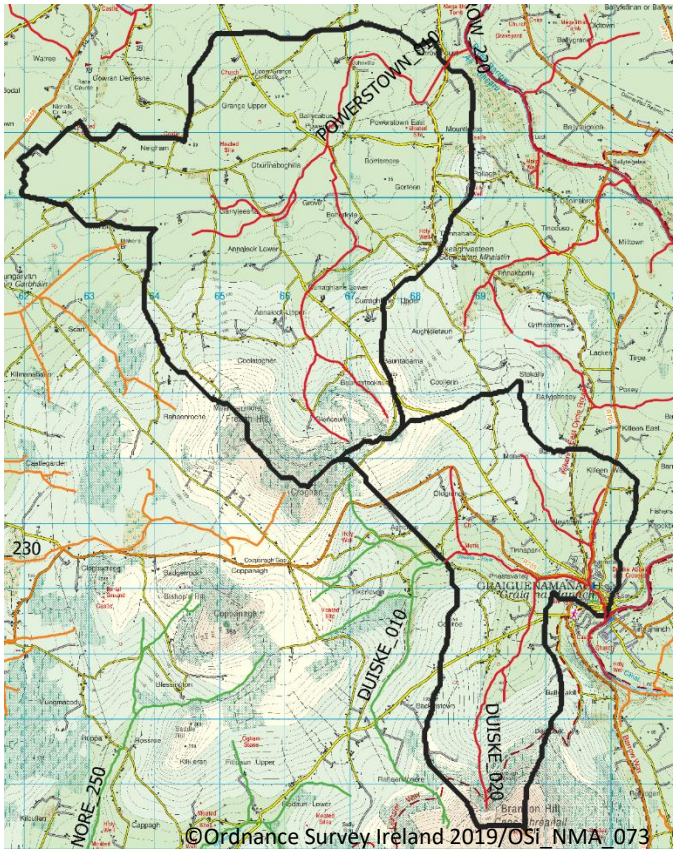
Desk Study

Duiske Priority Area for Action



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1 Background

The Duiske Prioritised Area for Action (PAA) is located in Kilkenny on the Kilkenny/Carlow border in the vicinity of Graiguenamanagh. There are two waterbodies in the PAA, the Powerstown_010 and the Duiske_020. Both waterbodies are tributaries of the Barrow River. A summary of the ecological status and pressures for these waterbodies can be seen in **Table 1**.

Regional workshops were held in Roscrea on 6-9 June 2017 and were attended by representatives of local authorities (Kilkenny, Tipperary, Waterford City and County, Kildare, Laois, Offaly, Carlow, Wexford & Wicklow), and other agencies (Bord Iascaigh Mhara, DHPCLG, EPA, National Dairy Sustainability Forum, National Federation for Group Water Schemes, Sea Fisheries Protection Authority, Waterways Ireland, LAWCO, Irish Water, IFI, Forest Service, Coillte, NPWS, Teagasc, GSI, DAFM, Marine Institute and EPA). Based on the draft River Basin Management Plan priorities, a set of agreed principles and the priorities of the workshop attendees, 34 areas were recommended for action in the South East region and the Duiske was selected for the following reasons:

- Would bring entire subcatchment to Good status.
- The Catchment Flood Risk and Management Plan (CFRAM) identified this river as potential for Natural Water Retention Measures (NWRM).
- Two deteriorated water bodies.
- One potential 'quick win'

1.1 EPA recommendations for further action in this area

The initial characterisation sub-catchment assessments undertaken by the Environmental Protection Agency (EPA) recommended that the following action be undertaken in this PAA:

- **Duiske _020:** IA7 Multiple Sources in Multiple Areas
    - Investigate source of cryptosporidium in Duiske_020 water body. Visit the pig farms in the subcatchment, check their records. Identify spreadlands. Investigate the potential impact of diffuse urban pressures in the Duiske_020 water body. Rule out tributaries where there are no issues. Look at raw data at intake to see if there are spikes which might indicate issues upstream.
- **Duiske_020:** IA6 Multiple Sources in Large Urban Area
    - Diffuse Urban pressure to be investigated.
- **Powerstown_010:** IA7 Multiple Sources in Multiple Areas
    - Focus on sources of nutrients (point sources from agriculture) and sediment (inadequate buffer strips on agricultural land and forestry in the upper reaches).

Table 1. Summary table of water bodies within the Duiske PAA.

WB Name	WFD Risk	Status Obj.	2009	2011	2014	2017	Pressure Cat.	Pressure Subcat.	Sig. Pressure
Powerstown_010	*At Risk*	Good	G	G	M	P	Urban waste water	Skeaghvosteen	No
							Agriculture	Agriculture	Yes
							Forestry	Forestry	Yes
Duiske_020	*At Risk*	Good	G	M	M	M	Agriculture	Agriculture	Yes
							Urban runoff	Diffuse sources run-off	Yes

2 Receptor Information and Assessment

The two waterbodies within the Duiske PAA and their associated monitoring stations are shown in **Figure 1.**

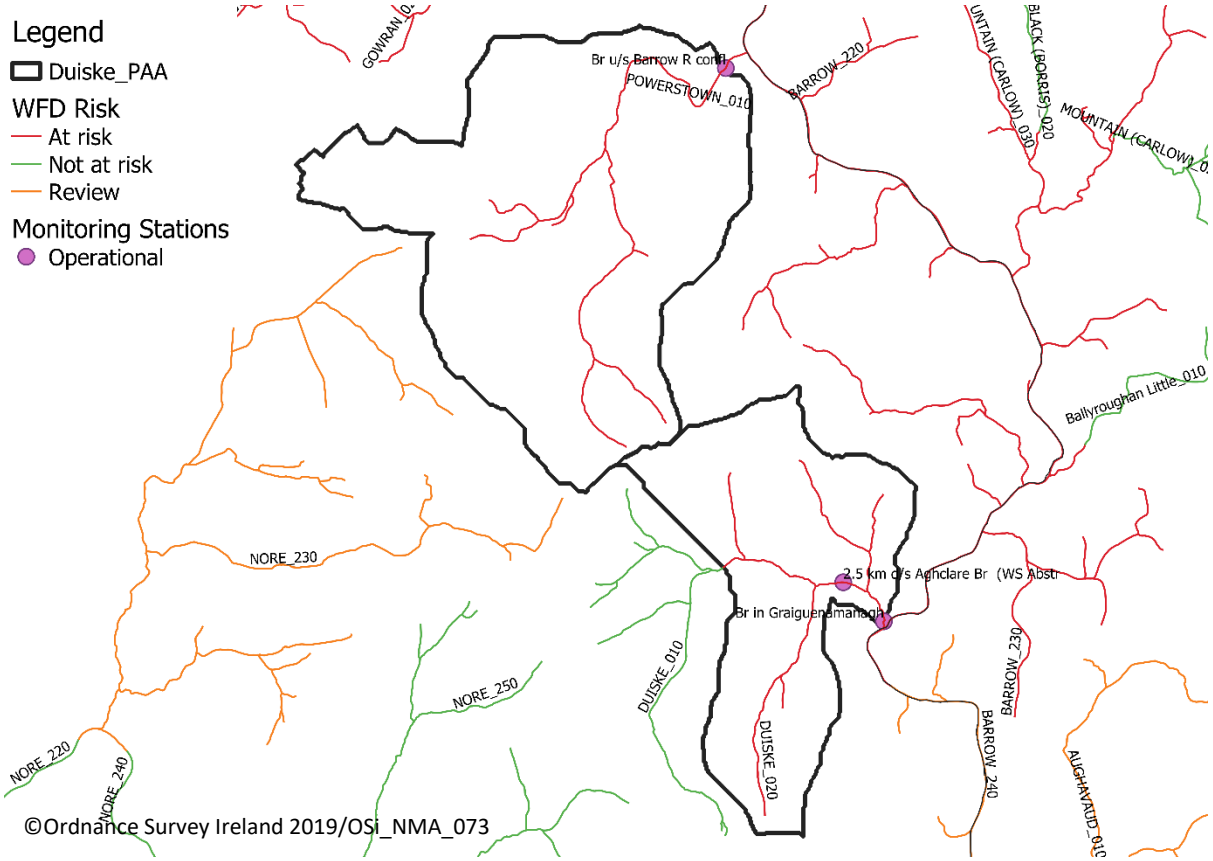


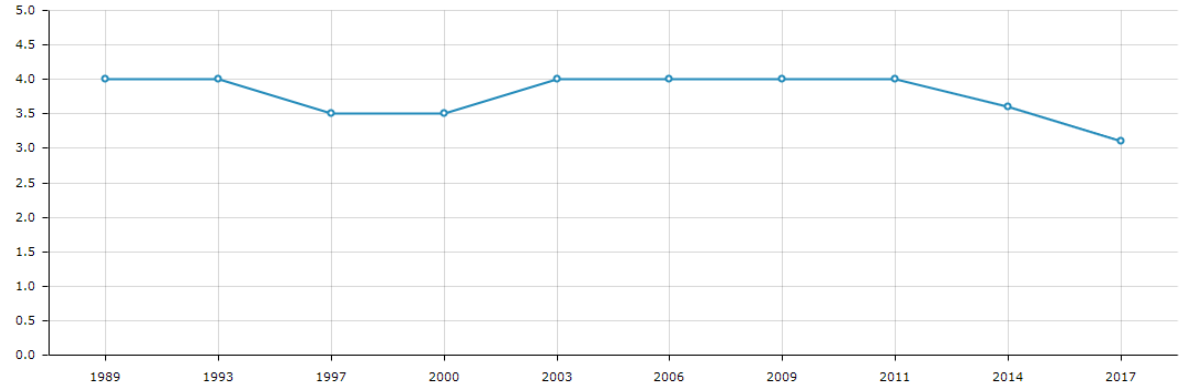
Figure 1. Monitoring stations located within the Duiske PAA.

2.1 Powerstown_010

- Powerstown_010 is monitored at Bridge u/s of Barrow River Confluence (station number RS14P020400).
- It is currently at poor status as monitored in 2017.
- Declined to moderate status in 2014 having previously been at good status since 2003 (**Fig. 2**).
- The significant pressures identified by the EPA during the characterisation process were agriculture and forestry.
- There were a number of BOD spikes between 2016 and 2018.

Table 2. Receptor information for the Powerstown_010.

Factor	Comment/Description
Risk Category	*At Risk*
Biological Status	
Monitoring Station(s) with Q-Values	Br u/s of R Barrow Confluence
2010-2015 Status	Moderate
Trends in Q value since 2009	Decline
2017 Q-value data	Poor
Hydrochemistry Data	
Monitoring Station(s) with data	Br u/s of R Barrow Confluence
Existing	Ammonia, Orthophosphate, TON, BOD
New	
Summary & Trends in PO_4, NH_3 and NO_3	
In App	NH3: Upwards
	PO4: Downwards
	NO3: Upwards
Other water quality data	BOD: Spikes up to 3.9 mg/l in 2013
Baseline Concentration (mg/l)	
NH3	0.053
PO4	0.035
NO3	2.887
Other relevant values	BOD: Spikes up to 3.9 mg/l in 2013
Distance to threshold	NH3: far; PO4: far; TON: far
Supporting Conditions	
Chemical Conditions	Pass
Oxygenation Conditions	Pass
Acidification Conditions	Pass
Hydromorphology	
RHAT Score	N/A
Evidence of arterial drainage	None
Ecological Status (2010-2015)	
Trends 2010-2015	Decline
Protected Areas	River Barrow and Nore SAC
WFD Objective	Good
EPA biologist notes (if any)	A complete absence of pollution sensitive species indicates a further decline to Poor ecological quality in the Powerstown stream. Heavy siltation of the river bed was evident in this slow flowing section of river.
Significant issue	Sediment, phosphate and possibly ammonia



	1989	1993	1997	2000	2003	2006	2009	2011	2014	2017
Result	4	4	3.5	3.5	4	4	4	4	3.6	3.1
Classification	Good	Good	Moderate	Moderate	Good	Good	Good	Good	Moderate	Poor
Q-Value	4	4	3-4	3-4	4	4	4	4	3-4*	3*

Figure 2. Q-values at Br u/s of R Barrow Confluence on Powerstown_010.

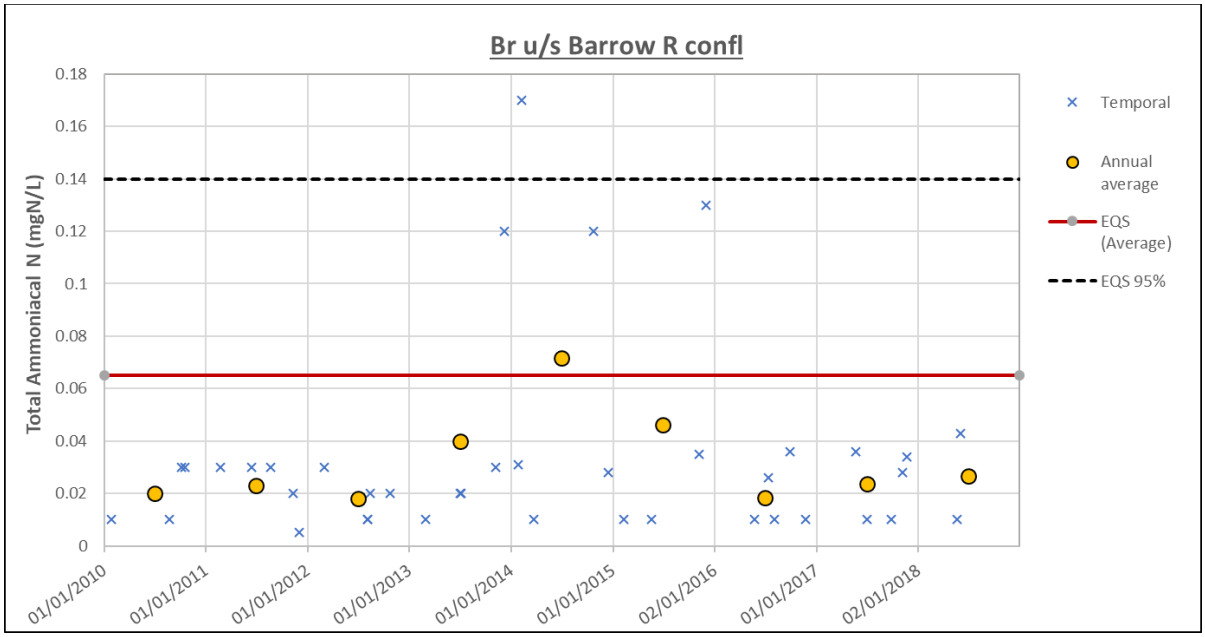


Figure 3. Ammonia concentrations at Bridge Upstream Barrow River Confluence on Powerstown_010.

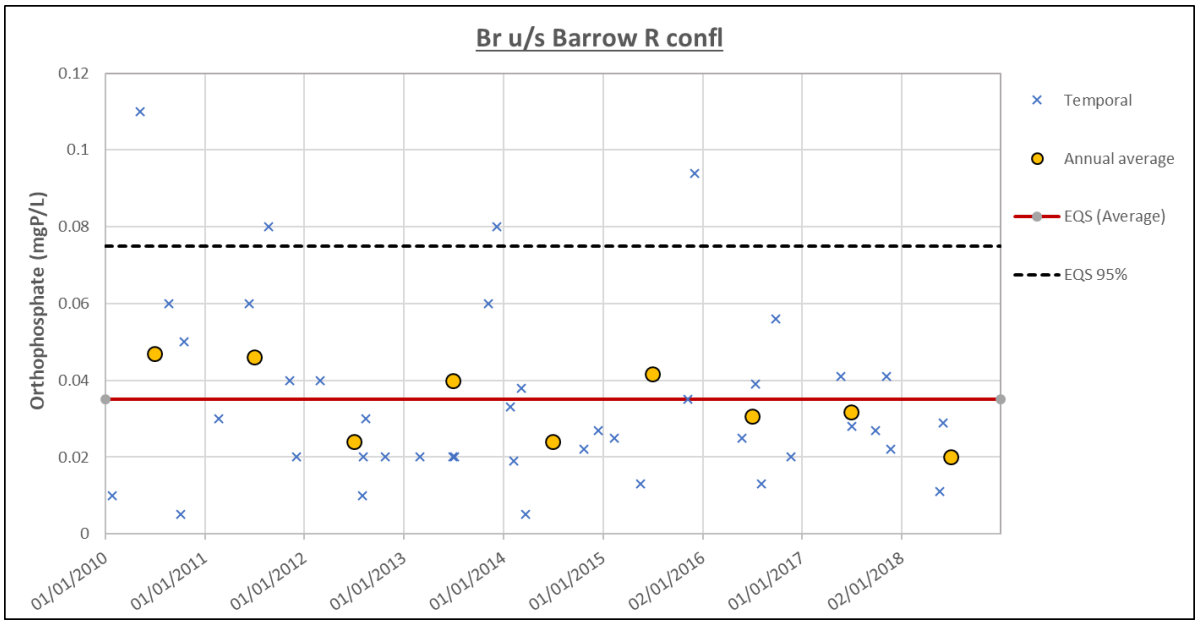


Figure 4. Ortho-phosphate concentrations at Bridge Upstream Barrow River Confluence on Powerstown_010.

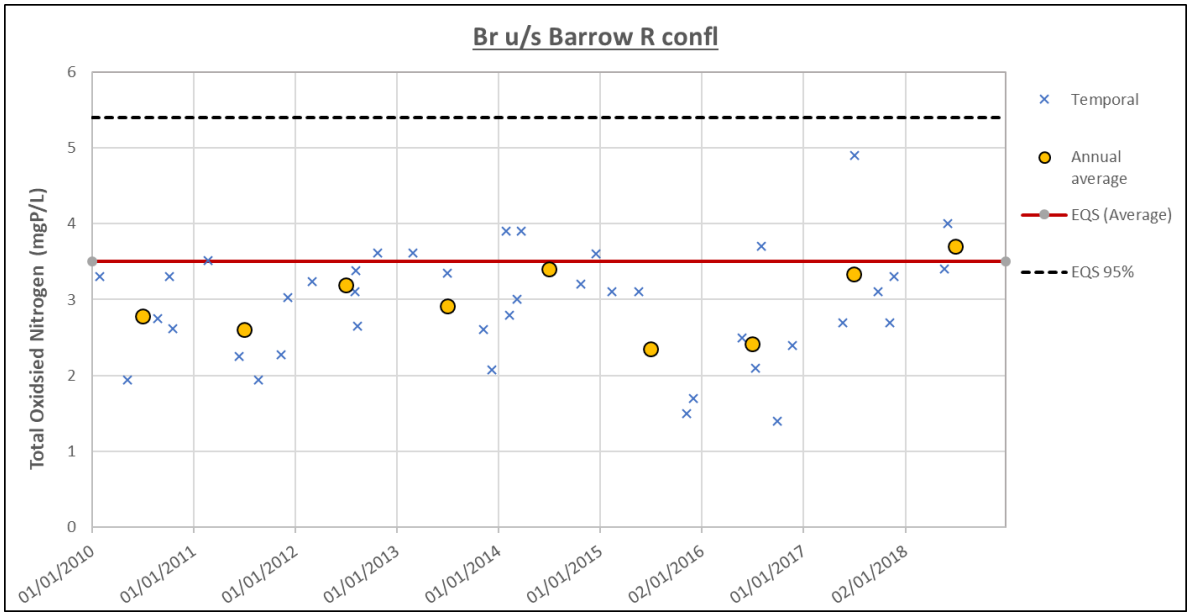


Figure 5. TON concentrations at Bridge Upstream Barrow River Confluence on Powerstown_010.

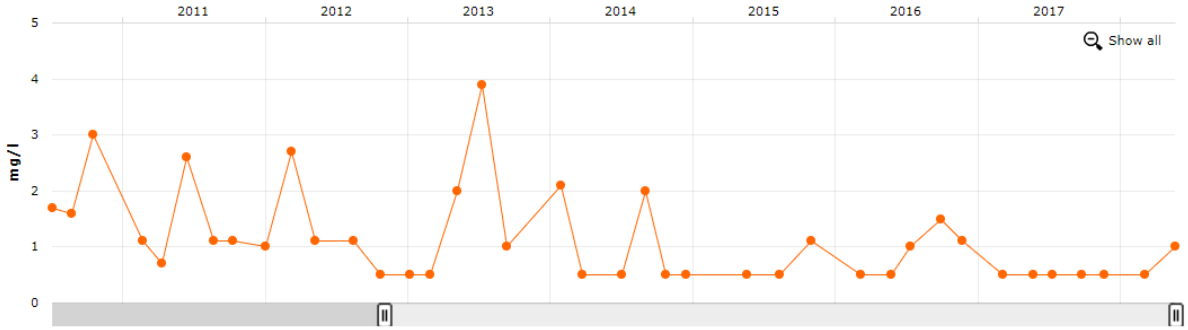


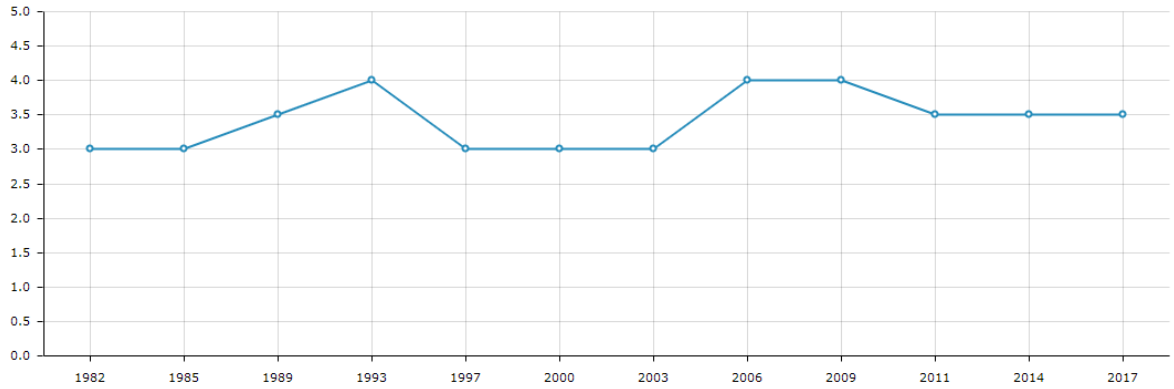
Figure 6. BOD concentrations at Br u/s of R Barrow Confluence on Powerstown_010.

2.2 Duiske_020

- Duiske_020 is monitored at Bridge in Graiguenamanagh (station number RS14D040200).
- It is currently at moderate ecological status (2017).
- It was at good status in 2009 but declined to moderate in 2011 (**Fig. 7**).
- There was an outbreak of Cryptosporidium in the drinking water source in the Duiske_020 in 2015. The plant was upgraded since and the County Council investigated possible sources of pollution. No clear source was identified. There has not been an outbreak since.
- The significant pressures identified during the characterisation process were agriculture and diffuse urban runoff.

Table 3. Receptor information for Duiske_020.

Factor	Comment/Description
Risk Category	*At Risk*
Biological Status	
Monitoring Station(s) with Q-Values	Br in Graiguenamanagh
2010-2015 Status	Moderate
Trends in Q value since 2009	Decline
2017 Q value data	Moderate
Hydrochemistry Data	
Monitoring Station(s) with data	2.5 km d/s Aghclare Br (WS Abstr
Existing	Ammonia, Orthophosphate, TON, BOD, Chromium, Copper, Zinc, Lead, Nickel, Cadmium
New	
Summary & Trends in PO_4, NH_3 and NO_3	
In App	NH3: Downwards PO4: Downwards TON: Downwards
Other water quality data	
Baseline Concentration (mg/l)	
NH3	0.016
PO4	0.009
NO3	3.73
Other relevant values	
Distance to threshold	NH3: far; PO4: far; TON: far
Supporting Conditions	
Chemical Conditions	N/A
Oxygenation Conditions	N/A
Acidification Conditions	N/A
Hydromorphology	
RHAT Score	N/A
Evidence of arterial drainage	None
Ecological Status (2010-2015)	
Trends 2010-2015	None
Protected Areas	River Barrow and Nore SAC; Duiske_020 Drinking Water Area
WFD Objective	Good
EPA biologist notes (if any)	Good ecological quality is maintained at the uppermost station (0100) but declines to Moderate at the lower station just before the confluence with the Barrow (0200).
Significant issue	Nitrate



	1982	1985	1989	1993	1997	2000	2003	2006	2009	2011	2014	2017
Result	3	3	3.5	4	3	3	3	4	4	3.5	3.5	3.5
Classification	Poor	Poor	Moderate	Good	Poor	Poor	Poor	Good	Good	Moderate	Moderate	Moderate
Q-Value	3	3	3-4	4	3	3	3	4	4	3-4	3-4	3-4

Figure 7. Q-values at Br in Graiguenamanagh on Duiske_020.

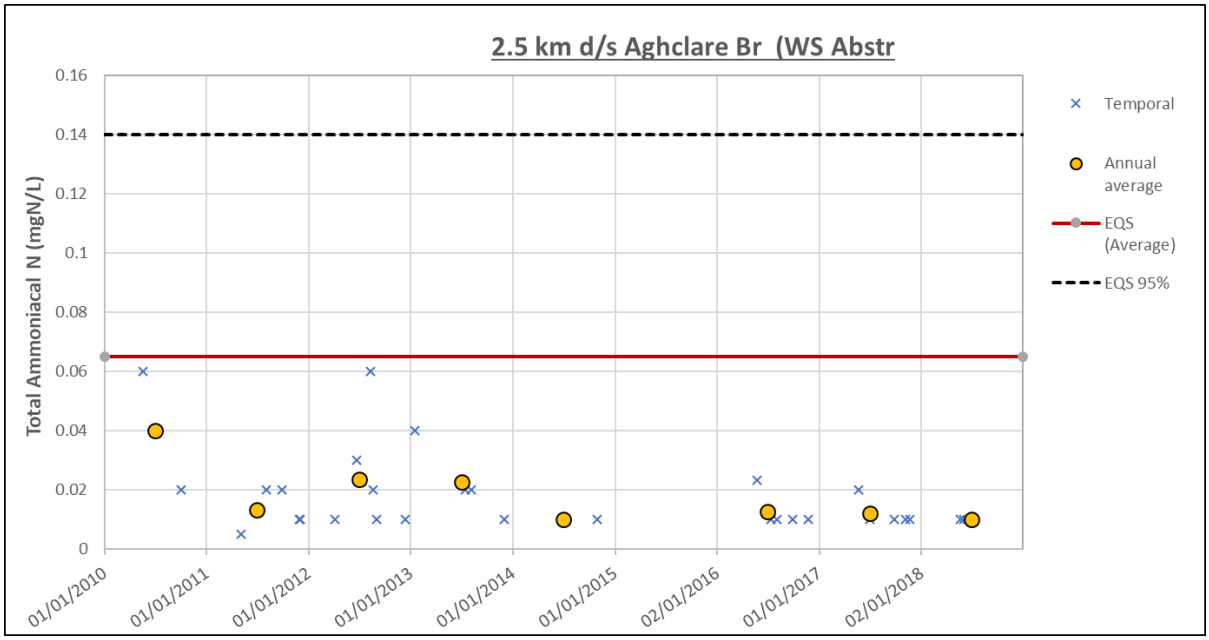


Figure 8. Ammonia concentrations at 2.5km downstream of Aghclare Bridge on Duiske_020.

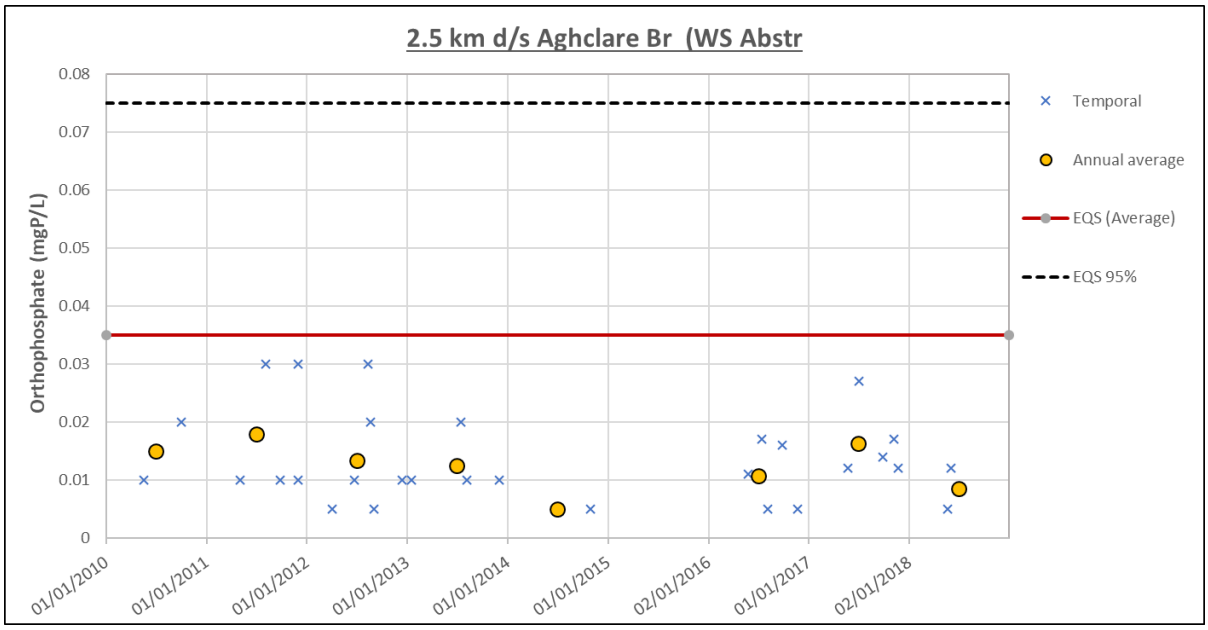


Figure 9. Ortho-phosphate concentrations at 2.5km downstream of Aghclare Bridge on Duiske_020.

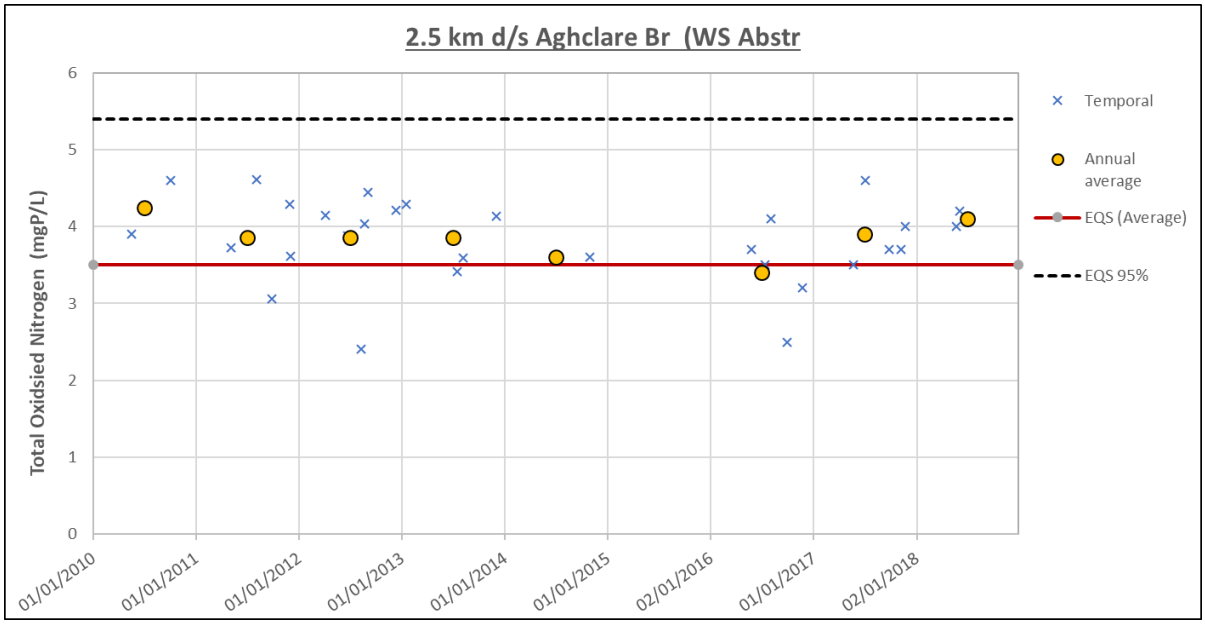


Figure 10. TON concentrations at 2.5km downstream of Aghclare Bridge on Duiske_020.

3 Significant Pressures

Table 4 presents the significant pressures identified by the EPA through the Initial Characterisation Assessment for the Duiske PAA.

Table 4. Significant pressures identified for the Duiske PAA by the Initial Characterisation process.

Waterbody	Pressure Category	Sub-category	Significant Pressure
Powerstown_010	Urban waste water	Skeaghvosteen (PE < 500)	No
	Agriculture	Agriculture	Yes
	Forestry	Forestry	Yes
Duiske_020	Agriculture	Agriculture	Yes
	Urban runoff	Diffuse sources runoff	Yes

3.1 Powerstown_010

- Sediment is the significant issue in Powerstown_010.
- There is a large quarry upstream of the monitoring point which was not identified in the initial characterisation process but is a likely source of sediment.
- There is a large area of forestry in the upper catchment which may also be contributing sediment during forestry operations.
- Phosphate was also identified as a significant issue. There are only two areas of high P PIP in the catchment (**Fig. 11**) which are likely to be contributing diffuse phosphate. Farmyards and septic tanks could also be other potential sources.
- Ammonia is also a significant issue in Powerstown_010. As there is no peat in the catchment, the Skeaghvosteen COA, septic tanks or farmyards may be possible sources of ammonia and phosphate.

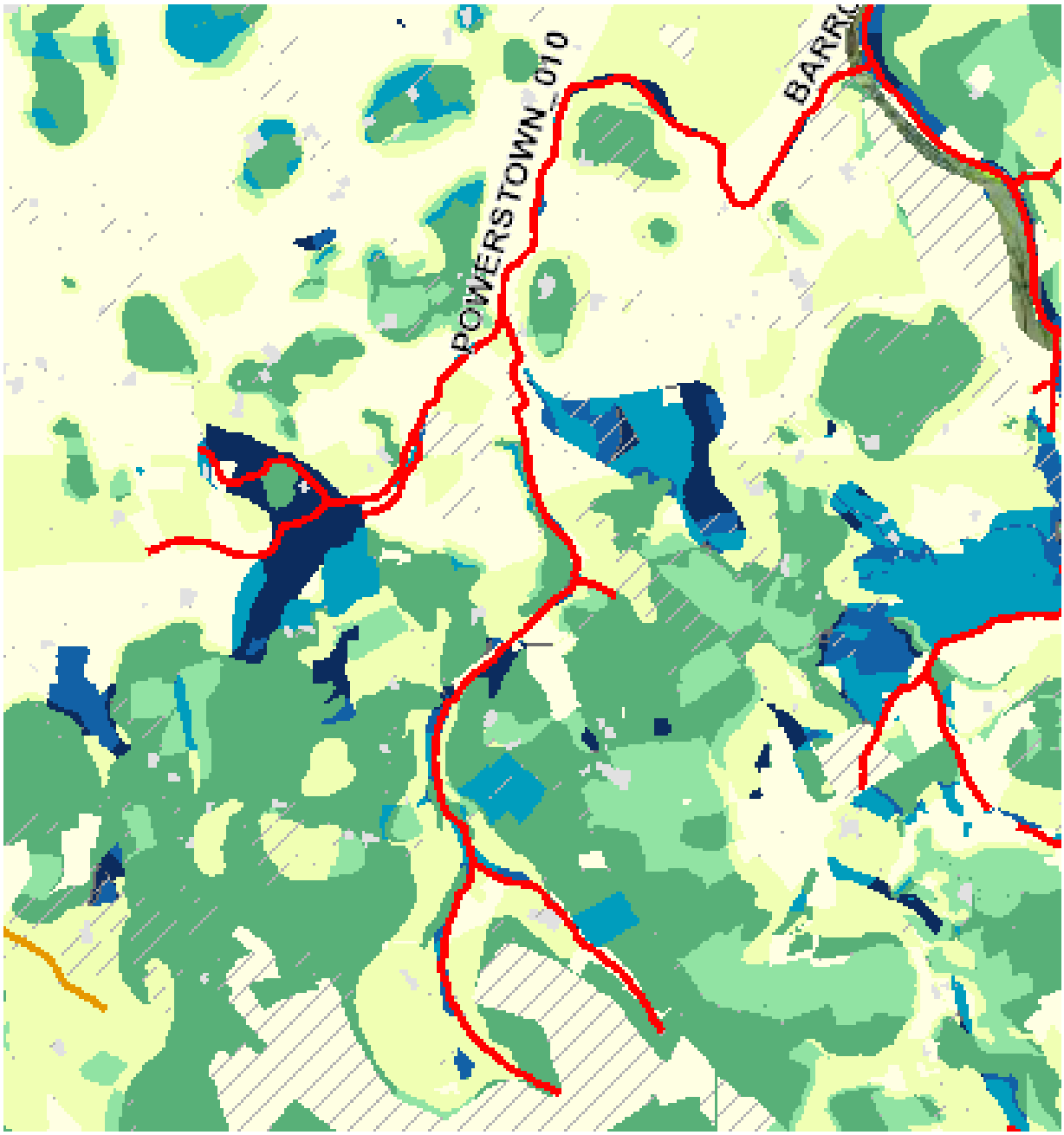


Figure 11. Surface water phosphate PIP map for Powerstown_010.

3.2 Duiske_020

- Nitrate is the significant issue in the Duiske_020.
- There is an area of high nitrate PIP in the upper reaches of the Duiske_020 (**Fig. 12**). The main land use in this area is forestry. However, forestry is unlikely to be a source of nitrate.
- The spreadlands associated with Intensive agriculture (e.g. piggeries) will also require investigation to determine if they are a source of excess nutrient within the catchment.

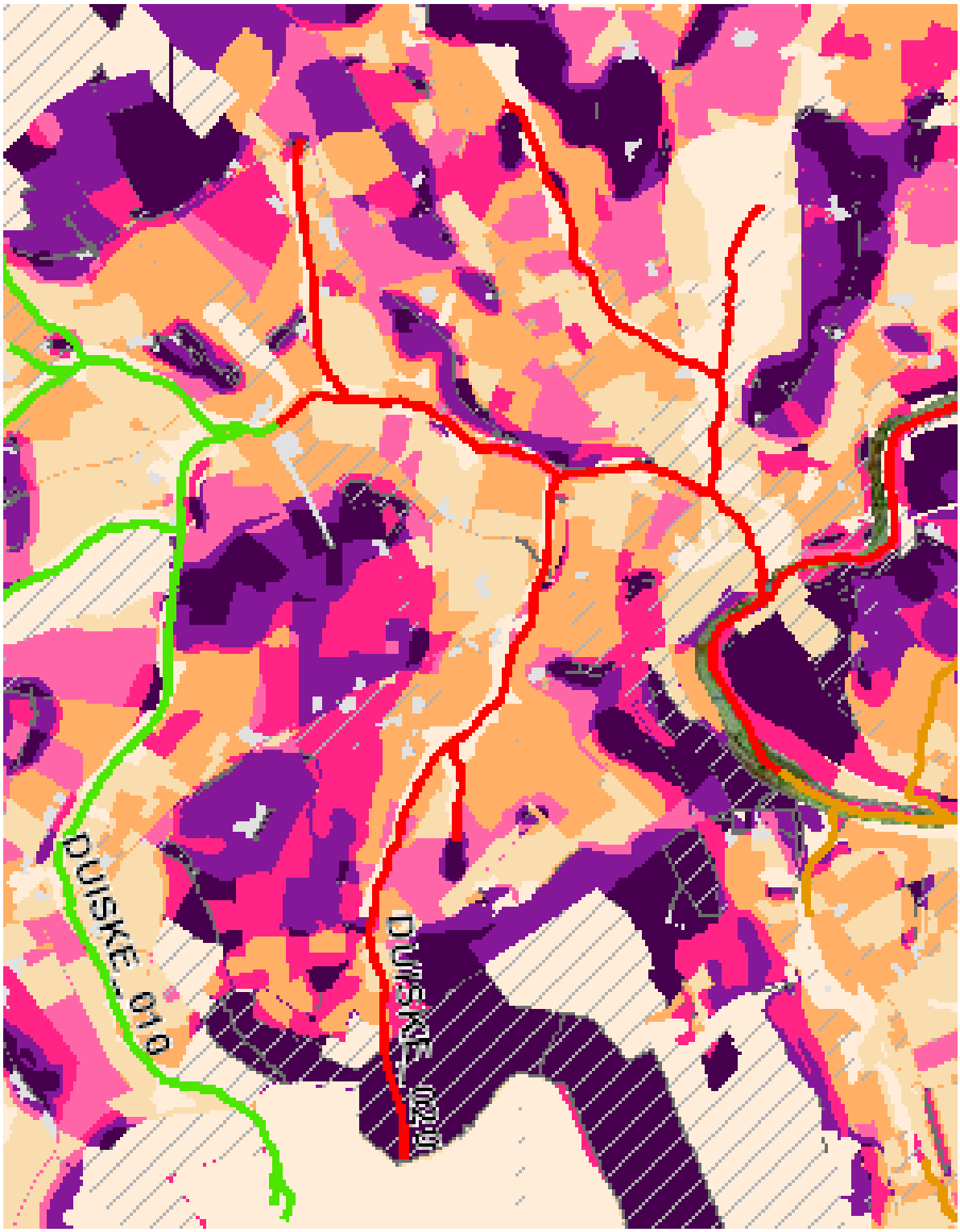


Figure 12. Surface water nitrate PIP for the Duiske_020.

4 Pathway Information and Analysis

Two main pathway compartments have been identified for the PAA. These two compartments are determined based on the aquifer map (**Fig. 13**). Compartment 1 consists of the productive, high transmissivity bedrock and compartment 2 consists of the more poorly productive, low transmissivity bedrock. There is also a subcompartment based on the wet and dry soils map (**Fig. 14**) and this compartment consists of the small areas of poorly drained soils in the Powerstown_010 adjacent to the stream.

4.1 Overview of Pathways in the PAA

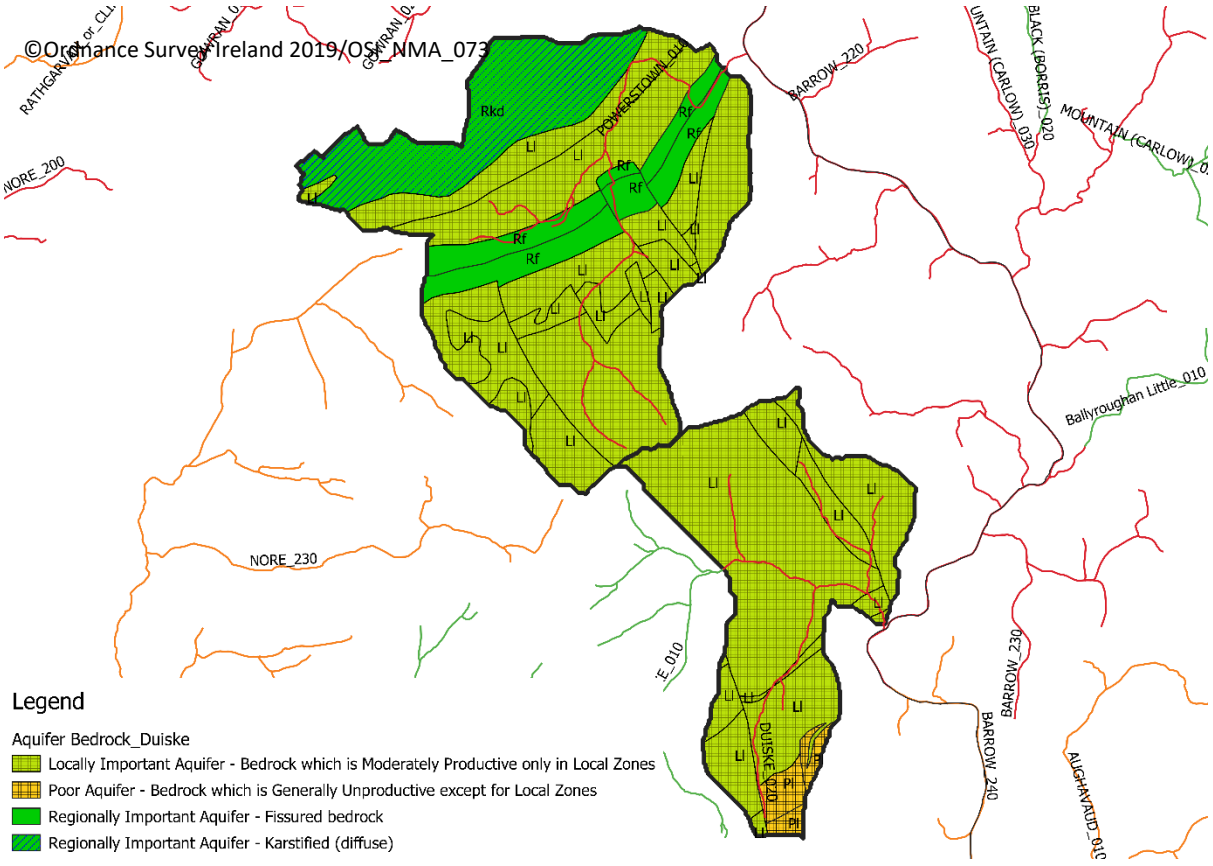


Figure 13. Bedrock aquifer map.

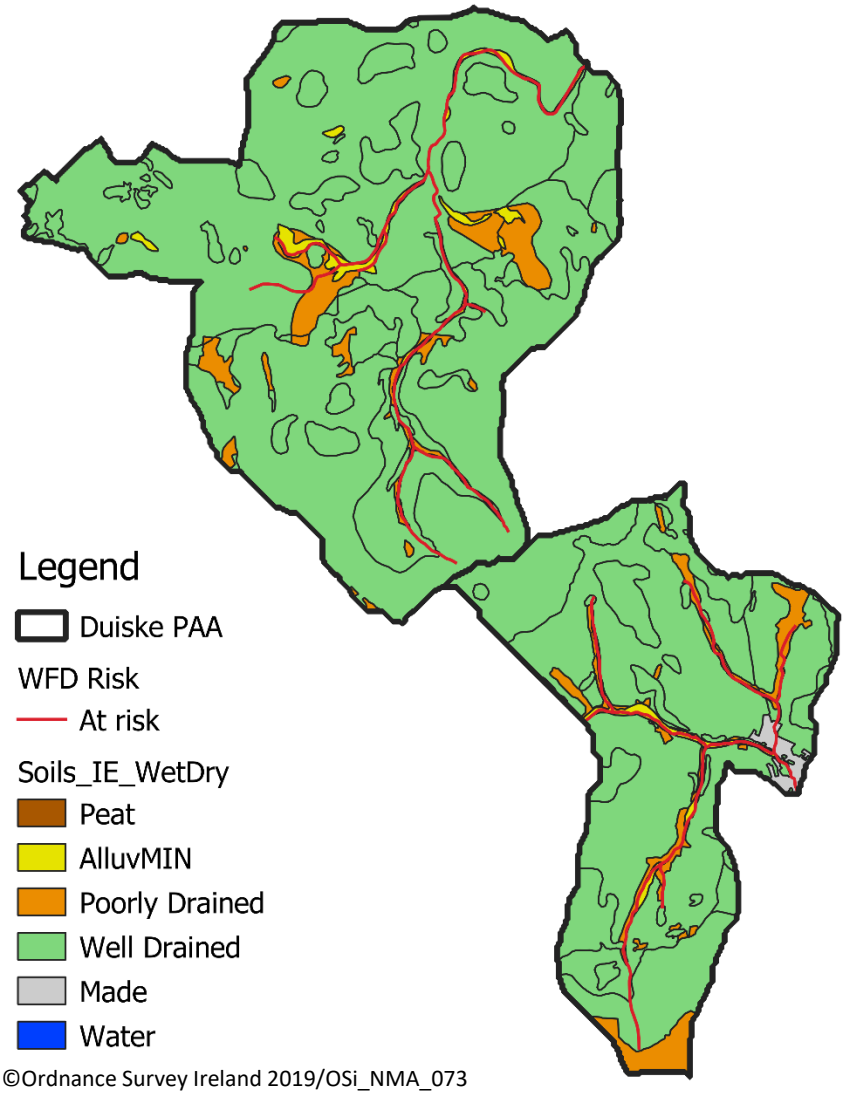


Figure 14. Wet and dry soils map.

Duiske PAA

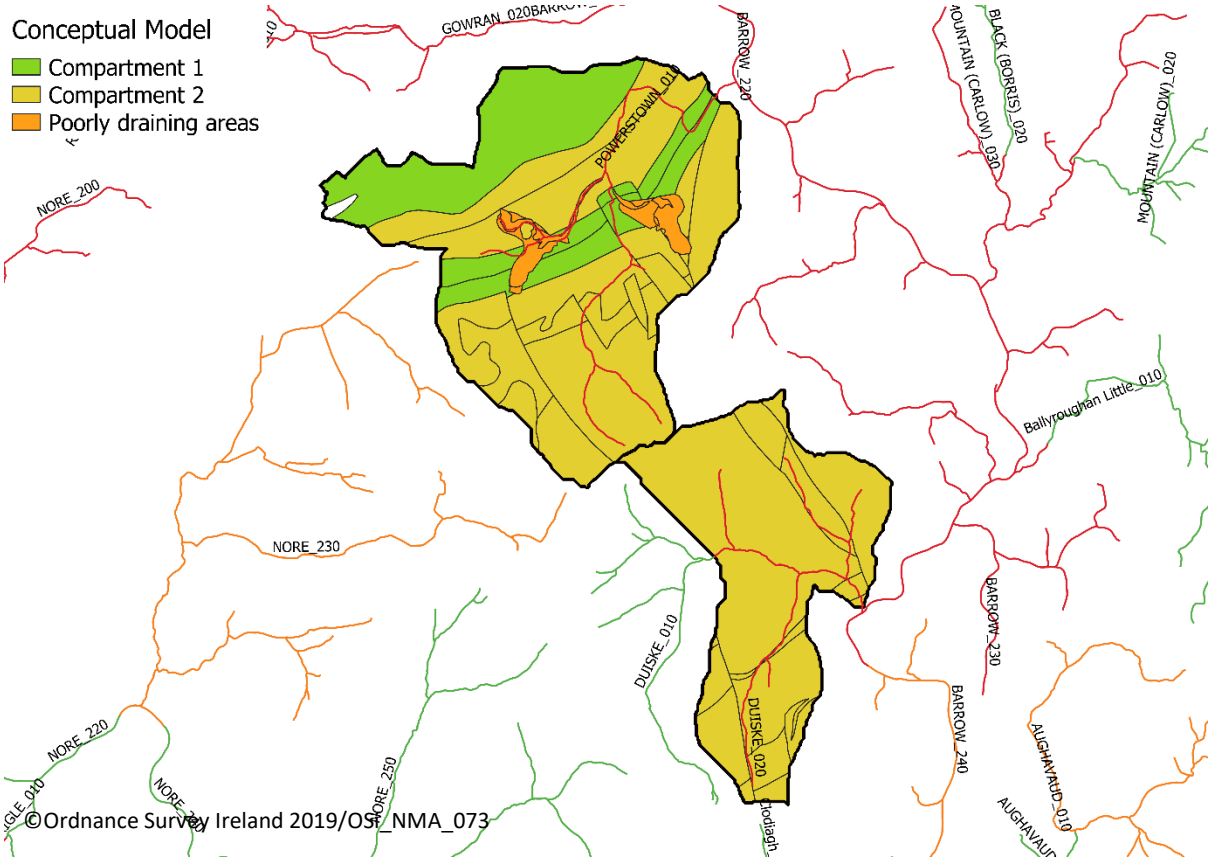


Figure 15. Conceptual model of pathways in the Duiske PAA.

Figure 16. Aerial photograph of Powerstown_010 showing forestry and quarry locations.

Figure 17. Aerial photograph of Duiske_020 showing location of forestry.

4.2 Powerstown_010

- Significant issue: Sediment, ammonia and phosphate
- Significant pressure: For sediment: quarry upstream of monitoring point, for phosphate: agriculture (possibly farmyards and DWWTS), for ammonia: unknown (possibly DWWTS, COA or farmyards)
- Relevant pathways: Sediment may be entering via overland flow or drains from the quarry. Phosphate may be entering from the two poorly draining areas with high P PIP. Point sources may also be contributing P. Ammonia is likely entering from DWWTS, farmyards or other point sources in the catchment.
- The quarry is located in compartment 2. Soils in this area are well drained so any sediment losses are likely to be direct via drains from the quarry to the stream rather than via overland flow.
- The two areas of poorly draining soils may be contributing P via overland flow from diffuse sources. Permanent pasture is the main land use in this area. However, these areas are relatively small and as such P may also be coming from other sources such as DWWTS or poorly managed farmyards.

- Ammonia is likely entering the waterbody via point sources, most likely from poorly performing DWWTS or leaky farmyards.

4.3 Duiske_020

- Significant issue: Nitrate
- Significant pressure: Agriculture, urban diffuse runoff
- Relevant pathways: Upper fractured zone
- The Duiske_020 is underlain by a generally poorly productive bedrock aquifer with a low transmissivity. However, soils in the catchment are predominantly well drained. There is an area of high nitrate PIP in the upper reaches of the catchment where there is a large area of forestry which may be contributing to high nitrate concentrations.
- The town of Graiguenamanagh is immediately upstream of the monitoring point. Urban runoff should be investigated in this area.

4.4 Pathways Conceptual Model

- Compartment 1 consists of a productive bedrock aquifer. This is a potential pathway for nitrates loss.
- Compartment 2 is a poorly productive aquifer and groundwater is less likely to be a pathway.
- Soils in the catchment are generally well drained apart from a few small areas, most notably two small areas in the Powerstown_010.
- In Powerstown_010 soils are generally well drained and as such there is little pathway for loss of sediment from land. Therefore, the pathway for sediment loss is likely direct to the stream with the quarry in the lower part of the catchment being a potential source. Most of the catchment has the potential to contribute nitrate due to the well drained soils. Areas in compartment 1 pose a particular risk due to the productive bedrock aquifer. There are very few areas with potential for P loss from diffuse sources with the majority of the catchment having well drained soils. Therefore, point sources such as farmyards or septic tanks may be sources of P and ammonia.
- In Duiske_020 the issue is nitrate. The catchment is underlain by a poorly productive aquifer and as a result of the generally well drained soils which overlay them, the main pathway for nitrate loss is thought to be via the upper fractured zone. Pathways for diffuse phosphate loss are limited and are confined to the small areas of poorly draining soils immediately adjacent to the waterbody.

Table 5. Main pathways identified in each compartment.

	Compartment 1	**Compartment 2**
Aquifer	Rkd, Rf	Ll, Pl
Rock Units	Dinantian dolomised limestones; Dinantian (early) sandstones, shales and limestones; Devonian Kiltorcan-type sandstones	Dinantian lower impure limestones; Devonian old red sandstones; Granites and other igneous intrusive rocks; Ordovician metasediments;
Soil type	Well Drained	Well Drained
Groundwater Vulnerability	X,H,E,M	X,H,E,M
PO_4 Susceptibility	L, H	L, H
NO_3 Susceptibility	M, H, L	L, M, H
PO_4 PIP	Rank 6 - 4	Rank 6, Some Rank 1
NO_4 PIP	Rank 1 - 5	Rank 1 - 4
Main Flow Paths	Groundwater	Subsurface via the upper fractured zone

5 Interim Story of the Duiske PAA

5.1 Powerstown_010

- The Powerstown_010 is *At Risk*.
- In 2017 it had a Q-value of 3 and is classified as poor status. This marked a decline from moderate status in 2014 and good status in 2011.
- Sediment, ammonia and phosphate were all identified as significant issues in the catchment.
- The quarry upstream of the monitoring point in Compartment 2 is the most likely source of sediment. Phosphate may be coming from the areas of poorly drained soils. Point sources such as DWWTS may be contributing both phosphate and ammonia.
- The two poorly draining areas should be investigated for both diffuse losses of phosphate and ammonia as well as losses from farmyards and septic tanks in this area, where percolation may not be sufficient.

5.2 Duiske_020

- The Duiske_020 is *At Risk*.
- The Duiske_020 is currently at moderate ecological status with a 2017 Q-value of 3-4. It declined from good status in 2009 to moderate status in 2011 and has remained at moderate status ever since.
- Nitrate is the significant issue in the waterbody with a 2014 baseline concentration of 3.73 mg/l.
- Agriculture and urban diffuse runoff were identified as significant pressures during the initial characterisation phase. Forestry may also be a significant pressure with a large area of forestry in the upper reaches of the catchment. This forested area has a PIP rank of 1 for nitrate loss and may be a critical source area for nitrate and will need to be investigated.
- Diffuse urban pressures are likely originating from the town of Graiguenamanagh immediately upstream of the monitoring point.

5.3 Overview

- There are a range of issues throughout the catchment with sediment, nitrate, phosphate and ammonia all potentially being significant issues.
- The predominantly well drained soils in the catchment provide a potential pathway for nitrate via the productive bedrock aquifer in compartment 1 or via the upper fractured zone in compartment 2.
- Poorly drained soils with potential for overland flow which might contribute phosphate are limited.
- Phosphate and ammonia may be coming from point sources such as farmyards or DWWTS.

6 Work Plan

The Quarry located in the lower Powerstown_010 catchment is a likely source of sediment in the waterbody. The watercourse should be walked in the vicinity of the quarry to identify where sediment from the quarry may be entering the waterbody.

The high ammonia concentrations in the Powerstown_010 are likely coming from point sources such as septic tanks or leaky farmyards. The most likely place for a septic tank to be causing an issue is on the poorly draining soil to the west of the catchment. This should be investigated first. There is also a farmyard in this area. A full stream walk may be needed to investigate the effect of possible point sources.

There are a number of assessments needed (SSIS/RA) on the tributaries of the Duiske_020 and locations are shown in Fig. 19. A stream walk should also be carried out at the top of the catchment in the area draining the forestry.

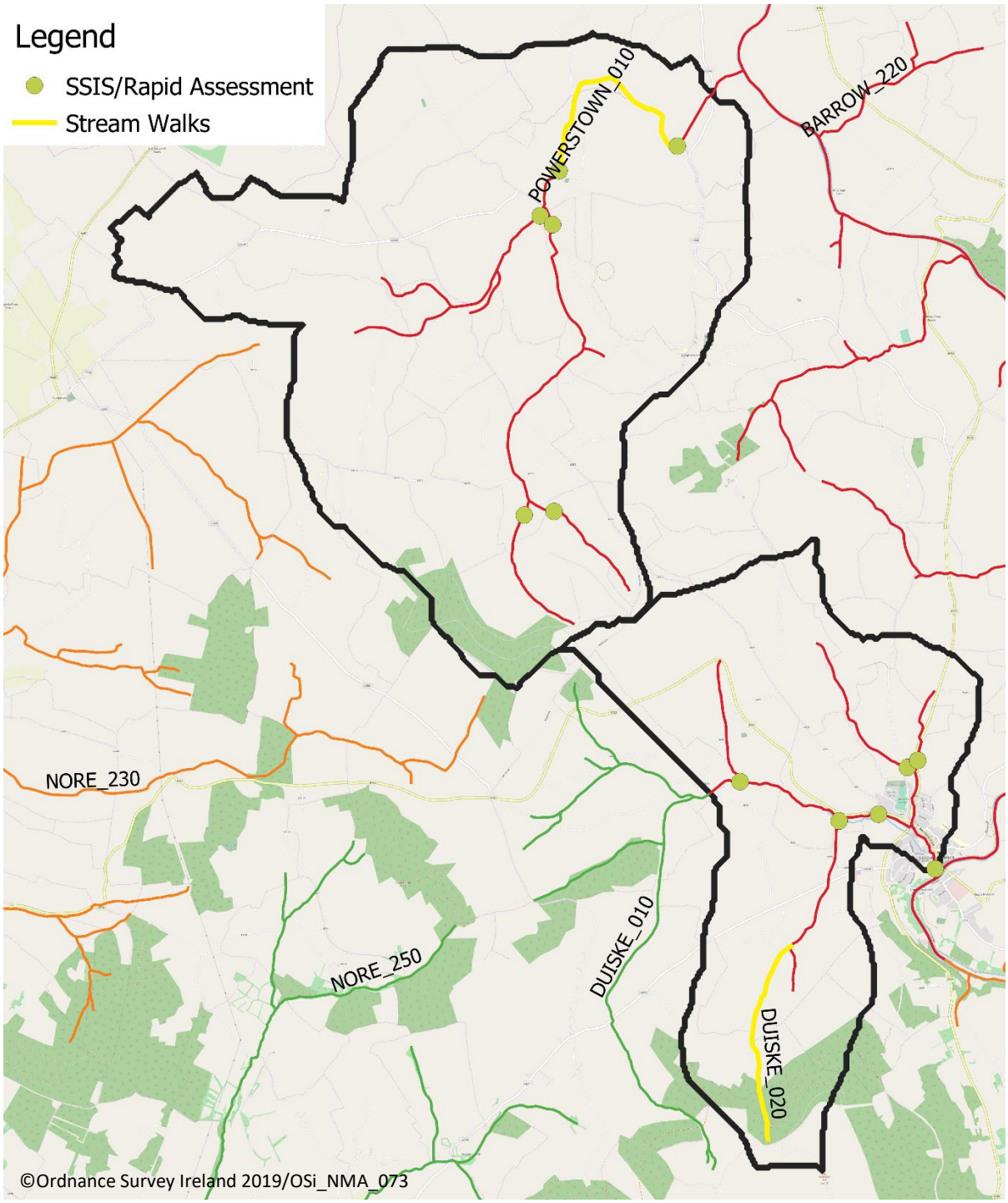


Figure 18. Work plan map showing locations were SSIS/rapid assessments and stream walks are needed.

7 Possible Mitigation Options

- Sediment traps or blocking of drains from the quarry to prevent sediment loss.
- Source control of nitrate applications
- Catch crops on arable land to prevent nitrate loss