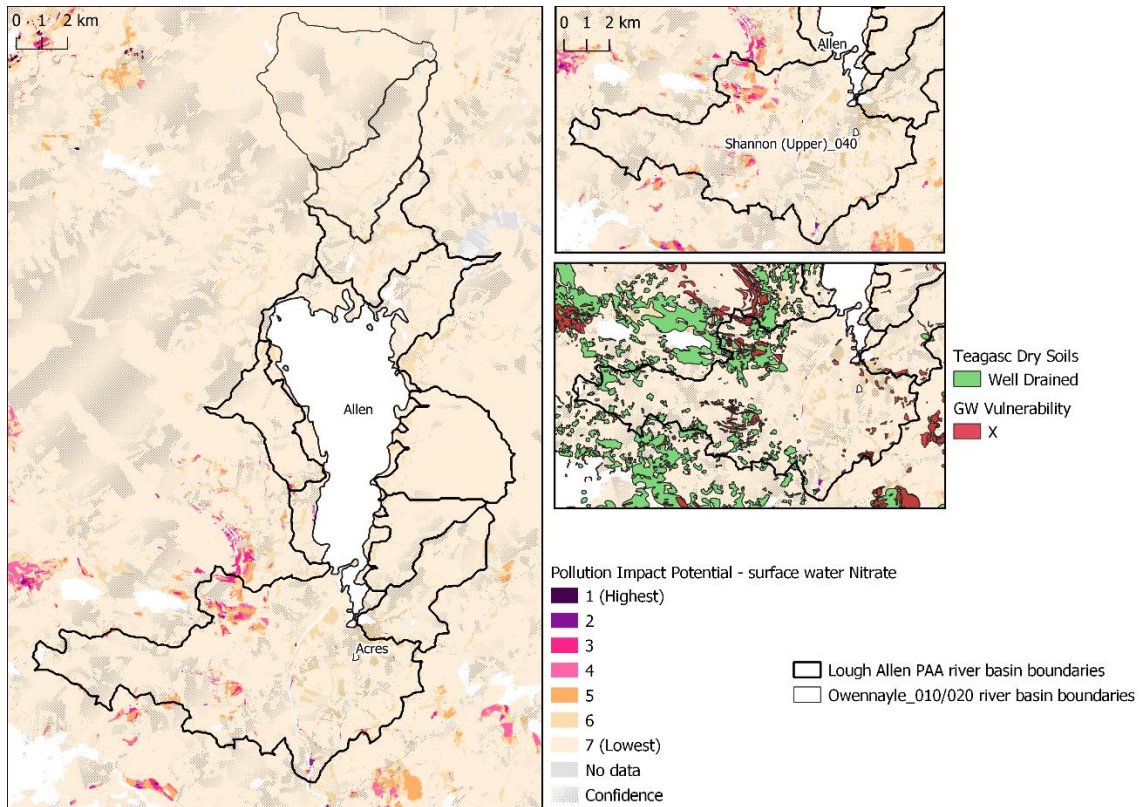


Figure 46 Potential Impact Potential map for surface water Nitrate for the Lough Allen PAA area.

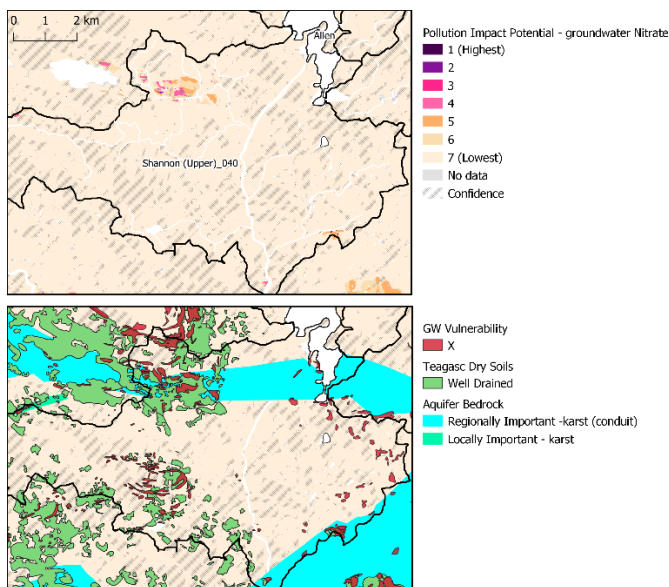


Figure 47 PIP map for groundwater Nitrate for Shannon (Upper)_040 area.

The PIP map for surface water nitrate loss (Fig. 46) shows predominantly low potential throughout the PAA due to the propensity of poorly draining soils. Some areas, shown in pink and orange, lying to the southwest of Lough Allen within the Shannon (Upper)_040 river basin, have a greater potential for nitrate loss to surface waters, these areas correspond with thin well-draining soil where depth to bedrock is less than 1m, where water does not seep into bedrock stores it may take a near-surface pathway to surface water where topography allows. The PIP map for groundwater nitrate loss (Fig. 47) highlights the same areas but limited to where the underlying bedrock is karst, leaving one area of

concern in the Shannon (Upper)_040 river basin near the headwaters of a tributary which flows to the main channel from the northwest.

3.4. Forestry

Forestry is listed as a significant pressure in the Tarmo_010 waterbody. The impact listed is *Other Significant Impacts: Sediment*.

The associated impact assessment details state:

High SW/NS P PIP: Rank 2 in the east and south of the sub-basin. Corine Land Cover Change (2012-18) - 17ha of scrub changed to conifer adjacent to the channel on the north side of the subbasin, noted in both 2006-12 and 2012-18. Leitrim CoCo - No new information. From satellite imagery - most probable pressures is forestry and agriculture, with sediment loss from forestry activities. Forest Service - Coillte Clearfell, Thinning & Replanting: Clearfelling 2015-2020: 5.33ha licenced. Thinning 2016-2019: 68.16ha licenced. Replanting: 1.21ha planted between 2012 and 2015. 0.00ha replanted between 2016-2019. Private felling: There was 6.34ha licenced for felling between 2017 and 2019 (6.34ha in 2018). Clearfelling minimal however, general forestry activities such as thinning and replanting have taken place in close proximity to channel, and is a likely significant pressure

Furthermore, Forestry is listed as a non-significant pressure in the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010. Forestry is the significant pressure in the Owennayle_010, upstream of the Owennayle_020 which has been considered here at desk study stage as it flows into the PAA (Shannon (Upper)_030).

Figure 48 below shows the combined forestry land-use of Coillte owned and privately-owned forestry in these river basins areas, Conifer High Forest is dominant and is planted on poorly draining and peaty soils (Fig. 58) in upland areas. See Appendix 3 for maps distinguishing Coillte owned from privately owned forestry.

Where impact due to forestry is suspected, LCA will pay attention to forestry drainage that may be transporting sediment, nutrients and/or pesticides to relevant waterbodies or causing an acidification effect, the hydromorphological impact of forestry on these upland streams will also be considered.

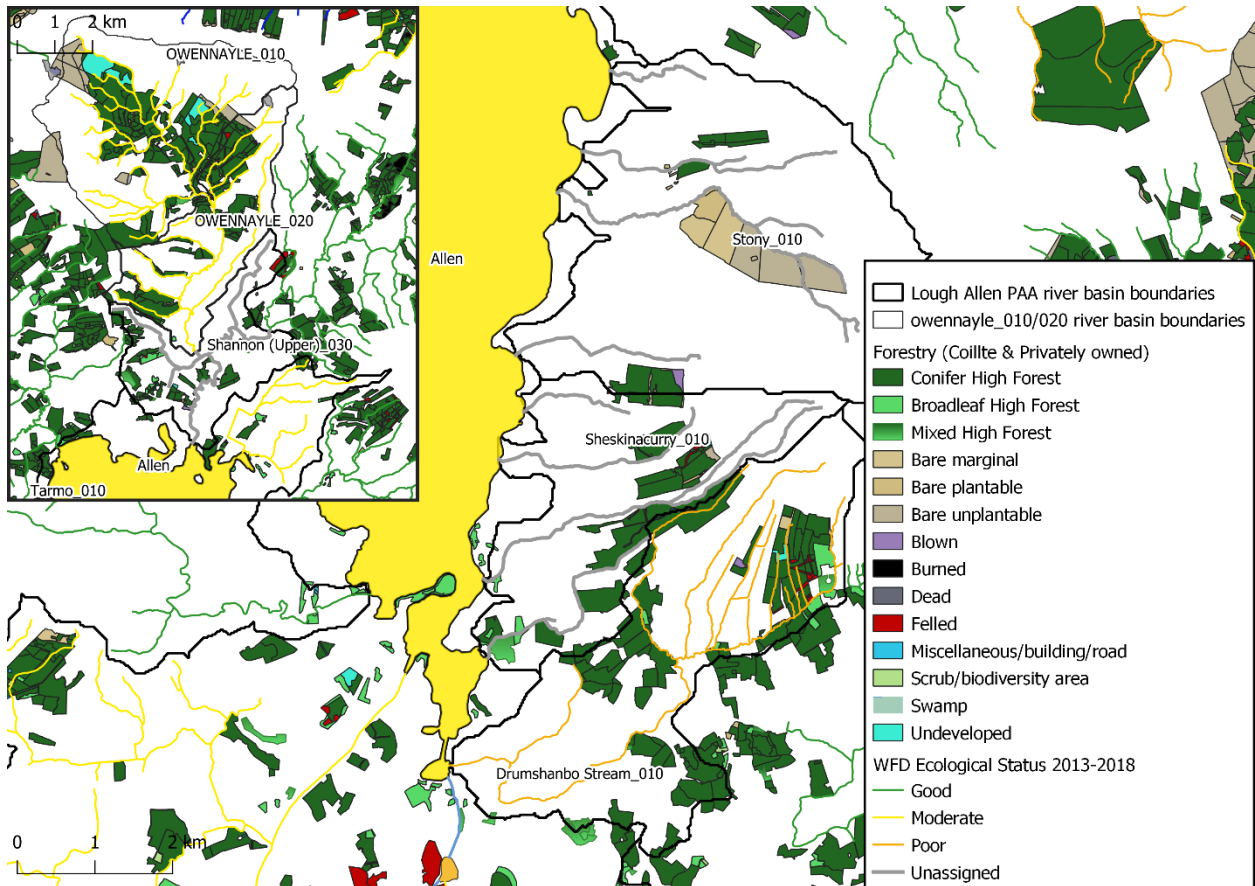


Figure 48 Forestry land-use, both Coillte owned and privately-owned, in the Stony_010, Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basin areas.

3.5. Hydromorphology

Hydromorphology (sub-category: Dams, barriers, locks, weirs) is listed as a significant pressure on the Drumshanbo stream_010 and the Shannon (Upper)_040. Impacts for the Drumshanbo Stream_010 are:

- Altered habitat due to Hydrological changes
- Altered habitat due to Morphological changes

The associated impact assessment details state:

Hymo MQI V1.05.01: Poor at the monitoring station reach – high impact from Upstream alteration of flows (dam/reservoir), River corridor connectivity/potentially erodible corridor (embankments, fisheries enhancements or other built features such as roads/pavements), and impact to channel morphology from peat extraction. Last available RHAT score was in 2008: Poor score with no riparian cover, no floodplain connectivity.

During LCA, consideration will be given to the over-all availability of suitable habitat for sensitive invertebrate species when assessing the Drumshanbo Stream_010, particularly at the WFD Operational station, 150m d/s STW outfall (RS26D050300).

The impact listed for the Shannon (Upper)_040 is:

- Altered habitat due to Morphological changes

The associated impact assessment details state:

Fish driving status. Hydromorphology MQI V1.05.01: Dams/Reservoirs weighting. Mix of High/Good/Moderate throughout, but Moderate at the reach of the monitoring station High impact to lateral connectivity from a dam, and presence of a potentially erodible corridor (marina also adjacent the basin outlet). Moderate RHAT for 2014: canal wall on left hand side, artificially raised

LCA in the Shannon (Upper)_040 will focus on determining if the section inputting to Lough Allen is impacted.

3.6 Anthropogenic (Unknown)

A significant pressure of Anthropogenic (subcategory: unknown) is listed for the Shannon (Upper)_040 and the Diffagher_010.

The impact listed for the Shannon (Upper)_040 is Other Significant Impacts - *Other: fish status*. The associated impact assessment details state:

Pressure not known. 2013-2015 Cycle 3 Update: Added Fish Status to Other Impact. At the local authority workshop for Cycle 2, it was noted that the salmonids in the Shannon Upper aren't doing well, that there are a number of barriers in order to get up this far, and a long distance to travel. Coarse fish noted to have taken over and presenting competition and therefore driving status.

The IA1 Provision of Information on this waterbody lists the IFI as the responsible organisation.

The associated impact assessment details for the Diffagher_010 state:

2023 Characterisation Update: Status driven by a small tributary to main channel draining SW of sub basin. The main channel is good (sampled 2021) but in 2020 scored moderate due to sediment caused by a landslide - this landslide did not appear to effect the tributary. A third site in the sub basin also assessed good in 2020. Forestry is present but no forestry activities in the relevant area were identified that could account for the status drop. Agricultural land use has declined over the last 10 years. No point sources identified,

LCA will focus on assessing the impact of the above-mentioned landslide on Lough Allen, the landslide is discussed below.

3.6.1. Landslide 28th June 2020

On Sunday the 28th June 2020 at the end of a week of increased rainfall following a prolonged period of approx. 13 weeks of very low rainfall, a landslide occurred in the Diffagher_010 catchment causing significant damage at the Dawn of Hope Bridge, with sediment blocking the road approx. 3km downstream at Corcormick Bridge and suspended sediment impacts being visible approx. 8km downstream of the Dawn of Hope Bridge as far as Corry Strand on Lough Gill (Fig. 49). An investigation carried out by Leitrim Co.Co. using drone footage pinpointed the initial failure area to approx. 1km NE of the Dawn of Hope Bridge on the boundary of an area of privately owned forestry and an area of blanket bog/wet heath in the Boleybrack Mountain SAC. Maynooth University, University College Dublin and Trinity College Dublin are undertaking academic research into the causes of the landslide with survey data from aircraft and drone footage hosted on DPERM (Data Platform for Emergency Response Management) based at Maynooth University. Leitrim Co. Co. has shared data from three sampling

rounds taken along the course of the river affected by the landslide and downstream of the main impact area on the 30th June, 21st July and 26th August (see Fig. 50-52). The Dawn of Hope Bridge site remained significantly impacted on the 26th August, two months after the event (Fig. 50), downstream sampling sites improved, however on the same date, over 5km downstream, at Greyfield Br the ortho-phosphate concentration was just above the EQS of 0.035mgP/l at 0.037mgP/l, a further 600m downstream at the Cloonmeone Br suspended sediment was at 34 mg/l (the threshold for salmonid waters is 25 mg/l). Figure 52 shows total phosphorus and suspended sediment concentrations from shoreline samples taken at Corry Strand after the landslide in comparison to Spencer Harbour, this data suggests sediment and associated phosphorus has impacted the lake as a result of the landslide. As part of the LCA it will be difficult to assess if a reservoir of nutrients is being retained in the lake bed sediment as a result of the landslide. WFD General Chemistry monitoring (Table 3) shows an increase in total phosphorous concentrations in 2021-2022 at Site 1, in the northwest of the lake near the Owengar River inflow. This suggests that sediment, transported by the landslide to the lake bed of Lough Allen, may still be contributing nutrients.

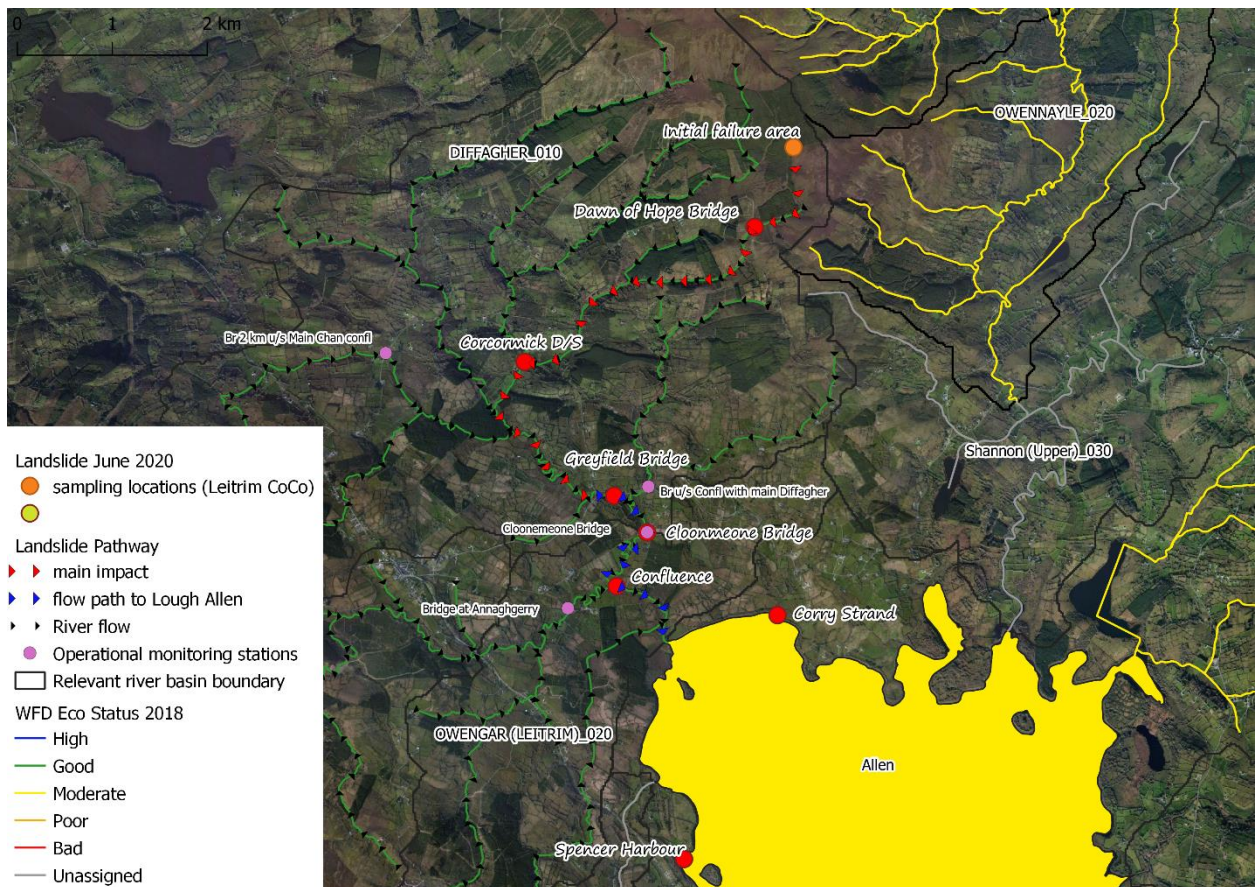


Figure 49 Pathway of June 2020 landslide.

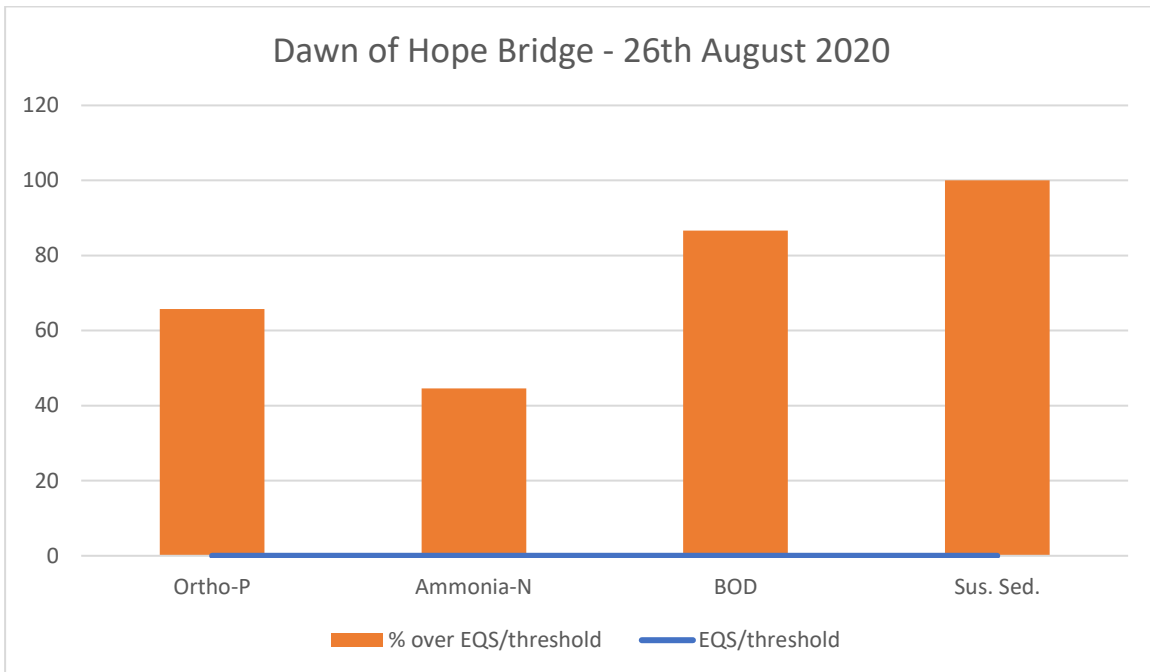


Figure 50 Showing the levels of nutrients, SS and BOD as percentage above the EQS/threshold at the Dawn of Hope Bridge on the 26/08/2020 (data from Leitrim Co. Co.).

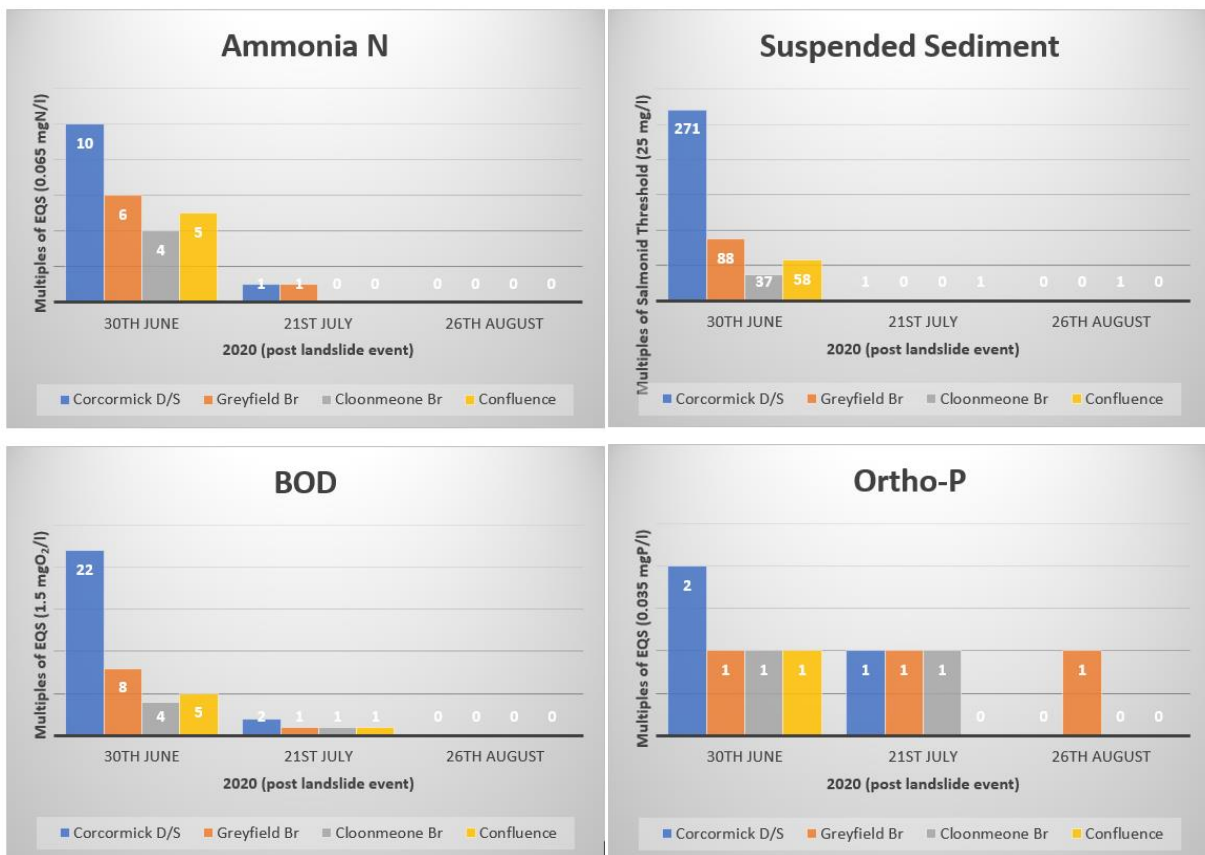


Figure 51 Showing the levels of nutrients, SS and BOD as multiples of the EQS/salmonid threshold at four progressively downstream locations between the Dawn of Hope Bridge and Lough Allen, taken at three dates after the landslide (data from Leitrim CoCo).



Figure 52 Showing the levels of TP and SS as multiples of the EQS/salmonid threshold at Corry Strand and Spencer Harbour in Lough Allen, taken at three dates after the landslide (data from Leitrim CoCo).

3.7. Extractive Industry

The extractive industry (peat) is listed as a significant pressure in the Owennayle_020 which flows into the Shannon (Upper)_030. It is listed as a non-significant pressure in four waterbodies; the Stony_010, the Sheskinacurry_010, the Tarmo_010 and the Drumshanbo Stream_010. For the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010 it is a peat extraction pressure and for Tarmo_010 it is quarries. The Corine Land Cover Map (2018) (Fig. 43) shows the Sliabh an Iarainn uplands in the east of the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010 river basins and the Corry Mountain uplands in the west of the Tarmo_010 river basin are areas of predominantly blanket peat. The uplands to the east (Bencroy, Knockacullian, Sliabh an Iarainn, Largan Mountain) and west (Corry Mountain, Kilronan Mountain) of Lough Allen are Namurian sandstones and shales which historically have been mined, mainly for coal (Connaught Coalfields, e.g. Arigna mines) but also for minerals/metals. Currently, the Corine Land Cover Map (2018) indicates the economic land use in these uplands is mainly forestry with sandstone and shale quarries to the west, notably there are also wind farms on the uplands to the west. Drainage channels from these activities to impacted rivers and streams will be assessed as part of the LCA, focusing on the transportation of sediment, nutrients and/or pesticides to relevant waterbodies and/or acidification effects, hydromorphological impacts will also be considered.

3.7.1. Peat

The impacts listed in the Owennayle_020 are:

- Acidification
- Other Significant Impacts: Sediment

The associated impact assessment details state:

Owennayle_020 had a change of 4.8% peat to burnt areas as well as some evidence of felling and planting. Activity was focussed in the headwaters of Owennayle_010 which remained at Moderate status, so inconclusive whether these activities were related to status change. SLAM V2.06 (12-14): Peat 14%. EPA Q-value Viewer: decline to Moderate conditions. This is the lowest condition this formally High ecological condition site has been in since monitoring started in 1976. Corine land cover change (2012-18) mapping indicates potentially 233 ha area of change from peat bog to burnt area. Cavan CoCo - No information regarding peat burning. No complaints recorded for this area.

Peat extraction is listed as a non-significant pressure in the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010 waterbodies. It is not clear from aerial imagery if cutting takes place in any of these river basins. The Teagasc subsoils map of areas of blanket peat and “cut” peat (taken to mean areas where peat is drained, either for cutting or agricultural reclamation of land) in these three river basins is shown in Figure 49. The impacts of peat extraction will be considered as part of the LCA. The following load apportionment model figures are included in the initial characterisation assessment details on the WFDApp

- Stony_010 impact assessment - LAMv2.04 23% P. Blanket Peat, it's not clear from aerial imagery if cutting takes place.
- Sheskinacurry_010 impact assessment -LAMv2.04 19% P. Blanket Peat near headwaters.
- Drumshanbo Stream_010 impact assessment - LAMv2.04 11% P.

3.7.2. Quarries

Extraction from quarries is listed as a non-significant pressure in the Tarmo_010. There is a shale quarry present in the river basin located approx. 400m from the headwaters of the most southern of Tarmo_010's three independent streams (Figure 53).

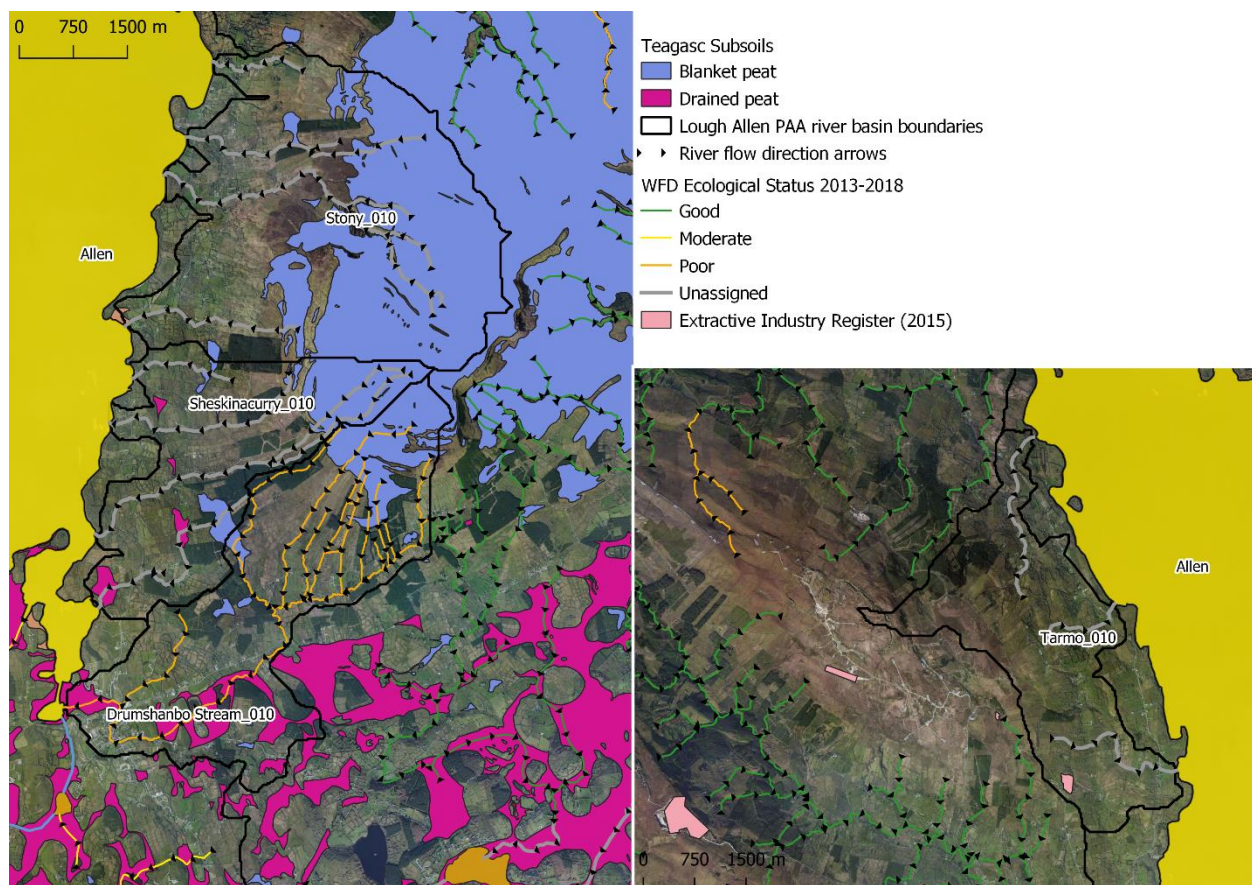


Figure 53 Teagasc Subsoils map showing areas of blanket peat and drained peat in the Stony_010, Sheskinacurry_010 and Drumshanbo Stream_010 river basins (left), map of areas on Extractive Industries Register in and around the Tarmo_010 river basin (right).

3.8. Other pressures

Pressures which have not been listed in 2nd cycle characterisation for waterbodies in the Lough Allen PAA but should receive consideration where appropriate as part of the LCA are discussed below.

3.8.1. Ballinagleragh Urban Wastewater Treatment

The Ballinaglera WWTP is located in the Shannon (Upper)_040 river basin and has a Certificate of Authorisation (A0469-01), it is an agglomeration with a p.e. of 64 as of 31st October 2011¹⁵, the WWTP provides secondary treatment, consisting of an activated sludge process and phosphorus removal, and has a design capacity of 100 p.e. The location of the WWTP and the associated emission points are shown in Figure 54. There are no EPA monitoring points on this section of the Shannon (Upper)_040 which flows into Lough Allen. Leitrim County Council have also granted a Section 4 discharge licence to a treatment system at Greaghnafarna housing estate (SS/W/95/01) which lies within the Shannon (Upper)_040 river basin but is located >400m from any river channel, it is also shown in Figure 54.



Figure 54 Ballinaglera WWTP and Greaghnafarna housing estate Section 4 discharge licence (SS/W/95/01) in relation to the Shannon (Upper)_040.

¹⁵ EPA Inspectors Report, Re: Application for a Waste Water Discharge Authorisation from Leitrim County Council, for the agglomeration named Ballinagleragh, Reg. Re: NO. A0469-01.

3.8.2. Dowra Urban Wastewater Treatment

The Dowra WWTW, located in the Shannon (Upper)_030 river basin, has a Certificate of Authorisation (A0299-01). It is an agglomeration with a p.e. of 130 as of 7th April 2011¹⁶, the WWTP provides secondary treatment, consisting of an activated sludge system and phosphorous removal, and has a design capacity of 176 p.e. The location of the WWTP and the associated emission points are shown in Figure 55. The single monitoring point on the Shannon (Upper)_020, *Dowra Br* (RS26S020300), is at the downstream limit of the waterbody as it flows into the Shannon (Upper)_030, just upstream of the Dowra Wastewater Works, but there is no available chemistry data after 2015, the available 2008-2015 data show no breaches of EQS/ecological threshold for ortho-phosphate, ammonia or TON, the BOD EQS is breached in 2010 and 2013-2014. There is no available data for any point on the Shannon (Upper)_030 downstream of the WWTW, the impact of which will be assessed as part of the LCA.



Figure 55 Dowra WWTW in relation to the Shannon (Upper)_030.

¹⁶ EPA Inspectors Report, Re: Waste Water Discharge Authorisation from Cavan County Council, for the agglomeration named Dowra Waste Water Treatment Works, Reg. No. A0299-01.

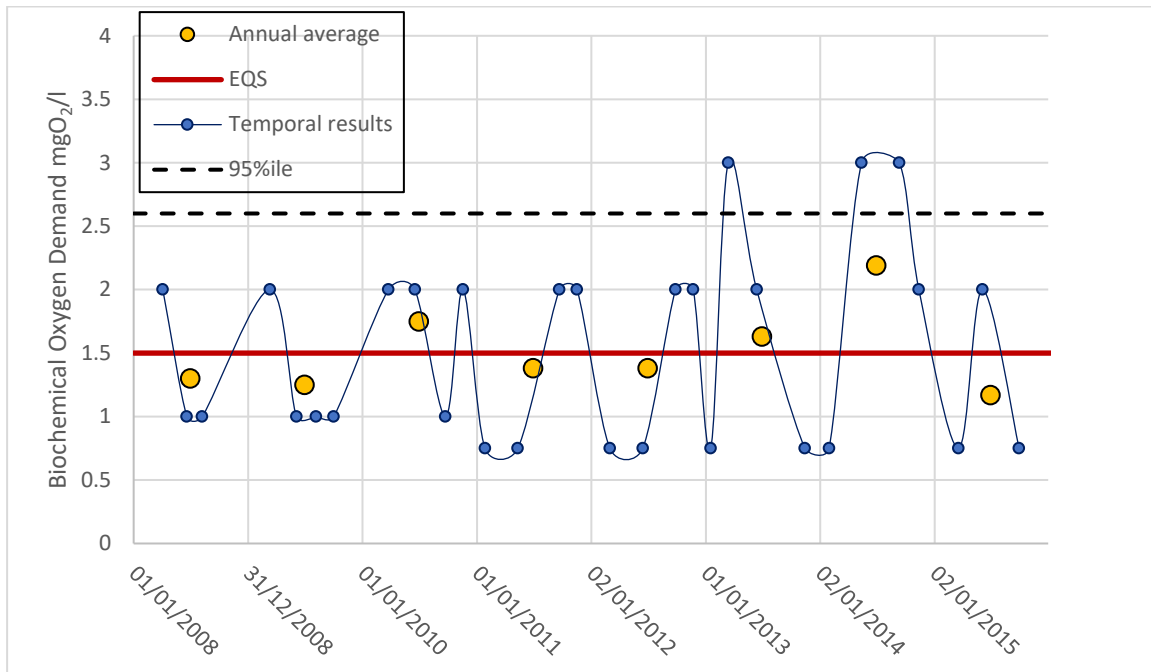


Figure 56 BOD data¹⁷ for monitoring station *Dowra Br* (RS26S020300) on the Shannon (Upper)_020, upstream of Dowra Wastewater Works.

3.8.3. Licensed facilities

Barna Waste Disposal Limited hold a licence (W0216-01) for a waste transfer facility at Ardcolumn in the Shannon (Upper)_040 river basin downstream of Lough Allen. The facility, however, is >600m from any WFD surface water body and as per its waste licence should not pose a risk to watercourses.

3.8.4. Domestic Wastewater Treatment units

Due to the predominantly poorly draining soil type in the Lough Allen PAA (Fig. 58), domestic wastewater treatment units are more likely to have a potential for phosphorous loss to surface water rather than nitrogen loss, 2018 SANICOSE modelling infers this trend also.

¹⁷ Please note the detection limit from 2008-2010 is 2 mgO₂/l, from 2011-2015 it is 1.5 mgO₂/l.

4. Pathway information and analysis

The Local catchment Assessment (LCA) utilises the source-pathway-receptor (SPR) approach, which requires an understanding of the pathway a pollutant may take to reach a waterbody. A conceptual model of potential pathways is developed below to inform the LCA.

4.1. Overview of Pathways within the PAA

The conceptual model of pathways for the Lough Allen PAA has been divided into three compartments, one for the urban area of Drumshanbo Town and two compartments based on the aquifer bedrock type¹⁸ (Fig. 57):

1. Drumshanbo town is made ground where flow pathways will be directed by the urban drainage system and overflows/discharges from the sewerage system, point discharge tends to dominate over diffuse flow.
2. Non-karstified bedrock where groundwater transmissivity is likely to be low, flow directions are expected to reflect the topography, and base flow to rivers and streams is likely to be generally relatively low. Groundwater flow pathways are likely to be short and through the weathered zone or fissures, particularly in the vicinity of the fault zones (Fig. 57). The aquifer categories are:
 - LI – locally important aquifer which is moderately productive only in local zones (Dinantian mixed sandstones, shales and limestones and Dinantian lower impure limestones)
 - Lm – locally important aquifer which is generally moderately productive (the Dinantian Glenade Sandstone Formation)
 - Pu – poor aquifer which is generally unproductive (Namurian shales)
 - PI – poor aquifer which is generally unproductive except for local zones (Namurian sandstones, Dinantian shales and limestones and Devonian Old Red Sandstone (ORS))

The majority of the area of this compartment is bedrock of the Lough Allen Uplands groundwater body (GWB) forming the uplands around Lough Allen with hard Namurian sandstone capping the highest regions and the poorly draining land of the slopes being underlain by Namurian shales which the draining streams cut through, the valleys contain drumlins of mainly ground-down shale debris contributing to the waterlogged nature of the soils and are underlain by Dinantian mixed sandstones, shales and limestone and Dinantian shales and limestones. In addition to bedrock the Lough Allen Uplands GWB, the river valley of the Upper Shannon entering Lough Allen from the north east is underlain by the Glenade Sandstone Formation of the Glenade Dowra GWB which is expected to have higher fissure permeability and therefore transmissivity, collapse features and some sinking streams and risings have been noted in this formation in Northern Ireland (Fermanagh) and may occur here also. To the south of Lough Allen the outflowing Shannon (Upper)_040 is mainly underlain by the eastern end of the Curlew Mountain GWB, this is an inlier bounded in this area by the Curlews Fault to the north and the Woodbrook Fault to the south separating it from the surrounding karstified limestone, it comprises Devonian ORS and Dinantian impure limestones and Dinantian mixed sandstones, shales and limestones. These rocks are devoid of intergranular permeability with the weathered zone being the main region of any

¹⁸ Groundwater flow info from GSI Groundwater body descriptions - <https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx>

transmissivity, with short flow paths towards the rivers, however locally permeability may be enhanced in the vicinity of the fault zones. See Appendix 1 for GWB map.

3. Karstified bedrock where groundwater-surface water interactions are expected where the overlying soil is well-draining (Fig. 58), where bedrock is at or near the surface (Fig. 60), and especially via karst features such as caves, springs, enclosed depressions and swallow holes (Fig. 57). These interactions may transport contaminants from the land, especially those which are hydrophilic, such as nitrate, to groundwater which may discharge to surface waters via springs. These groundwater pathways are difficult to predict where tracer lines have not been established, flow is likely to be through the epikarst layer or through deeper conduit pathways where flow direction may locally be very variable and may not reflect the overlying topography, it may discharge outside the surface water catchment area, likewise, discharges from springs within the catchment may originate from outside the boundaries. Flow velocities may be rapid and variable both spatially and temporally. The bedrock consists of Dinantian pure bedded and unbedded limestones and the aquifer category is:

- Rkc – regionally important karstified bedrock which is dominated by conduit flow (Bricklieve Limestone Formation)

The Bricklieve Limestone Formation of the Geevagh GWB runs in an east-west direction across the south of Lough Allen underlying a sliver to the north of the Shannon (Upper)_040 and to the south of the Drumshanbo Stream_010. It is bounded to the north in this area by the shale rich Lough Allen Uplands GWB and to the south by the Curlews Fault bringing it into contact with the Curlew Mountain GWB. Drumlins and peat are frequent in this area providing some barrier to surface water-groundwater interactions however inter-drumlin areas where the limestone bedrock outcrops or sub-crops will be pathways for contamination of groundwater, as the Geevagh GWB is At Risk springs/risings may pose a danger to surface water bodies as is suspected in the case of phosphate and the Drumshanbo Stream_010 (see section 2.2.6. and 3.3).

The two aquifer type compartments are further subdivided based on the overlying soil (Fig. 58) as this tends to determine the likelihood of surface water flow verses sub-surface flow:

- A. Poorly draining soil or peat where surface water flow is likely and in agricultural areas drains are to be expected, these soil types tend to create pathways for potential phosphate loss. Peat dominates the upland areas with poorly draining soil dominating the hillsides and valleys, most of the mainly shale derived drumlins occupying the valleys are overlain by poorly draining soil. Areas of low-lying peat tend to be classified as cut peat by the subsoils map (Fig. 59) and occupy inter-drumlin areas to the south of the Lough Allen uplands where elevation falls off. Drainage of peat creates pathways for ammonia and sediment loss, among other contaminants. Mineral alluviums are deposited along slower flowing sections of the Shannon comprising the banks and floodplains, they are moderately draining sediments deposited by the river systems and are not considered to be well modelled by the EPA Susceptibility Maps, nutrient transport pathways in these sediments are less well understood but are considered to behave more like poorly draining soils than well-draining soils, allowing for surface water phosphate pathways. Where they are located the water table would be expected to be at or close to the surface leading to the increased likelihood of surface water run-off, any significant sub-surface flow in these deposits would be expected to be laterally transported to the river channel as base flow.
- B. Well-draining soils in the PAA are scattered areas on some drumlins to the south which contain more freely draining material or thin soils overlying bedrock. Well-draining soil can act as a pathway for nitrogen loss from agricultural areas to ground and/or surface water. Where soils are

thin and overlying karst bedrock groundwater is extremely vulnerable to contamination which has the potential to be rapidly transported to surface waters via springs.

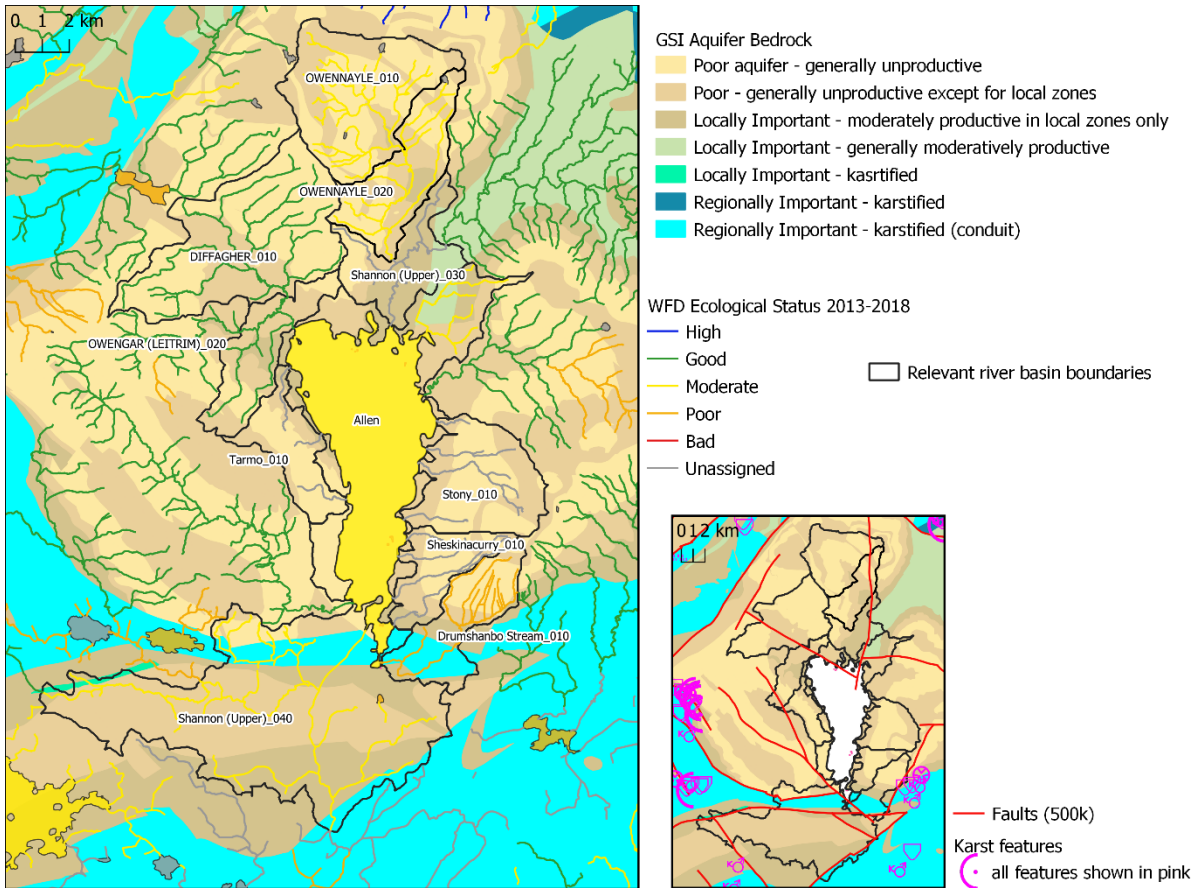


Figure 57 The aquifer bedrock for the Lough Allen PAA, major faults also shown, recorded karst features shown to lie outside PAA boundaries.

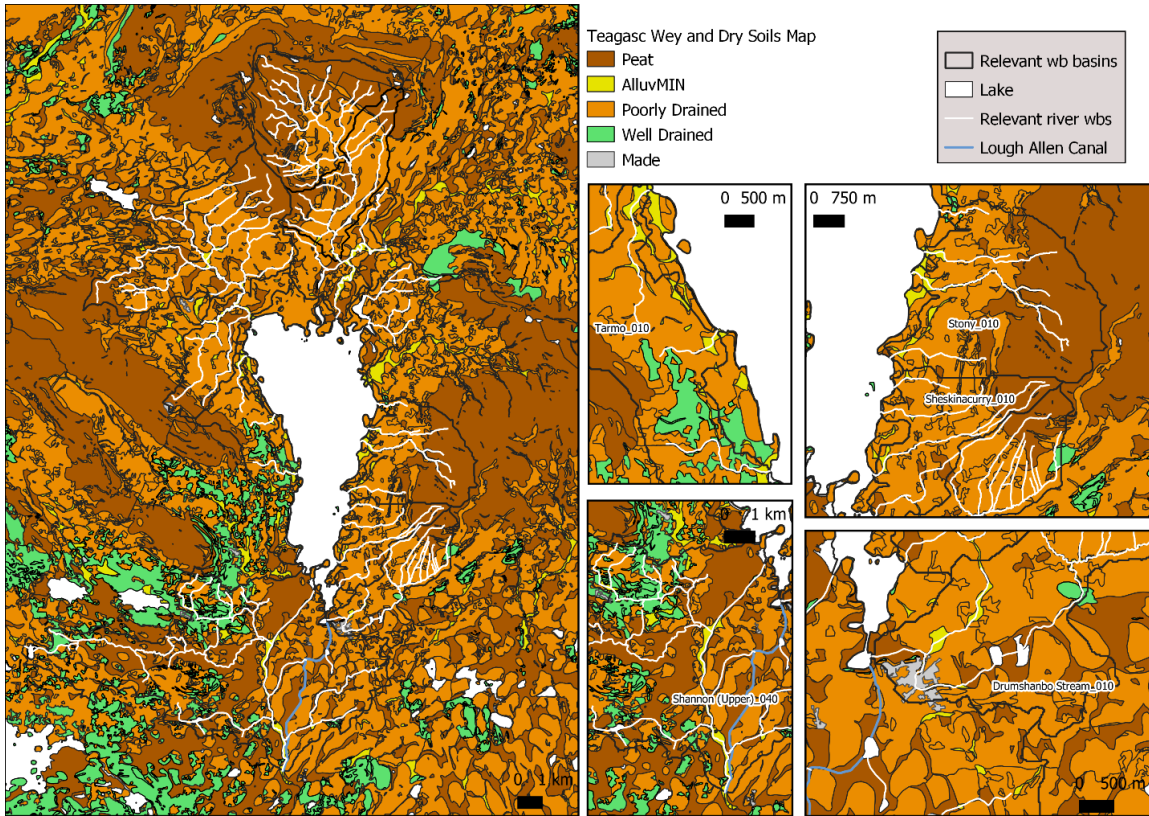


Figure 58 The wet and dry soils for the Lough Allen PAA.

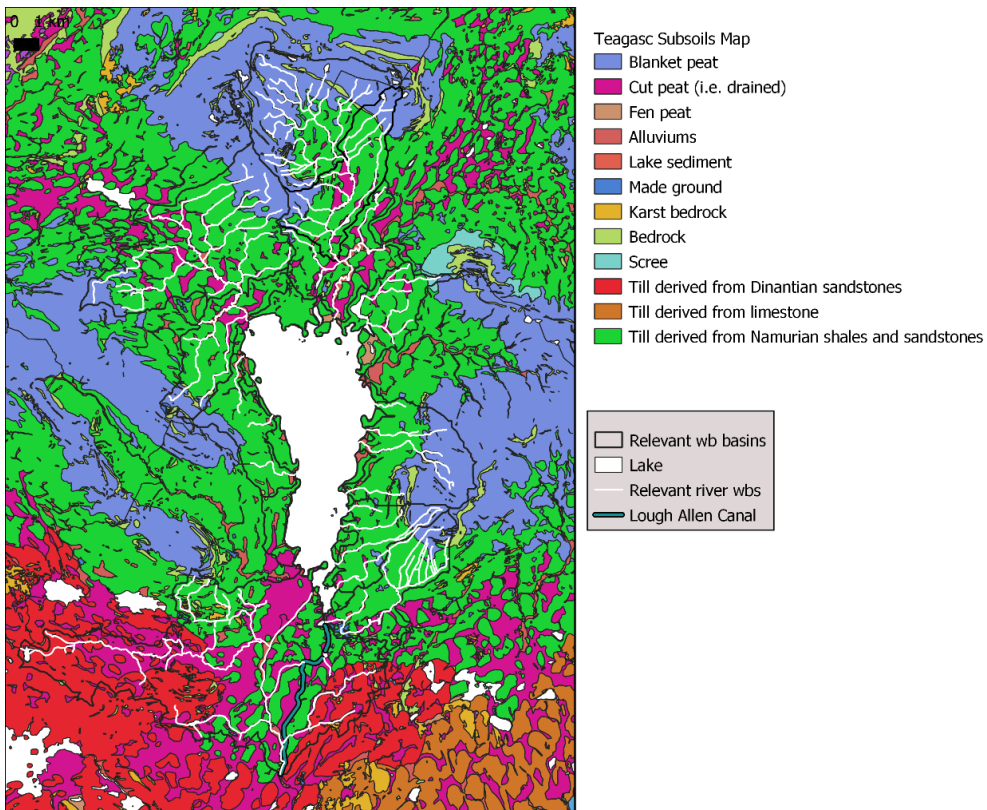


Figure 59 The subsoil type for Lough Allen PAA.

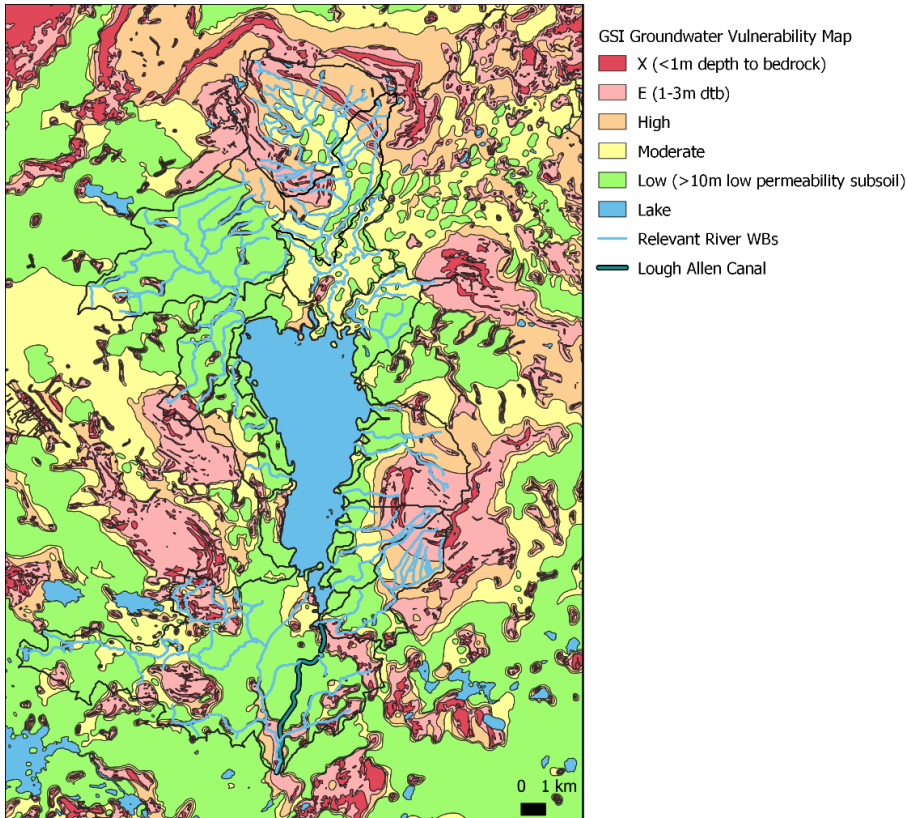


Figure 60 The groundwater vulnerability for the Lough Allen PAA.

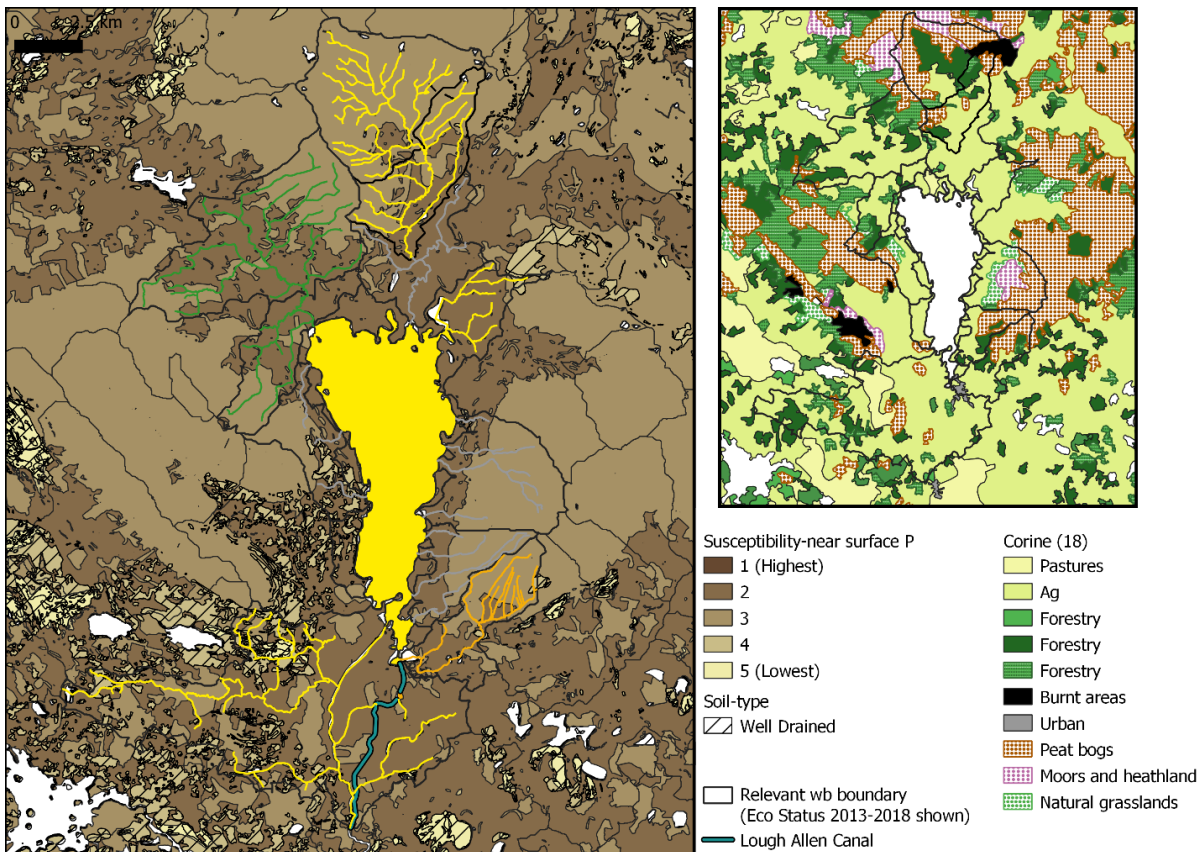


Figure 61 The near surface PO4 susceptibility map for the Lough Allen PAA with Corine (2018) map for comparison.

Susceptibility for Phosphorous loss tends to be moderate to high due to the predominance of poorly draining soils, as with the PIP map areas of agricultural land-use on these soils have the highest susceptibility. Areas of well-draining soil, shown on the map by the hashed design, have low susceptibility to P loss.

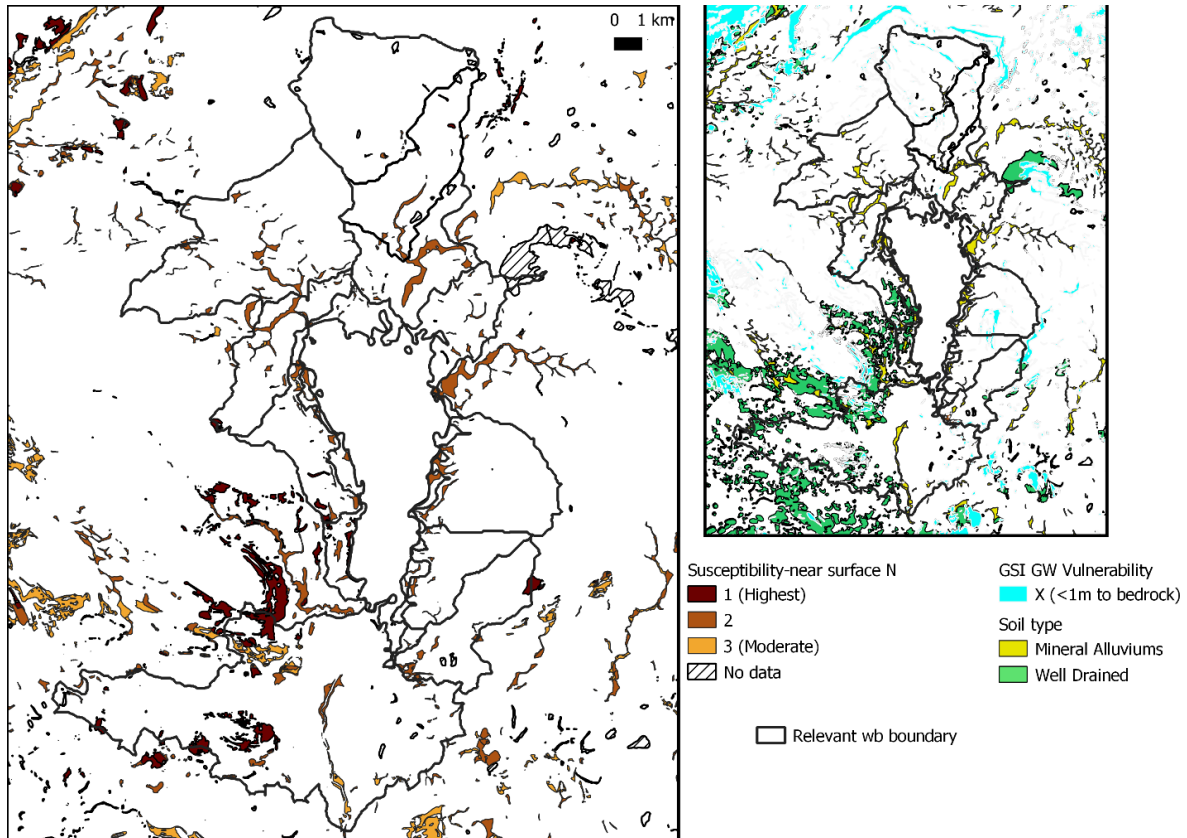


Figure 62 The near surface NO3 susceptibility map for the Lough Allen PAA with map showing moderately-well draining soil type and areas of X groundwater vulnerability for comparison.

Susceptibility for Nitrogen loss to near surface flow is highest where bedrock is at the surface or <1m thick well-draining soils drape bedrock. Where 1-3m thick well-draining soils/subsoils overly bedrock susceptibility is moderate. Other areas picked out as moderate-high by the susceptibility map correspond to mineral alluvium deposits however these soils are not considered to be well modelled by the EPA Susceptibility Maps as discussed above.

Table 6 Conceptual model information for the pathways.

	Compartment 1 Urban (Drumshanbo)	Compartment 2 Non-Karst bedrock	Compartment 3 Karst bedrock		
Direct ¹⁹	D0144-01: WWTP discharge SWO x2 EO (SW6) Possible unlicensed discharge Possible misconnections	A0469-01: Ballinagleragh WWTP discharge and SWO A0299-01: Dowra WWTP discharge, SWO and EO Agricultural, forestry and extractive industry drains Possible misconnections, including from DWWT units	D0144-01: WWTP Discharge, SWO at WWTP inlet and EO in transition zone between urban compartment and karst bedrock compartment Forestry and agricultural drains		
Aquifer (Fig. 57)	Rkc, LI	LI, Lm, Pu, PI	Rkc		
Rock Units	Rkc: Dinantian pure bedded Lst LI: Dinantian pure unbedded Lst Dinantian mix Sst, Sh, Lst Devonian ORS	LI: Dinantian mix Sst, Sh and Lst, Dinantian lower impure Lst, Lm: Dinantian Sst, Pu: Namurian shales, PI: Namurian Sst , Dinantian Sh and Lst, Devonian ORS	Dinantian pure bedded Lst (Bricklieve Limestone Formation)		
	Sub-Compart. 2A	Sub-Compart. 2B	Sub-Compart. 3A	Sub-Compart. 3B	
Soil type (Fig. 58)	Made Ground	Poorly draining/Peat/Alluviums	Well-draining	Poorly draining/Peat/Alluviums	Well-draining
Subsoil (Fig. 59)	Made Ground	TNSSs, TDSs, Rck, L/BktPt, Cut/A	TNSSs, TDSs, Rck	TNSSs/Cut/A	KaRck, TNSSs
Subsoil Permeability	N/A DTB<3m	Low ²⁰ or N/A where DTB<3m (Alluviums occasionally Mod)	Low or N/A where DTB<3m	Low or N/A where DTB<3m	Low or N/A where DTB<3m
Groundwater Vulnerability (Fig. 60)	X-E	X,E,H,M,L	X,E,H,M,L	X,E,H,M,L	X,E,H,M
PO ₄ Susceptibility (Fig. 61)	Mod-High	Mod-High	Low	Mod-High Higher where Ag land-use	Low

¹⁹ Point discharges to waterbody

²⁰ 5-6 acres of GNSSs (sands and gravels derived from Namurian shales and sandstones) along SW shore of Mahanagh Lough in Shannon (Upper)_030 where subsoil permeability is high

NO ₃ Susceptibility Near-surface (Fig. 62)	Mod-High	Low (Alluviums often classified as High)	High where DTB<1m otherwise Low	Low (Alluviums often classified as High)	Low-Mod
NO ₃ Susceptibility Sub-surface	Low-Mod	Low	Low	Low	Low where vuln. M, H Mod where vuln. E High where vuln. X
PO ₄ PIP (Fig. 44)	Moderately High	Ag land-use tends High Upland peat - Mod Forestry and nat. hab. - Low	Low	Ag land-use tends High Forestry and nat. hab. - Low	Tends Low Mod where vuln. X
NO ₃ PIP Surface water (Fig. 46)	Low	Low	Low Mod where DTB<3m Moderately High DTB<1m	Low	Low where vuln. M, H Moderately Low where vuln. E Moderately High where vuln. X
NO ₃ PIP Groundwater (Fig. 47)	Low	Low	Low	Low	Tends Low Moderately low-High where vuln. X
Main Flow Paths	Surface flow, point discharges, base flow to stream from Lsts via conduits/epikarst/fracturing related to fault zones	Surface flow, Point discharges from drains	Near-surface or sub-surface flow	Surface flow, Point discharges from drains	Near-surface or sub-surface flow SW-GW interactions via karst features
Most likely SW Issue(s)	Diffuse/small point: PO ₄ , NH ₄ , hydrocarbons, heavy metals, sediment, microbial pathogens, herbicides, surfactants SWOs/EO: as above + NO ₃ , BOD/COD GW/SW interactions: Geevagh (Rkc) GWB At Risk, may transport PO ₄ , NO ₃ from surrounding Ag landuse	PO ₄ , sediment	NO ₃ where DTB<3m and pathway to waterbody exists.	PO ₄ , sediment GW/SW interactions: Geevagh (Rkc) GWB At Risk, may transport PO ₄ , NO ₃ from surrounding Ag landuse	NO ₃ where DTB<1m (vuln. X) and GW pathway to waterbody exists (via risings/spring/base flow). PO ₄ where karst bedrock at surface and rapid GW pathway to waterbody exists (via risings/spring/base flow).

5. Interim ‘story’ of the Priority Area for Action

The PAA consists of Lough Allen, its inputting and outputting river waterbody, the Shannon (Upper)_040, and five other of its inputting river waterbodies: the Shannon (Upper)_030; and four independent streams, the Tarmo_010, the Stony_010, the Sheskinacurry_010 and the Drumshanbo Stream_010. A further three river waterbodies are discussed here at desk study stage due to their likely impact on waterbodies within the PAA: the Diffagher_010 flows into the Owengar (Leitrim)_020 which flows into Lough Allen, both waterbodies have been affected by a landslide event occurring on the 28th of June 2020; the Owennayle_020 flows into the unassigned Shannon (Upper)_030, its Biological Status dropped from Good to Moderate in 2017.

Lough Allen is at Moderate Ecological Status (2016-2021) driven by its macrophyte status. The Shannon (Upper)_040 is at Moderate Ecological Status (2016-2021) driven by its fish status, the section of the river waterbody flowing into Lough Allen does not contain any WFD monitoring stations therefore its impact on the lake is unknown. The Drumshanbo Stream_010 is at Moderate Ecological Status (2016-2021) driven by invertebrate status with ortho-phosphate, total ammonia and BOD impacts, the three significant pressures listed in the 3rd cycle initial characterisation of this waterbody are the Drumshanbo Waste Water Treatment Agglomeration, agriculture and hydromorphology. The Tarmo_010, Stony_010, Sheskinacurry_010 and Shannon (Upper)_030 all have low confidence, modelled Ecological Status.

5.1. Allen

Risk category: At Risk

Status: Moderate Ecological Status (2016-2021) driven by macrophyte status, hydromorphological conditions moderate also.

Hydrochemistry summary: Seven sites throughout the lake sampled for supporting chemistry with data available from 2008-2022 for TP and Chlorophyll_a and from 2007-2022 for Total Am, except for Site 5 which has no data from 2020-2021. The annual average for the lake (all sites combined) was at the TP EQS threshold in 2020 and breached the threshold in 2021. Site 7 has reached the threshold TP EQS or breached it from 2008-2022 and breached the EQS for Chlorophyll_a from 2008-2011, 2013-2019, 2021-2022, located in the southern section of the lake where the flow is likely to be in a northerly direction from *South Pond*, into which the Drumshanbo Stream_010 flows and the Lough Allen Canal is connected, towards the Shannon (Upper)_040 outlet. A notable jump in the lakes overall annual average TP occurred from 2020-2022. The TP issue at Site 7 worsened while breaches of the EQS were also noted at Site 1, Site 2, Site 5 and Site 6. Excepting Site 7, Site 6 tended to have higher concentrations of TP, followed by Site 1. Site 6 is in the southern section of the lake, just north of Inisfale Island, where the lake narrows before flowing into the Shannon (Upper)_040 outlet. Site 1 is in the northwest of the lake near the Owengar River inflow, this inflow was impacted as a result of the 28th June 2020 landslide initiating in the upstream Diffagher_010.

Baseline Concentration: Baseline (2020-2022) average all sites: TP 0.028 mg P/l; Total Am 0.015 mg N/l; Chlorophyll_a 4.9 µg/l

Significant issue: TP

Macrophyte status is driving Ecological Status, 2017 survey found an impoverished plant community comprised of low counts of two nutrient tolerant plants: *Littorella uniflora* 75%, filamentous algae 25%. Historical and current nutrient issues in the southern section of lake, south of Shannon (Upper)_040 outlet, since 2020 TP concentrations in this section of the lake have increased while TP issues have also newly emerged in areas further north in the lake.

Significant pressure:

- Agriculture (Pasture), impact listed as Nutrient Pollution, associated impact assessment details state: *Agriculture noted in both CoCo workshops as potential pressure. High PIP SW-P around most of the banks of the lakes.*
- Invasive Species (Zebra Mussel), impact listed as Altered habitat due to Morphological changes. There are no records of zebra mussel on Lough Allen and the average pH recorded in the lake is lower than favoured for shell growth, however, zebra mussel are recorded further downstream on the Shannon catchment therefore they may have been introduced to Lough Allen by boat movement, if so, nutrient impacts may be masked.

Other pressures:

- Nutrients/sediment from inputting river waterbodies: four unassigned waterbodies; inputting section of Shannon (Upper)_040 which is unmonitored; from the Owengar (Leitrim)_020 as a result of the 28th June 2020 landslide initiating in the upstream Diffagher_010.
- P loss from DWWTS in surrounding poorly draining/peaty soils
- Pollutants/hydromorphological pressures from leisure/hospitality industry activities on the lake shores.
- Forestry pressures: *Deadman's Point*; west of *Corry Strand*; west of *Drumman's Island*; north of Drumshanbo in townland of *Corlough* and on boundary of townlands of *Murhaun* and *Derrintober*.

Relevant pathways: Drains through and surface flow over poorly draining/peaty soils, lands surrounding lake are predominantly agricultural with moderately high to high PIP for P loss.

Some patches of well-draining soils on the west shores of the lake below Corry Mountain, where these permeable soils are thin and overlying impermeable shale bedrock (DTB<1m) there is a moderate to high PIP for N loss to surface waters, specifically there is a ribbon of this type of land along the shores of the lake in the townland of *Srabraggan* where land-use is agricultural and aerial imagery shows what appear to be large sheds for housing livestock.

The *Bricklieve Limestone Formation* underlying the area around the very southern section of the lake may allow for groundwater discharges to the lake, this Rkc aquifer, Geevagh, is At Risk with the Significant Pressure listed as agriculture, therefore it may act as a pathway for nutrients, herbicides or pesticides.

5.2. Shannon (Upper)_040

Risk category: At Risk

Status: Moderate Ecological Status (2016-2021) driven by fish status.

Invertebrate status, monitored downstream of Lough Allen at *Battle Br*, is at good with a 2020 Q score of 4, invertebrate status is not monitored anywhere on the section of the river flowing into Lough Allen.

Hydrochemistry summary: One surveillance/operational monitoring station located near the downstream limit of the waterbody, *Battle Br*, roughly 8km downstream of the Lough Allen outlet, there is no WFD monitoring station located on the section of the river flowing into Lough Allen. Data is available for *Battle Br* from 2008-2022 and the annual average MRP, Total Am and BOD concentrations do not breach the relevant EQS. The 2016-2021 status details on the WFD App list a Chemical Surface Water Status Fail due to levels of benzo(a)pyrene.

Baseline Concentration: Baseline (2020-2022): MRP 0.007 mg P/l; Total Am 0.019 mg N/l; TON 0.24 mg N/l; BOD 0.7 mg O₂/l

Significant issue: Impact assessment details state: *At the local authority workshop for Cycle 2, it was noted that the salmonids in the Shannon Upper aren't doing well, that there are a number of barriers in order to get up this far, and a long distance to travel. Coarse fish noted to have taken over and presenting*

competition and therefore driving status. The responsible organisation for the impact assessment is the IFI.

Significant pressure:

- Anthropogenic Pressure (unknown), impact listed is Fish Status
- Hydromorphology (Dams, barriers, locks, weirs), impact is Altered habitat due to Morphological changes

Other pressures:

- 2nd cycle Initial Characterisation listed Agriculture (Pasture) as a non-significant pressure.
- Considering the section of the waterbody inputting to Lough Allen alone, pressures include: agriculture; the Ballinaglera WWTP (CoA); DWWTs; forestry at townland of *Cuiltia* and at *Tullynapurtlin/Kilmore*

Relevant pathways: Focusing just on the section of the Shannon (Upper)_040 river basin upstream of Lough Allen the predominant pathway is drains through, and surface flow over, the poorly draining/peaty soils, agricultural landuse with moderately high to high PIP for P loss.

5.3. Drumshanbo Stream_010

Risk category: At Risk

Status: Moderate Ecological Status (2016-2021) driven by invertebrate status, Q assessment 2020 (poor 2014 and 2017)

Hydrochemistry summary: One operational monitoring station located approx. 50m downstream of WWTP primary discharge (within mixing zone) with 2007-2022 data available:

- *d/s STW outfall* (RS26D050300) MRP annual averages breach the EQS from 2007-2011, 2016-2020, 2022. Tot Am breach from 2007-2010 and 2016-2020., BOD annual averages consistently breach the EQS except for in 2018 and 2022.

Ambient monitoring stations upstream and downstream of the WWTP have 2012-2022 data available:

- *U/S Drumshanbo WW* (RS26M800930) MRP annual averages are all below the EQS, Tot Am breached the annual average EQS in 2015, there are occasional elevated Tot Am concentrations, most recently in May 2022, BOD breaches from 2012-2016, in 2020 and in 2022.
- *d/s Sewage Trtmt Works* (RS26D050400) records EQS breaches of the annual average for MRP in 2012 and from 2016-2020, for Tot Am from 2012-2015, 2018-2019 and in 2021, and for BOD from 2012-2016 and from 2019-2021.

Baseline Concentration:

Operational Monitoring point

- *d/s STW outfall* (RS26D050300) baseline (2020-2022): MRP 0.127 mg P/l; Total Am 0.049 mg N/l; TON 1.87 mg N/l; BOD 1.8 mg O₂/l

WWTP Ambient monitoring stations

- *U/S Drumshanbo WW* (RS26M800930) baseline (2020-2022): MRP 0.023 mg P/l; Total Am 0.046 mg N/l; BOD 1.6 mg O₂/l
- *d/s Sewage Trtmt Works* (RS26D050400) baseline (2020-2022): MRP 0.085 mg P/l; Total Am 0.079 mg N/l; BOD 1.6 mg O₂/l

Significant issue:

- upstream of Drumshanbo Mart and the Drumshanbo WWTP discharge and SWOs on the agglomeration network there are records of occasionally elevated Total Am and BOD issues.
- Downstream of the WWTP discharge BOD, MRP and Total Am issues, especially in the summer months (low flow conditions).

Significant pressure:

- The Drumshanbo WWTP (D0144-01) is listed as a significant pressure, impact is listed as nutrient and organic pollution.
- Agriculture (Pasture) is listed as a significant pressure, impact is listed as nutrient pollution, impact assessment details state: *PIP SW-P high in most of sub-basin, sediment issues with animal access. Also equine centre present along stretch where appears to have increase in Am 2013-2018 Cycle 3 Update: Leitrim CoCo - Note: it is uncertain if there is a discharge from the cattle mart to the public sewer or to surface waters. A full investigation is required. No information regarding the discharge from the equestrian centre.* The Equestrian Centre is located near the WWTP d/s ambient monitoring station (RS26D050400) where ammonia concentrations tend to be higher than the operational monitoring point approx. 100m upstream (RS26D050300). Drumshanbo Mart is located upstream of the Operational MP and may have an unlicensed discharge to surface waters. It should also be noted that the underlying karst groundwater body in the southern part of the RWB, the Geevagh, is At Risk with the initial characterisation pressures listed as agriculture and anthropogenic (unknown), the impact assessment stating: *Groundwater contribution of phosphate to associated surface water bodies (At Risk) - - Anthropogenic Pressures (Diffuse phosphate) (At Risk) - -, DRUMSHANBO or AGHAGRANIA STREAM_010*
- Hydromorphology (Dams, barriers, locks, weirs) is listed as a 3rd Cycle significant pressure, impacts listed as Altered habitat due to Hydrological changes and Altered habitat due to Morphological changes. The associated impact assessment details state: *Hymo MQI V1.05.01: Poor at the monitoring station reach – high impact from Upstream alteration of flows (dam/reservoir), River corridor connectivity/potentially erodible corridor (embankments, fisheries enhancements or other built features such as roads/pavements), and impact to channel morphology from peat extraction. Last available RHAT score was in 2008: Poor score with no riparian cover, no floodplain connectivity.*

Other pressures:

- Extractive Industry (Peat) is listed as non-significant pressure, impact assessment details state: *LAMv2.04 11% P.* Cutting was not obvious from aerial imagery, the Teagasc subsoils map records areas of “cut” peat (taken to mean areas where peat is drained, either for cutting or agricultural reclamation of land) around *Derryhallagh* and *Roscunnish Lough* and along the downstream stretch of the river in *Carricknabrack*.
- Forestry is listed as non-significant pressure, impact assessment details state: *LAMv2.04 15% P.* Coniferous forestry plantations on poorly draining/peaty soils are found in the *Sliabh an Iarainn* uplands and upstream of *Roscunnish Lough*.

Relevant pathways:

- The predominant pathway is drains through and surface flow over the poorly draining/peaty soils, where landuse is agricultural outside Drumshanbo town moderately high to high PIP for P loss, where landuse is forestry in the uplands pathway for sediment loss.

- Drumshanbo town is made ground where flow pathways will be directed by the urban drainage system and overflows/discharges from the sewerage system, point discharge tends to dominate over diffuse flow, though run-off from hard ground will have little to no attenuation of pollutants.
- Karst bedrock, underlying the lower reaches of the catchment around Drumshanbo town and *Derryhallagh* and *Roscunnish Lough*, is of the Geevagh GWB which is At Risk, pollutants from surrounding agricultural land-use, from underperforming DWWT or from other sources, discharged where groundwater vulnerability is low, may be transported via conduit flow or via the epikarst to the river.

5.4. Shannon (Upper)_030

Risk category: Review

Status: low confidence, modelled, High 2016-2021 Ecological Status

Hydrochemistry summary: No data available

Baseline Concentration: No data available

Significant issue: No previous monitoring, not on current monitoring programme

Historic data (2008-2015) and recent data (2021-2022) available for the inflowing Owennayle_020, taken where the waterbody joins the Shannon (Upper)_030 at *Br d/s Owennayle Br* (RS26O050100) records BOD annual average concentrations above the EQS in 2008-2011 and 2013-2014, recent concentrations from 2021-2022 are below the EQS.

Significant pressure:

The WFDApp records that Agriculture (Pasture) has been updated from a non-significant pressure to a significant pressure for cycle 3, impact is listed as nutrient pollution, associated impact assessment details state:

SLAM (v2.4) indicates that pasture contributes to 73% phosphate. High PIP SW-P 2013-2018 Cycle 3 Update: Deemed significant for Cycle 3. High to Very High PIP for SW-P. Limited forestry activity compared to agriculture. Leitrim CoCo - Unaware of any historic or current licensing in the area for forestry activities. No monitoring carried out by LCC.

Other pressures:

- The Dowra WWTW, Certificate of Authorisation (A0299-01) located in the east of the waterbody along the Shannon channel.
- The inflowing Owennayle_020 dropped to Moderate Ecological Status in the 2013-2018 period driven by invertebrate assessment carried out in 2017, the EPA ecologist noted the following: *A decline to moderate conditions was noted in the lower section [of Owennayle] (0100) where cattle access may lead to unnecessary nutrient loadings. This is the lowest condition this formally high ecological condition site has been in since monitoring started in 1976.* Forestry is also dominant upstream in the Owennayle_010 planted on upland peat and poorly draining soils. The 2020 Q assessment showed a recovery, driving the 2016-2021 Ecological Status up to High.
- Forestry plantations on poorly draining and peaty soils in the townlands of *Eden* and *Canbeg* along the main Shannon channel just upstream of Lough Allen, further upstream in *Dowra* located near the Shannon channel flowing in from the east of the waterbody. Also, along a trib. flowing in from the west of the waterbody in *Doolargy Glebe* and *Corraweehill Glebe* and in *Mahanagh* and *Kiltyfeenaghty Glebe* (west and east of *Mahanagh Lough*, respectively).

Relevant pathways: The predominant pathway is drains through and surface flow over the poorly draining soils, peat and wet alluviums, the agricultural landuse has moderately high to high PIP for P loss.

5.5. Tarmo_010

Risk category: Review

Status: low confidence, modelled, Good 2016-2021 Ecological Status

Hydrochemistry summary: No data available

Baseline Concentration: No data available

Significant issue: No previous monitoring, not on current monitoring programme

Significant pressure:

- The WFDAApp records that Agriculture (Pasture) has been updated from a non-significant pressure to a significant pressure for cycle 3, impact is listed as nutrient pollution, associated impact assessment details state: *High SW and NS P PIP, no chemistry or biology data available. 2013-2018 Cycle 3 Update: Deemed a significant pressure for Cycle 3 with nutrients checked. High SW/NS P PIP: Rank 2 in the east and south of the sub-basin. Leitrim CoCo - No new information. From satellite imagery - most probable pressures is forestry and agriculture. Possible nutrient losses from the spread of slurries on land and fertiliser.*
- Forestry is listed as a significant pressure in the Tarmo_010 waterbody. The impact listed is *Other Significant Impacts: Sediment*. The associated impact assessment details state: *High SW/NS P PIP: Rank 2 in the east and south of the sub-basin. Corine Land Cover Change (2012-18) - 17ha of scrub changed to conifer adjacent to the channel on the north side of the subbasin, noted in both 2006-12 and 2012-18. Leitrim CoCo - No new information. From satellite imagery - most probable pressures is forestry and agriculture, with sediment loss from forestry activities. Forest Service - Coillte Clearfell, Thinning & Replanting: Clearfelling 2015-2020: 5.33ha licenced. Thinning 2016-2019: 68.16ha licenced. Replanting: 1.21ha planted between 2012 and 2015. 0.00ha replanted between 2016-2019. Private felling: There was 6.34ha licenced for felling between 2017 and 2019 (6.34ha in 2018). Clearfelling minimal however, general forestry activities such as thinning and replanting have taken place in close proximity to channel, and is a likely significant pressure. Forestry plantation on poorly draining soil along section of left bank of most northern of Tarmo_010's three independent streams in townland of Tullymurry. Plantations on well-draining soils in townlands of Tents and Tawnycorragh near the most southern of Tarmo_010's three independent streams.*

Other pressures:

- Extractive Industry (Quarries) is listed as a non-significant pressure, there is a shale quarry present in the river basin located approx. 400m from the headwaters of the most southern of Tarmo_010's three independent streams

Relevant pathways:

- The predominant pathway is drains through and surface flow over the poorly draining/peaty soils, the agricultural landuse on these soils has high PIP for P loss.
- Areas of well-draining soil in the southern section of the waterbody catchment are underlain by low permeability till or in steep gullies by the shale bedrock, the near-surface N susceptibility map picks out one area of high susceptibility; a narrow gully where bedrock is at or close to the surface in the townland of Tents with agriculture along the left bank and a coniferous forestry plantation along the right bank.

5.6. Stony_010

Risk category: Review

Status: low confidence, modelled, High 2016-2021 Ecological Status

Hydrochemistry summary: No data available

Baseline Concentration: No data available

Significant issue: No previous monitoring, not on current monitoring programme

Significant pressure: None listed

Other pressures:

- Agriculture (Pasture) listed as a non-significant pressure
- Extractive Industry (Peat) listed as a non-significant pressure, the impact assessment states: *LAMv2.04 23% P. Blanket Peat, it's not clear from aerial imagery if cutting takes place.*
- Forestry listed as a non-significant pressure

Relevant pathways: The predominant pathway is drains through and surface flow over the upland peat and downslope the poorly draining soils on the Sliabh an Iarainn mountain sides. Agricultural landuse where there is high PIP for P loss is on the shores of the Lough Allen where the slopes are gentler. Where forestry is planted on the upland peat or where it is overgrazed by sheep there may be a pathway for sediment loss.

5.7. Sheskinacurry_010

Risk category: Review

Status: low confidence, modelled, Good 2016-2021 Ecological Status

Hydrochemistry summary: No data available

Baseline Concentration: No data available

Significant issue: No previous monitoring, not on current monitoring programme

Significant pressure: None listed

Other pressures:

- Agriculture (Pasture) listed as a non-significant pressure
- Extractive Industry (Peat) listed as a non-significant pressure, however it is not clear from aerial imagery if cutting takes place on the upland blanket peat.
- Forestry listed as a non-significant pressure and is the predominant landuse on the steep mountain sides

Relevant pathways: The predominant pathway is drains through and surface flow over the upland peat and downslope the poorly draining soils on the Sliabh an Iarainn mountain sides. Agricultural landuse where there is high PIP for P loss is on the shores of the Lough Allen where the slopes are gentler. The forestry plantations on the mountain sides or where there is overgrazing by sheep may result in a pathway for sediment loss.

6. Communications Plan

A public meeting will be held on the 29th of May, 2023, at the Mayflower Community Centre, Drumshanbo. Posters informing the public of the meeting will be displayed locally on noticeboards and a notification will be placed in local newspapers, LAWPRO's social media will also be utilised to advertise the event. Leitrim and Roscommon County Councils will be notified as well as Inland Fisheries Ireland and Forestry Service. The Community Water Officer will notify community groups with an interest in the PAA. ASSAP will attend the public meeting and organise a farming specific meeting at a later date. The LAWPRO team will carry out the LCA to identify and refine the significant pressures for this waterbody. We will then work with relevant stakeholders/implementing bodies to agree the measures required.

7. Work plan

7.1. Consultation on the desk studies LA, IFI etc/ Further information required

The following information was provided by or will be sought from the following stakeholders:

- ASSAP will be consulted on all waterbodies where agriculture is a significant pressure.
- Leitrim Co. Co.
 - Physiochemical data and drone footage of the 28th June 2020 landslide event in the Owengar (Leitrim) subcatchment. Physiochemical data from post-event monitoring.
 - Georeferencing given for Drumshanbo Stream_010 monitoring points, 150m d/s STW outfall (RS26D050300) and 300 m d/s Sewage Trtmt Works (RS26D050400), put them at <50m and approx. 100m downstream of the WWTP primary discharge, respectively. From satellite imagery the river appears to be no more than 5m in width which would place the 0300 monitoring point within the mixing zone. Information will be sought on whether the in-practise location of these monitoring points is in keeping with the georeferencing listed on the WFDApp.
- Cavan Co. Co.
 - Further information will be sought on the Historic Waste Facility (S22-02567) groundwater body located just north of Dowra just outside the river sub-basin boundary of the Shannon (Upper)_030 in the Shannon (Upper)_020.
- IFI
 - Further information on the moderate Fish Status of the Shannon (Upper)_040.
 - Records, if any, of Zebra Mussel in Lough Allen
- Irish Water
 - Further information will be sought on the EO incident of uncontrolled release referred to in the 2019 AER, specifically if the EO in question is SW6 located between the RS26D050300 and RS26D050400 river monitoring stations.

7.2. Local Catchment Assessment Work Plan

Lough Allen

- The LCA will focus on nutrient levels in the river waterbodies feeding Lough Allen and high PIP areas around the lake shore. The initial focus will be on the impact from the Drumshanbo Stream_010 and determining if there is impact from the Lough Allen Canal to *South Pond*.
- Hydromorphological pressures, i.e., the sluice gates at Bellantra Bridge, plantation forestry in the catchment, soft bank engineering on the shore, recreation pressure and modified shoreline vegetation, will be assessed for sediment impact and impacts on macrophyte habitat availability.
- The inflowing section of the Owengar (Leitrim)_020, which was impacted by the June 2020 landslide, will be assessed for any ongoing sediment discharges to the lake. The extent of the internal phosphorous load in the lake bed as a result of the landslide is more difficult to assess.
- The presence and impact of the invasive Zebra Mussel is to be confirmed.

Drumshanbo Stream_010

- The LCA will focus on determining if the WWTP primary discharge is the only significant impact or if upstream impacts are also significant. SSIS and chemistry sampling will be conducted upstream of WWTP primary emission point but downstream of Drumshanbo Mart, the main Drumshanbo urban area and the inflowing tributary from the north-east.
- Leitrim Co. Co. have advised that the Drumshanbo Mart discharge, if to surface waters, is unlicensed, the presence of a discharge will be investigated as part of LCA.
- During LCA, consideration will be given to the over-all availability of suitable habitat for sensitive invertebrate species when assessing the Drumshanbo Stream_010, particularly at the WFD Operational station, *150m d/s STW outfall (RS26D050300)*.
- LCA will investigate the source of additional ammonia downstream of the WWTP primary discharge. Focus will be on an EO on the network and the equine centre.
- LCA will assess the source of ammonia and BOD impacts at the *U/S Drumshanbo WW (RS26M800930)* station.
- Assessment and mapping of animal access points will be carried out as part of the LCA to ascertain if a cumulative impact is significant.

Tarmo_010, Stony_010, Sheskinacurry_010, Shannon (Upper)_030 and Shannon (Upper)_040 inflowing to Lough Allen.

- LCA will initially focus on assessing for impact in these streams closest to the outflow to Lough Allen
- Suitable SSIS sites will need to be located.

See Appendix 4 for a map showing the initial LCA assessment points.

8. Review of mitigation options

The significant issue in Lough Allen is considered to be Total Phosphorous, LCA will focus on nutrient levels in the river waterbodies feeding Lough Allen and high PIP areas around the lake shore, internal phosphorous load in the lake bed is more difficult to assess. WFD General Chemistry monitoring shows an increase in total phosphorous concentrations from 2020-2022 at several lake monitoring sites, including Site 1 in the northwest of the lake, this area was impacted by sediment transported down the Owengar River inflow by a landslide initiated in the upstream Diffagher_010 on June 28th, 2020, this sediment may still be contributing phosphorous. Hydromorphological issues in Lough Allen also require further investigation, while the presence and impact of the invasive Zebra Mussel is yet to be confirmed. The significant pressure in the Drumshanbo Stream_010 is considered to be the WWTW with the significant issue being Total Ammonia and Ortho-phosphate, this is to be confirmed by LCA. Mitigation options will then be considered based on LCA findings and referred to the relevant stakeholder.

Appendix 1_Protected Areas and Groundwater bodies

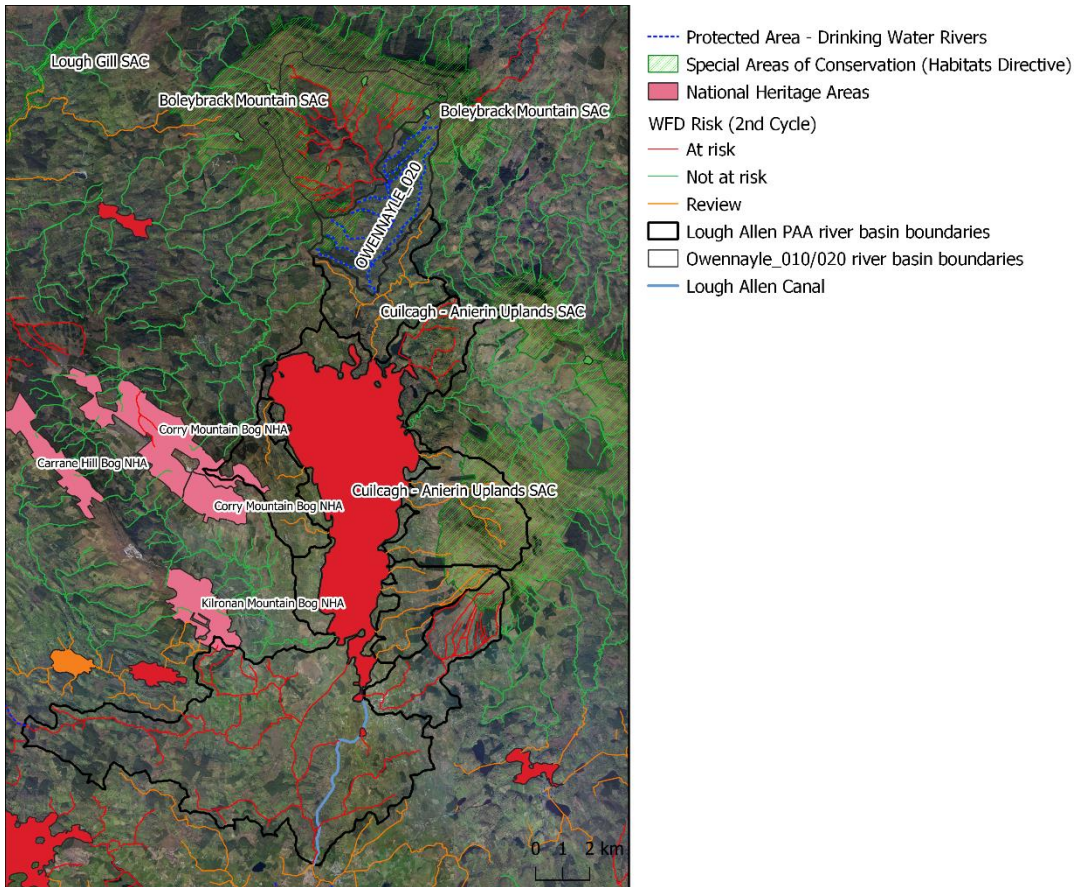


Figure 63 Protected Areas for Drinking Water, Natura2000 sites and National Heritage Areas in and around Lough Gill PAA.

Please note the Owennayle_020 was listed on the September 2016 WFD Register of Protected Areas as a Drinking Water River, but it is not listed on the December 2018 Register.

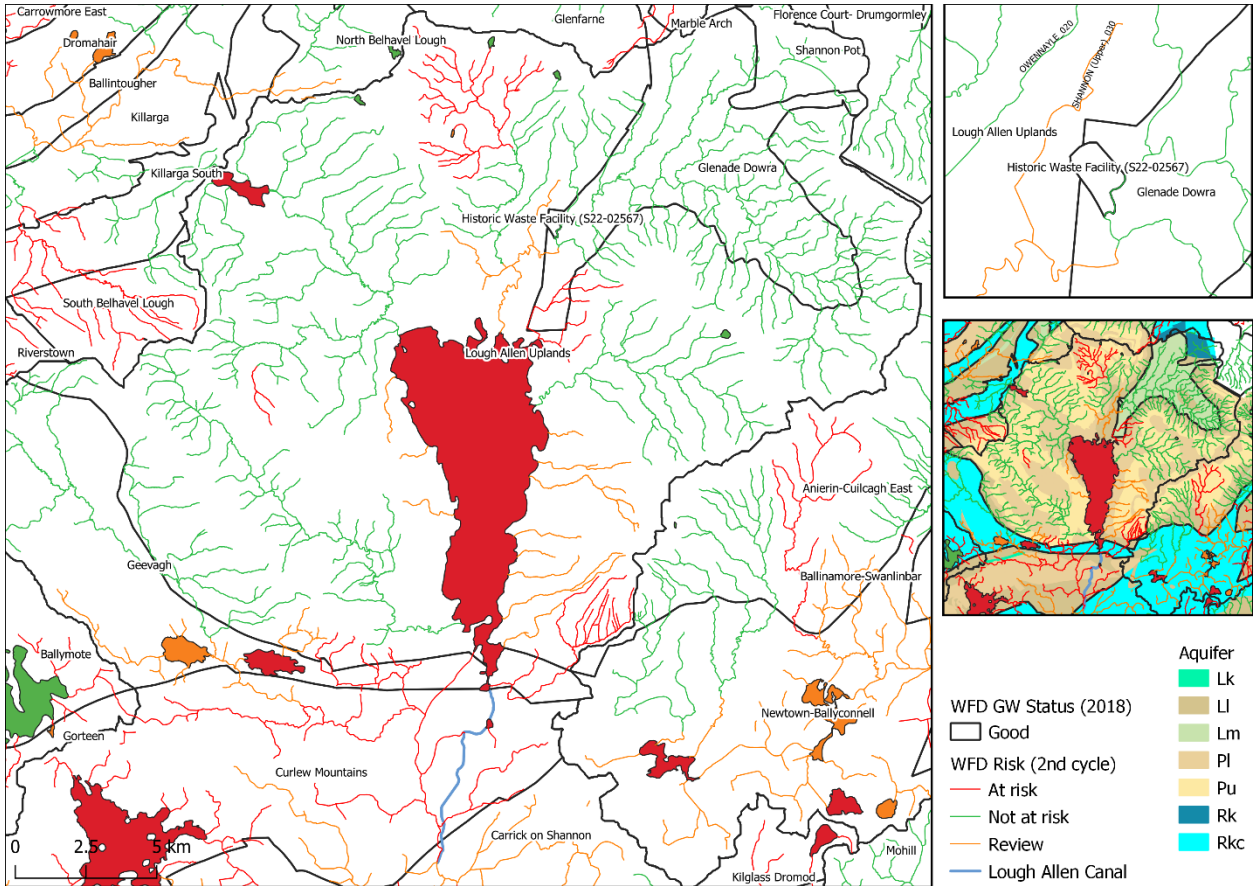


Figure 64 Groundwater bodies associated with the Lough Allen PAA area

Appendix 2_Drumshanbo WWTP Assimilative Capacity Calculations

- The Q95 estimate from the EPA Hydrotool at point 26_3589 is 0.0224377m³/sec
- The catchment area contributing to this flow is 9.884km²

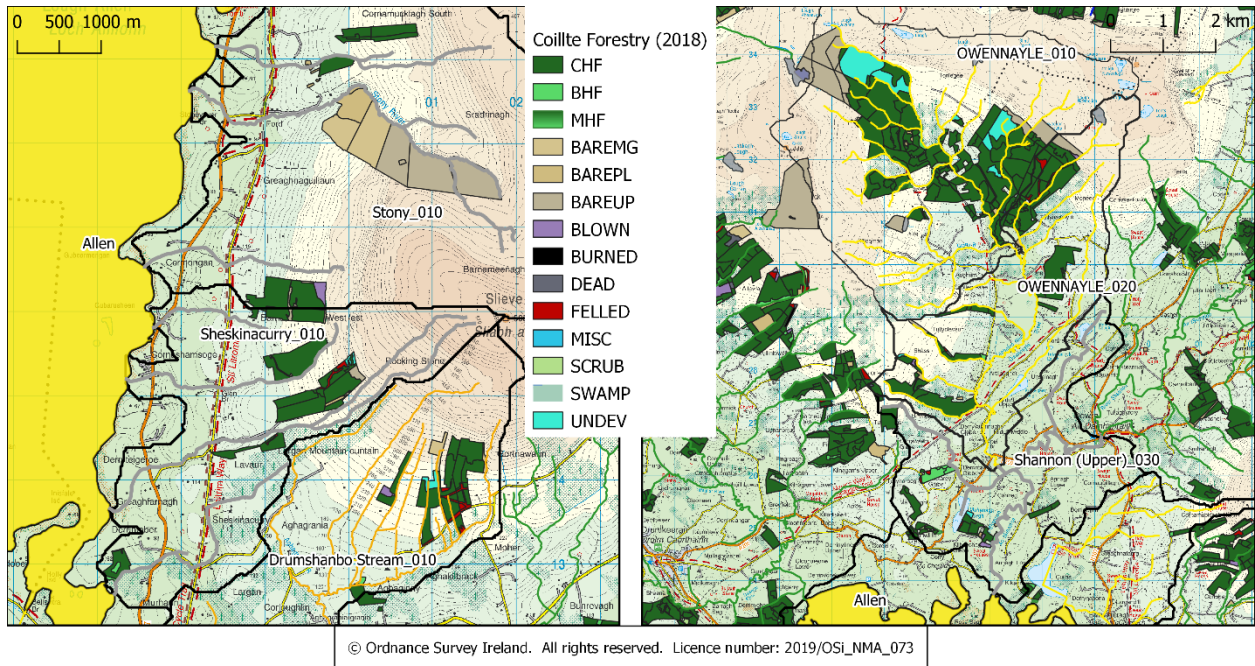
Upscaled to the RS26D050400 monitoring point:

- Total catchment area of Drumshanbo Stream is 12.058km²
- Remaining Drumshanbo Stream catchment area that does not contribute to flow at 0400 is 0.336km² (estimated using contour map)
- 12.058 – 9.884 – 0.336 = 1.838km²
- 1.838 + 9.884 = 11.722km² is the catchment area contributing to the flow at 0400
- Catchment area contributing to flow at 0400 is 1.19 times the size of catchment area of flow at EPA Hydrotool point 26_3589
- Upscaled flow is **0.027m³/sec**

Waterbody Name	Drumshanbo Stream_010					
Waterbody Code	IE_SH_26D050400					
Waterbody Status	Poor (2013-2018)					
Effluent Characteristics			Notes			
Effluent Flow m3/d	900		Effluent Characteristics: Effluent Flow = DWF to the Treatment Plant (m ³ /day) taken from 2019 AER; BOD (as cBOD), Total Ammonia and MRP from annual mean figures in 2019 AER. Recent Water Flow: estimated by upscaling Q95 at 26_3589 on the EPA River Flow Estimates-Hydrotool. Recent Water Quality: 2019 annual average concentrations at 0930 MP (u/s ambient MP for WWDA)			
Flow m3/sec calc)	0.010416667					
BOD (conc in effluent) mg/l	2.12					
Total Ammonia	1.15					
MRP	0.27					
Rec Water Flow						
95%ile Flow m3/sec	0.027					
Rec Water Quality						
BOD mg/l O2	Ammonia mg/lN	Orthp/MRPmg/lP				
1	0.051	0.018	C _(back)	Good Status 95%ile EQS		
Mass Balance Formula						
Resultant conc mg/l		$FC_{(back)}+f_{c(eff)}$				
		$F+f$				
			Background Conc mg/l	Resultant conc mg/l	Standard mg/l	
			BOD	1	1.312	2.6
			Ammonia	0.051	0.357	0.14
			MRP	0.018	0.088	0.075
Head Room mg/l = Cmax-C						
Option 2	mg/l	Cmax = Max permissible conc (EQS) (mg/k)	Option 2	Background Conc mg/l	Resultant conc mg/l	Standard mg/l
BOD Headroom =	1.6	C = Background upstream conc. (mg/l)	BOD	1	1.312	2.6
Ammonia Headroom	0.089		Ammonia	0.051	0.357	0.14
MRP Headroom	0.057		MRP	0.018	0.088	0.075
Percentage Headroom utilised (%) = (T-C)100/Headroom						
BOD % Headroom utilised	19.5					
Ammonia % Headroom utilised	343.8202					
MRP % Headroom utilised	122.807					
Notional Clean:						
Head Room mg/l = Cmax-C						
Option 3	mg/l	Cmax = Max permissible conc (EQS) (mg/k)	Option 2	Background Notional Clean Conc mg/l	Resultant conc mg/l	Standard mg/l
BOD Headroom =	2.34	C = Background notional clean conc. (mg/l)	BOD	0.26	0.778	2.6
Ammonia Headroom	0.132		Ammonia	0.008	0.326	0.14
MRP Headroom	0.07		MRP	0.005	0.079	0.075
Percentage Headroom utilised (%) = (T-C)100/Headroom						
BOD % Headroom utilised	22.13675					
Ammonia % Headroom utilised	240.9091					
MRP % Headroom utilised	105.7143					

Figure 65 Mass balance calculations for Drumshanbo WWTP discharge on Drumshanbo Stream_010.

Appendix 3_Forestry



WFD Ecological Status 2013-2018

- High
- Good
- Moderate
- Poor
- Bad
- Unassigned

- Lough Allen PAA river basin boundaries
- Owennayle_010/020 river basin boundaries

Figure 66 Coillte owned forestry in the Stony_010, Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basins.

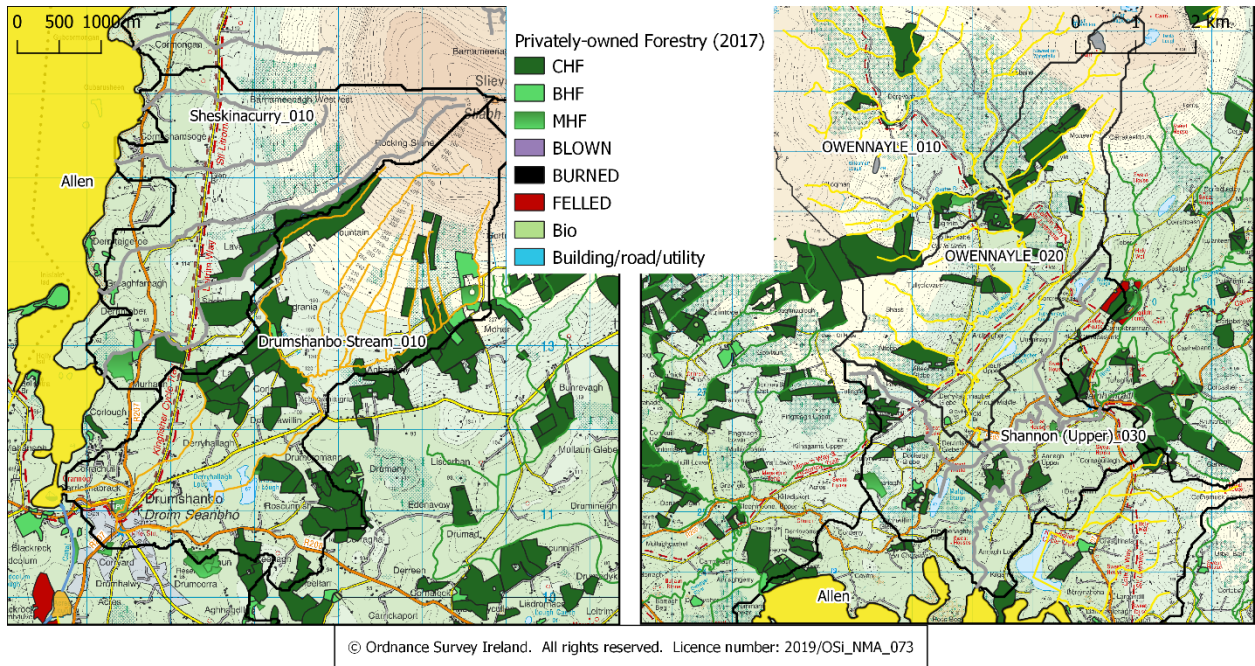


Figure 67 Privately-owned forestry in the Sheskinacurry_010, Drumshanbo Stream_010, Owennayle_010 and Owennayle_020 river basins.

Appendix 4_Initial LCA assessment locations



Figure 68 Initial LCA assessment locations for the Lough Allen PAA.