



Gageborough Priority Area for Action AFA0081

Midlands & Eastern Region

Deskstudy Report

18th November 2019

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1 Non-Technical Summary

The Gageborough Priority Area for Action (PAA) consists of three waterbodies. These include the Gageborough_010, Gageborough_020 and the Syonan Castle Stream_010. All three waterbodies are at Moderate Ecological Status (2010-2015) and are categorised as *At Risk*. The Moderate Ecological Status is driven by biological status.

Based on the review of the conceptual model for the Area for Action and aerial imagery, the waterbodies overlay locally important aquifers (all limestones with varying degrees of purity) and the soils are predominantly free draining, with small portions of poorly draining, peaty soils and alluvium, which are typically found along the waterbody edge. Therefore, the following pollutants have the potential to enter the waterbody, nitrate may leach from the well-draining land into the groundwater and discharge into the surface waters, the main pathways for phosphorus, sediment and pesticides are overland flow, and along drains and ditches, where poorly draining soils exist.

There is no chemistry data available for any of the waterbodies. The biologists' notes indicate that enhanced macrophyte and macroalgal growth are an issue within the Gageborough_010 and Gageborough_020, due to enrichment. Whilst enhanced filamentous algal growth and calcification were noted as an issue within the Syonan Castle Stream_010.

The significant pressures are identified (from the WFD App) as agriculture and hydromorphology. Diffuse and small point source pollution from agriculture will be the focus of the field assessment, in particular nitrates will be focused on, as the Surface Water Nitrate Pollution Impact Potential (PIP) maps highlights the middle reaches of Gageborough_010 and lower reaches of Gageborough_020 as sensitive areas for Nitrates. Similarly, Phosphorus and sediment will be the focus along the upper reaches of the Gageborough_010 and Syonan Castle Stream_010 and the lower reaches of the Gageborough_020 where the Surface Water P PIP map indicates the highest risk category.

Biological surveying-Small Stream Risk Scoring (SSIS) will be conducted along the Gageborough_010, Gageborough_020 and Syonan Castle Stream_010 where suitable to aid in narrowing down impact in the waterbodies and identifying where to focus our efforts. Where SSIS is not suitable and further information is necessary, chemical analysis will be undertaken.

Depending on the pressure identified, specific mitigation measures will be implemented. Mitigation options for diffuse nitrate from agriculture should focus on nutrient management planning to prevent/reduce nitrate loss to groundwaters. Whilst diffuse agricultural pressures such as phosphorus, sediment and pesticides should focus on pathway interception measures to target

overland flow pathways and along drains and ditches. Point source nutrient issues need to be addressed at farmyard level with the assigned ASSAP advisor. Hydromorphology was deemed a significant issue in the Gageborough_020, the historic and current maps were reviewed, waterbody straightening, culverts and additional tributaries were identified. These will be verified during field assessment and the potential impact will be determined.

2 Background

2.1 PAA background information

There are three waterbodies included in the Gageborough PAA: Gageborough_010, Gageborough_020 and Syonan Castle Stream_010. These waterbodies, along with Ballinderry, Brosna_050, Brosna_060, Brosna_070, Brosna_080, Ballynagrenia Stream_010, Ballynagrenia Stream_020 and Gageborough_030 combine to form the 25A_9 BROSNA_SC_030 subcatchment in catchment area 25A Lower Shannon. The subcatchment is 159.58km² in area and consists of 11 rivers.

The Midlands and Eastern catchment assessment workshops were held in Ballycoolin, Dublin from the 9th to 12th of May 2017. They were attended by representatives of local authority staff (operational staff on all days and both operational and senior staff on the final day of the workshop), Local Authority Waters and Communities Office (LAWCO) (now part of the Local Authority Waters Programme LAWPRO), Irish Water, Inland Fisheries Ireland, Forest Service, Coillte, National Parks and Wildlife Service, Teagasc, Department of Housing Planning and Local Government, Geological Survey Ireland, National Federation of Group Water Schemes, Department of Agriculture, Food and the Marine, Bord na Mona, Waterways Ireland and the Environmental Protection Agency. The workshop was facilitated jointly by LAWCO and the EPA. The Gageborough PAA was selected as a priority area for action in the 2nd cycle. The EPA report includes the following reasons:

- Joint County project.
- Potential 'quick wins'.
- Headwaters to river Gageborough.
- One deteriorated water body.

There are no Natura protected sites identified within the Gageborough PAA. There are also no drinking water protection areas in the PAA identified on the WFD app. There is a surface water drinking abstraction point at Ballyboughlin bridge which is North of Clara, Co. Offaly. This abstraction point serves the Clara/Ferbane area and is located outside the PAA along the Gageborough_030 before converging with the Brosna_080. The Gageborough PAA however feeds into this waterbody and therefore is an influencing factor.

Pesticides have been detected within this supply above the drinking water limit over the last number of years, subsequently the supply was added to the EPA pesticide watch list in 2017.

As part of this characterisation process each waterbody has been assigned investigative actions (IAs) to assist in the overall WFD objective of meeting good status. These actions have been assigned accordingly based upon the action required. Within this PAA all actions have been assigned to

LAWPRO, and therefore must be completed as part of the assessment process. The following IA's apply to this PAA:

Waterbody	Investigative Assessment No.	Assigned Organisation	Description of IA
Gageborough_010	IA7	LAWPRO	Focus on sources of nutrients and sediment upstream of monitoring station RS25G010045 – Gageborough E of Bunanagh (roadside).
Gageborough_020	IA7	LAWPRO	Investigative assessment to be carried out along the river, to include it being walked and focus on both sediment and nutrients.
Syonan Castle Stream_010	IA7	LAWPRO	Investigative assessment to be carried out between monitoring points 25S040300 – Br N of Lisnagree (W of Streamstown Ho) and 25S040500 – Br u/s Gageborough R confluence; as a deterioration in biology has taken place between the upstream and downstream monitoring points.

Table 1: Investigative assessment actions required within each waterbody

Description of Catchment:

The Gageborough river itself comprises of three waterbodies, Gageborough_010, Gageborough_020 and Gageborough_030. Most recent status information on the river is as follows (from WFD App, 2015 data):

- Gageborough_010 (headwaters) is at Moderate ecological status and is categorised as *At Risk* of failing to meet the objectives of the Water Framework Directive (WFD).
- Gageborough_020 is at Moderate ecological status and is categorised as *At Risk*.
- Gageborough_030 (not in the PAA) is at Good ecological status and is categorised as *Not At Risk*

The Syonan Castle Stream_010 confluences with the Gageborough river along the Gageborough_020. This waterbody has a Moderate ecological status and is “*At Risk*” of failing to meet the WFD objectives. The objective is to achieve good status in the Gageborough_010, Gageborough_020 and the Syonan Castle Stream_010 by 2021.

Biologists’ notes indicate that the enhanced macrophyte and macroalgal growth at a number of stations continues to indicate some enrichment in the Gageborough_010 and Gageborough_020,

whilst filamentous algae (lower reaches) and extensive calcification and compaction (upper reaches) were noted in the Syonan Castle Stream_010. The significant pressures identified within the catchment (from the WFD App) are agriculture and hydromorphology. There is no EPA chemistry data available within this catchment.

The catchment area consists of a gentle sloping valley from North to South. The topography falls from the higher area at Killare church, Co. Westmeath at the North (120m OD) to the lowest point at the South of the catchment at 63m OD near Gageborough bridge, Russagh, Co. Offaly. The catchment is generally low lying and flat with no considerable upland areas.

The waterbodies in the catchment overlay a locally important aquifer (pure & impure limestones). Soils are predominantly well draining with a small portion of both poorly draining, peaty soils and alluvium running along the waterbody channel.

Approximately 90% of the PAA is dominated by permanent pasture. There are no Urban Wastewater Treatment plants operating within the PAA. Domestic wastewater treatment systems are servicing the area. The waterbodies within the PAA are shown below in Figure 1.

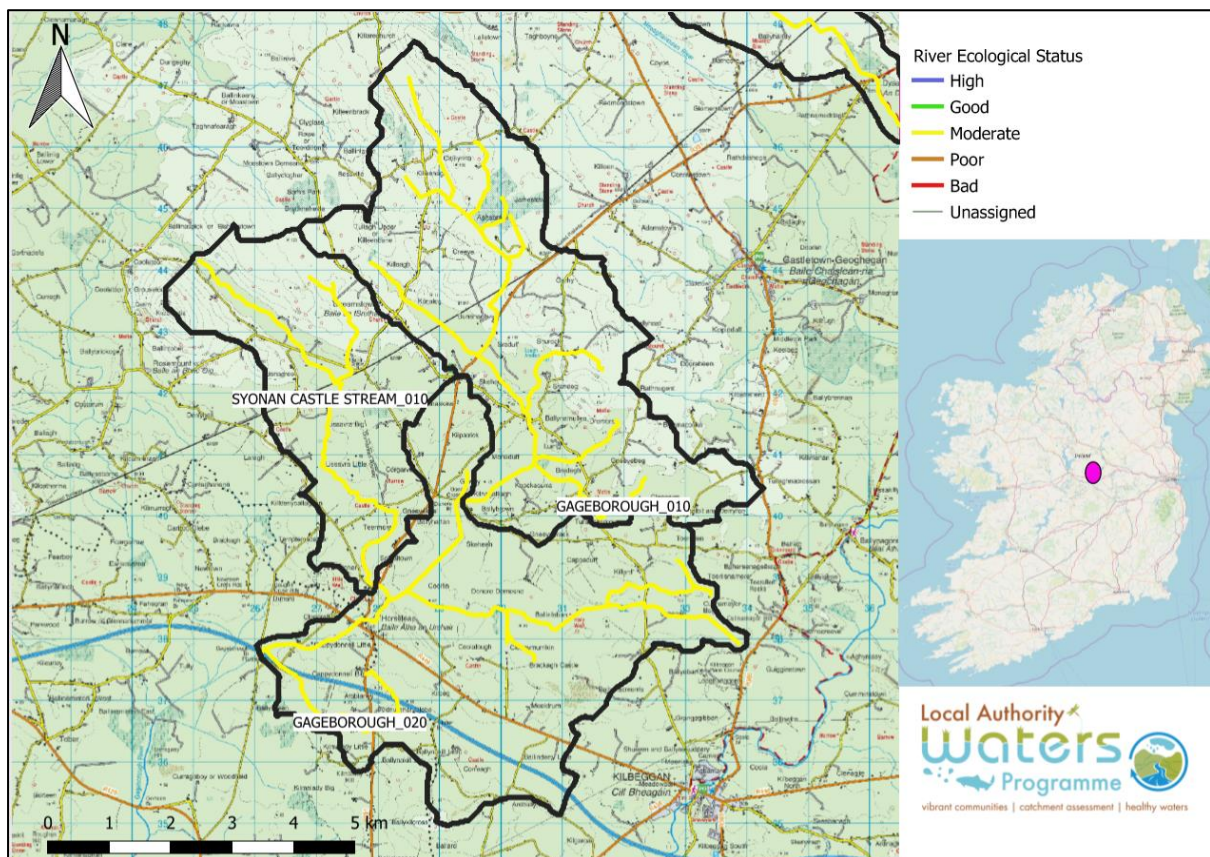


Figure 1: Gageborough Priority Area for Action

2.2 Information Sources Consulted

Several information sources were consulted during the preparation of the desk study for the Gageborough PAA including:

- WFD web application – EPA characterisation data
- Data from Offaly County Council
- Data from Westmeath County Council
- Data from Irish Water
- Data from the Office of Public Works
- GEOHIVE OSi

2.3 PAA Summary Information

A summary of risk, ecological status, known pressures and associated significance for the Gageborough PAA are presented in Table 2 below. All the waterbodies within the PAA are characterised as *At Risk*. The ecological status of the Gageborough PAA is Moderate. Gageborough_010 and Syonan Castle Stream_010 ecological status has had no changes in the last three ecological assessment iterations (Table 2). Gageborough_020 status dis-improved from Good to Moderate between 2009 and 2012, remaining at Moderate ecological status in 2015. The Moderate ecological classifications are based primarily upon Invertebrate Status or Potential. Table 3 identifies the EPA's five operational monitoring stations within the PAA: two along the Gageborough_010 and Syonan Castle Stream_010 and one along the Gageborough_020. Chemistry sampling is not carried out at these stations, macroinvertebrate sampling determines the status.

Gageborough - AFA0081

WB Code	WB name	WB Type	Risk	High status obj.	2009	2012	2015	No of pressures	Pressure category	Pressure subcategory	Pressure name	Significant pressure (Y/N)
IE_SH_25G010100	GAGEBOROUGH_010	River	At risk	No	M	M	M	2	Agriculture	Pasture	0	Yes
									HYMO	Culverts	0	No
IE_SH_25S040500	SYONAN CASTLE STREAM_010	River	At risk	No	M	M	M	2	HYMO	Channelisation	0	No
									Agriculture	Pasture	0	Yes
IE_SH_25G010300	GAGEBOROUGH_020	River	At risk	No	G	M	M	2	HYMO	Culverts	0	Yes
									Agriculture	Pasture	0	Yes

Table 2: Summary of status and pressure for Gageborough_010, Gageborough_020 and Syonan Castle Stream_010

(AR= At Risk, H= High, G= Good, M= Moderate, P= Poor, B= Bad, U= Unassigned)

Waterbody	Monitoring Point Code	Name	Type	Comments
Gageborough_010	RS25G010045	GAGEBOROUGH - E of Bunanagh (roadside)	Operational	Q only
	RS25G010100	Donore Br	Operational	Q only
Syonan Castle Stream_010	RS25S040300	Br N of Lisnagree (W of Streamstown Ho)	Operational	Q only
	RS25S040500	Br u/s Gageborough R confl	Operational	Q only
Gageborough_020	RS25G010300	Gageborough Br 1.2km S of Dunard	Operational	Q only

Table 3: EPA monitoring locations within the Gageborough PAA

3 Receptor information & assessment

3.1 Context and Setting

The Gageborough was selected as a PAA as just two out of five EPA monitoring stations within the catchment is achieving Good biological status. All other EPA monitoring stations are at Moderate biological status, which require improvement and prevention of further deterioration. There are no SAC's, SPA's or NHA's located within the PAA. The PAA feeds into the Clara/Ferbane drinking water supply, which has had pesticide exceedances above the drinking water limit over the past number of years.

3.2 WFD Information

Table 4 provides 2017 Q value data for the two monitoring stations along Gageborough_010 (Gageborough East of Bunanagh (roadside) and Donore Bridge). The 2017 Q ratings have shown no change at either monitoring point when compared to 2014 data. The Q value data for the two-monitoring stations along the Syonan Castle Stream_010 (Bridge N of Lisnagree (W of Streamstown House) and Bridge u/s Gageborough River Confluence) showed a deterioration from Good to Moderate status at the "Bridge N of Lisnagree in 2017" and station "Bridge u/s Gageborough River confluence" did not change between 2014 and 2017. "Gageborough Bridge 1.2km S of Dunard" is the EPA monitoring station along the Gageborough_020, this improved in 2017 from Moderate to Good status.

All waterbodies within the PAA are characterised as *At Risk* of failing to meet the WFD objective of good ecological status. Currently just 2 out of the 5 monitoring stations are meeting the requirements. Local catchment assessments are needed to prevent further deterioration and to reduce/eliminate the nutrients entering the waterbodies as mentioned by the EPA biologists.

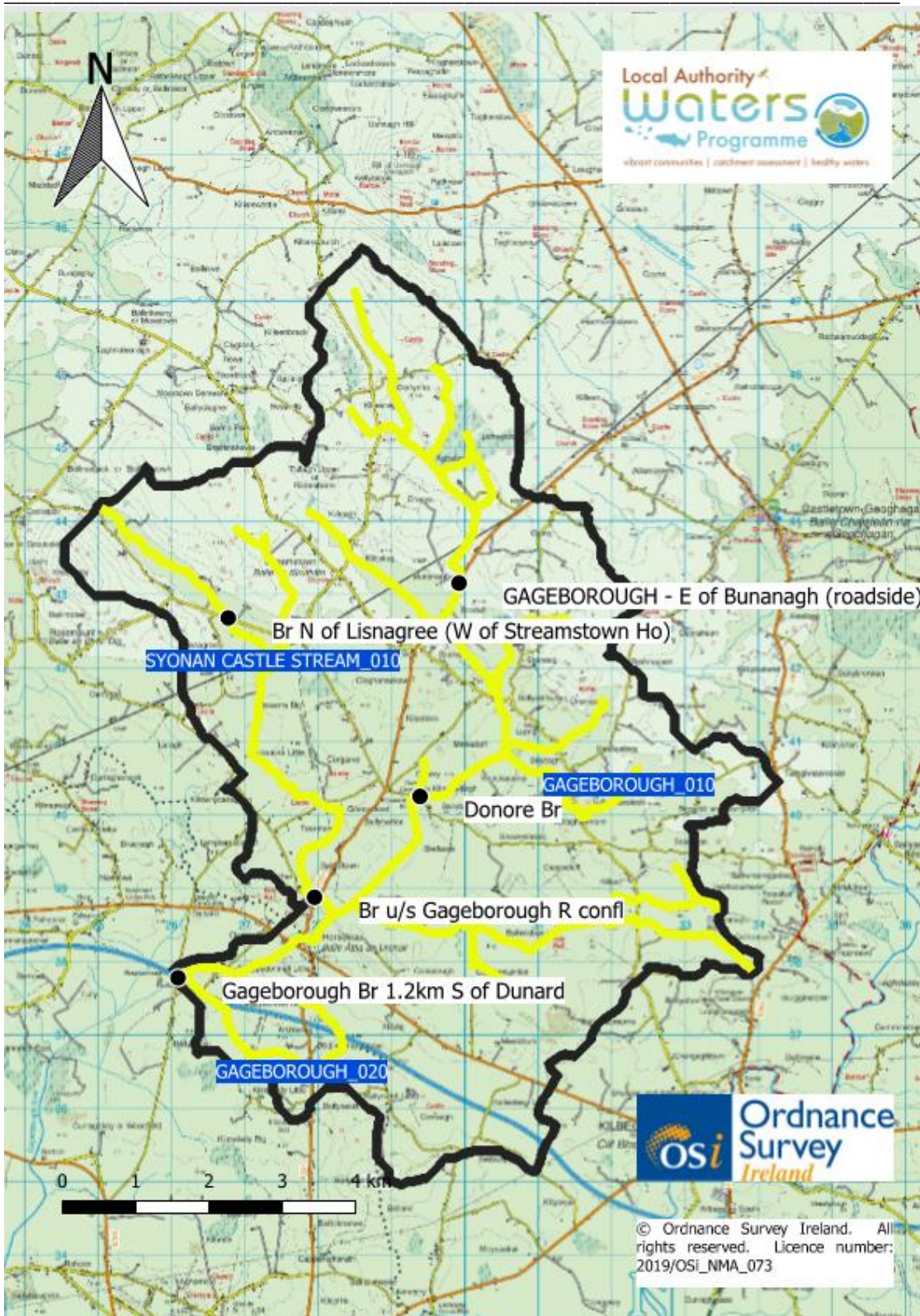


Figure 2: Locations of EPA monitoring stations within the Gageborough PAA

Waterbody	Gageborough_010		Gageborough_020	Syonan Castle Stream_010		
Risk Category	At risk		At risk	At risk		
HYMO						
Monitoring station	GAGEBOROUGH - E of Bunanagh (roadside)	Donore Br	Gageborough Br 1.2km S of Dunard	Br u/s Gageborough R confl	Br N of Lisnagree (W of Streamstown Ho)	
Monitoring station type	PreWFD	Operational	Operational	Operational	Operational	
Biological Status						
Variations/trends in Q values	2009					
	2010					
	2011	3-4	3-4	3-4	3-4	
	2012					
	2013					
	2014	3-4	4	3-4	3-4	4
	2015					
	2016					
	2017	3-4	4	4	3-4	3-4
2018						
Water chemistry	None Available					
Conceptual model required (Y/N)	Y		Y		Y	
Ecological Status	M		M	M		
EPA Biologist comments	The macroinvertebrate fauna indicated that the Gageborough river was in a satisfactory condition at three of the four stations surveyed in 2017. A welcome improvement was noted at Gageborough Bridge (0300). Although the macroinvertebrates indicated good ecological conditions at the three stations surveyed, the enhanced macrophyte and macroalgal growth continues to indicate some enrichment. The paucity of pollution sensitive macroinvertebrate fauna coupled with the excessive instream growth of filamentous algae continues to indicate unsatisfactory enriched conditions in the upper reaches (0045).			The paucity of pollution sensitive macroinvertebrate fauna indicated unsatisfactory ecological conditions at both stations surveyed on the Syonan Castle stream in 2017. Extensive calcification and compaction of the river bed was noted at the upper station. Enhanced filamentous algal growth observed in the lower reaches (0500) is indicative of nutrient enrichment.		
Significant issue: monitoring point	Unknown		Unknown	Unknown		
Significant issue: Waterbody	Agriculture and Hydromorphology					
Protected Areas	N/A					

Table 4: Outline of parameters influencing water quality in the Gageborough PAA

Gageborough_010

Biological status for monitoring station Gageborough - E of Bunanagh (roadside)_RS25G010045 has been Moderate for 4 of the last monitoring events. Status dropped from Good to Moderate in 2002 (figure 3).

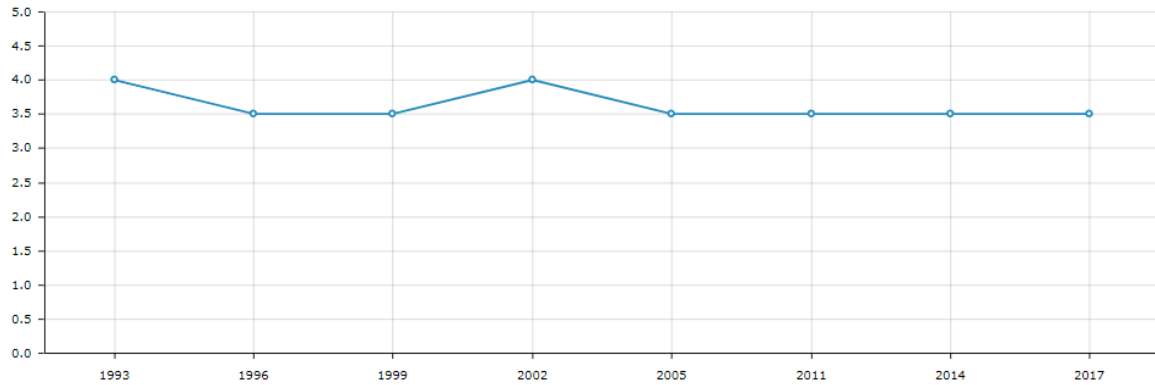


Figure 3: Gageborough - E of Bunanagh (roadside) biological status

Biological status at Donore Bridge (RS25G010100) has been Good for the last 2 monitoring cycles. The status dropped to Moderate in 2008 and returned to Good in 2014 (Figure 4). Although Donore bridge is meeting the WFD standard, monitoring station Gageborough - E of Bunanagh (roadside) is not and as a result the waterbody is classified as Moderate status. Therefore, this waterbody is characterised as *At Risk* of failing to meet WFD objectives.

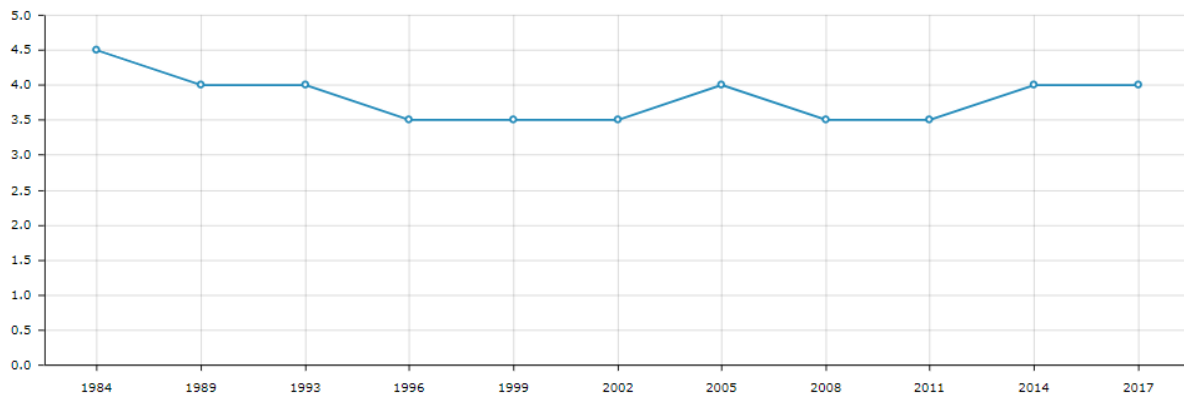


Figure 4: Donore Bridge biological status

Gageborough_020

Biological status for the monitoring station Gageborough Br 1.2km S of Dunard (RS25G010300) has been classified as Good twice in the last 4 monitoring cycles (Figure 5). Status dropped to Moderate in 2011 and returned to Good in 2017. As there is no additional EPA monitoring locations along this waterbody and it has achieved good biological status, the Gageborough_020 is expected to improve from Moderate to Good ecological status in the next iteration, based on 2013 – 2018 data. The EPA biologists did note extensive macrophytes and macroalgae growth within the channel, this enrichment requires assessment to ensure this waterbody does not deteriorate.

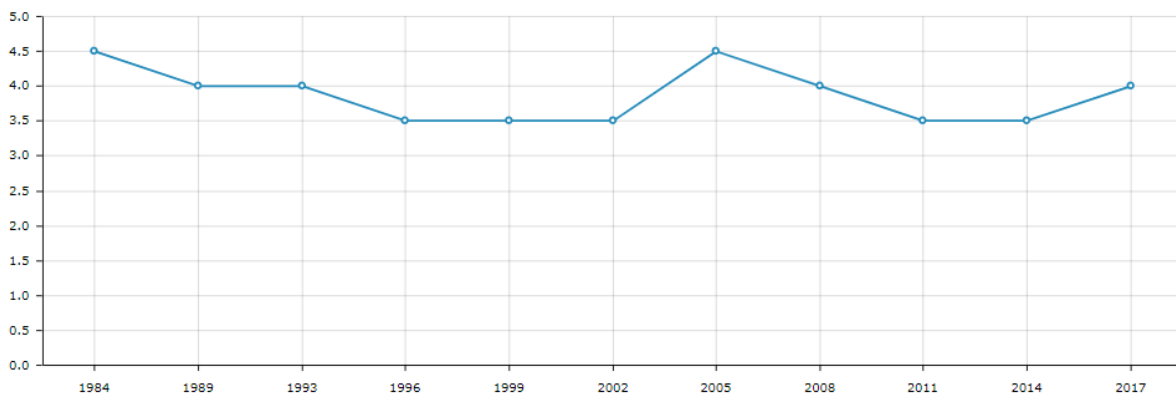


Figure 5: Gageborough Br 1.2km S of Dunard biological status

Syonan Castle Stream_010

Biological status for the monitoring station Br N of Lisnagree (W of Streamstown Ho) _RS25S040300 located along the upper reaches of the Syonan Castle Stream_010 has been Good once in the last 4 monitoring cycles. Status improved to Good in 2014 and has since deteriorated as recently as 2017 (Figure 6). High levels of calcification and compaction were recorded by the EPA biologists in 2017, there may be a link between a drop-in status and the presence of calcification as this causes a loss in habitat.

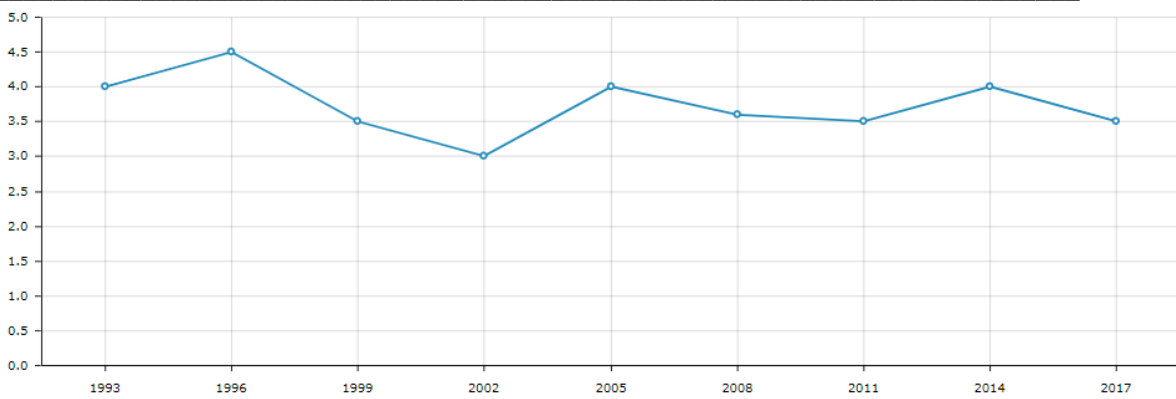


Figure 6: Br N of Lisnagree (W of Streamside Ho) biological status

Biological status for the monitoring station Br u/s Gageborough R confl located in the lower reaches of the Syonan Castle Stream_010 (RS25S040500) has been Moderate for the last 4 monitoring cycles. The EPA biologists noted enhanced filamentous algae growth at this monitoring location in 2017. The status deteriorated from Good to Moderate in 2005 (Figure 7).

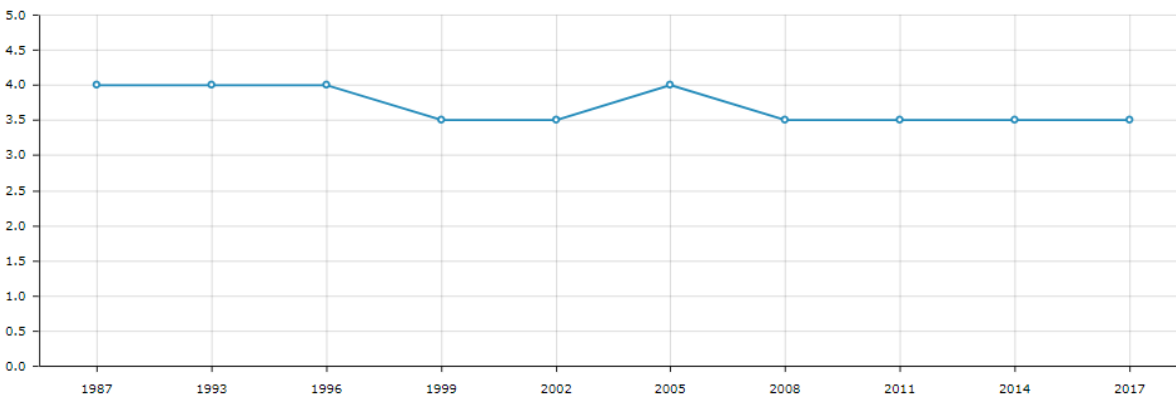


Figure 7: Br u/s Gageborough R confl biological status

3.3 Supplementary information

Offaly County Council (OCC) have a drinking water abstraction point on the Gageborough river, which serves the Clara/Ferbane area. The surface water abstraction point is located at Ballyboughlin bridge, which is outside the Gageborough PAA boundary. It is, however, along the Gageborough_030, which the Gageborough PAA feeds into. OCC have recorded elevated pesticide concentrations above the drinking water limit of 0.1µg/l within the supply in recent years (see table 5).

Pesticide	Local Authority	Public Water Supply	Year	Date	Concentration (µg/l)	Sampling Location
MCPA	Offaly County Council	Clara/Ferbane PWS	2017	04/09/2017	0.15	Clara
Mecoprop	Offaly County Council	Clara/Ferbane PWS	2017	04/09/2017	0.16	Clara
MCPA	Offaly County Council	Clara/Ferbane PWS	2018	30/05/2018	0.18	Gallen View, Ferbane
Fluroxypyr	Offaly County Council	Clara/Ferbane PWS	2018	26/06/2018	0.20	Fluroxypyr - treated water @ Clara WTP
Triclopyr	Offaly County Council	Clara/Ferbane PWS	2018	26/06/2018	0.10	Treated water @ Clara WTP
2,4-D	Offaly County Council	Clara/Ferbane PWS	2019	09/04/2019	0.44	Kiosk @ River Street

Table 5: Pesticide exceedances in the Clara/Ferbane Public Water Supply

As a result, this water supply was added to the EPA pesticide Watch List in 2017. Due to the number of exceedances, in 2018 OCC generated a pesticide exceedance response plan to assist in identification of the source of pesticides within the drinking water catchment area. The aim of this response plan

was to roll it out within quick succession of an exceedance alert as to try and identify the source. The first exceedance of 2018 occurred on May the 30th, MCPA was detected at 0.182ug/l. Also, in June both Triclopyr (0.103µg/l) and Fluroxypyr (0.199µg/l) were detected above the drinking water limit. Therefore, on the 17th of July 2018 OCC rolled out the plan and collected 14 samples within the Clara/Ferbane drinking water supply catchment area. These samples were tested for the full Irish Water (IW) pesticide suite, the sampling locations are indicated in figure 8 below. A number of the sampling locations are within the Gageborough PAA catchment area. As the drinking water catchment falls between both County Offaly and Westmeath, OCC included sampling locations within Westmeath.

One location had no detection of pesticides, this was sampling location 14, which is located in the upper most reaches of the Syonan Castle Stream_010. Pesticides were detected at all other sampling locations, traces included MCPA, Trichlopyr, Fluroxypyr, Dichlobenil, 2,4 D, and Atrazine-LC- (see table 6 below). There was just one sampling location in which a pesticide was detected above the drinking water limit (0.1µg/l), sampling location 13 detected Diflufenican-Triaz-LC- at 0.273µg/l. This sample was taken directly downstream of a horticultural nursery, whilst sampling location 14 (containing no pesticides) was taken directly upstream of the nursery, therefore this potential source will require further assessment.

The most commonly detected pesticides within this sampling event included MCPA, Trichlopyr and Fluroxypyr. This correlates with the exceedances in the drinking water, although the drinking water limits were not exceeded within the PAA. The sources within the PAA are potentially contributing to the issue further downstream and need to be addressed, in order to reduce overall input. The limit of 0.5µg/L for Total Pesticides was not exceeded at any of the sampling locations. However, sampling location 13 did reach 0.45µg/L. Pesticides detected at sampling location 13 included Trichlopyr (0.045µg/L), Dichlobenil (0.041µg/L), Difluenican-Triaz-LC- (0.273µg/L) and Diuron_LC (0.017µg/L).

Sampling Location	Total Pesticide	MCPA	Trichlopyr	Fluroxypyr	Dichlobenil	2,4 D	Atrazine-LC-	Diflufenican-Triaz-LC-	Diuron-LC-
1	0.06	0.013	0.022	0.026	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
2	0.03	< 0.0050	0.022	< 0.0050	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
3	0.07	0.012	0.01	0.045	0.006	<0.005	< 0.0050	< 0.0050	< 0.0050
4	0.04	< 0.0050	< 0.0050	0.03	0.008	<0.005	< 0.0050	< 0.0050	< 0.0050
5	0.06	0.014	0.009	0.028	0.007	<0.005	< 0.0050	< 0.0050	< 0.0050
6	0.05	0.013	0.009	0.03	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
7	0.04	0.013	0.008	0.02	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
8	0.06	0.005	0.007	0.044	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
9	0.01	< 0.0050	< 0.0050	0.009	< 0.0050	0.005	< 0.0050	< 0.0050	< 0.0050
10	0.05	< 0.0050	0.011	0.042	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
11	0.01	< 0.0050	< 0.0050	0.014	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050
12	0.02	0.006	0.006	< 0.0050	< 0.0050	<0.005	0.006	< 0.0050	< 0.0050
13	0.45	< 0.0050	0.045	< 0.0050	0.041	<0.005	< 0.0050	0.273	0.017
14	<0.01	< 0.0050	< 0.0050	< 0.0050	< 0.0050	<0.005	< 0.0050	< 0.0050	< 0.0050

Table 6: Pesticides detected during the July 2018 pesticide sampling event.

* Yellow indicates concentrations of pesticides in close proximity to the total pesticide drinking water limit (0.5µg/l)

* Red indicates an exceedance of the pesticide drinking water limit (0.1µg/l)

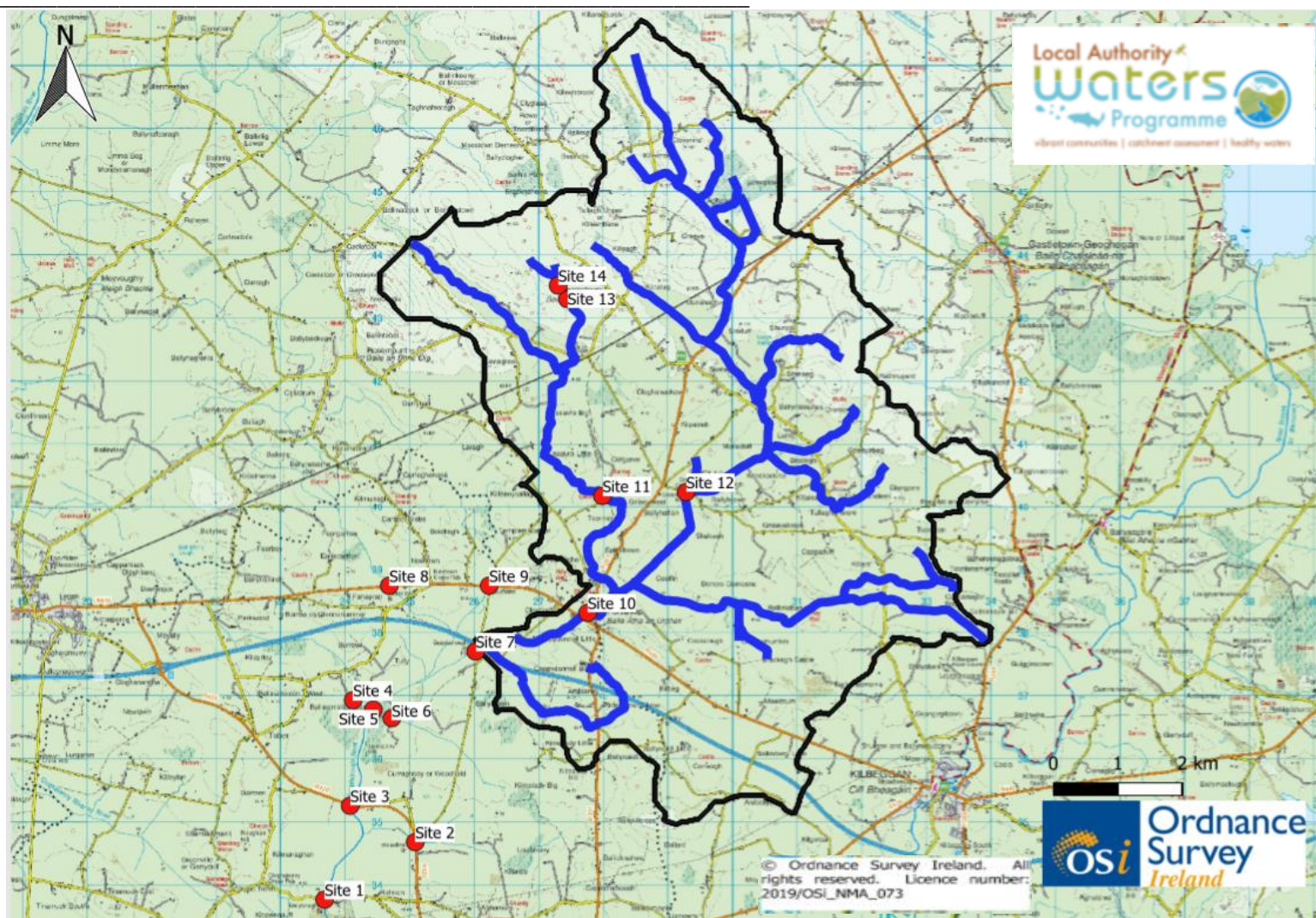


Figure 8: OCC pesticide monitoring locations within the Clara/Ferbane drinking water supply catchment area

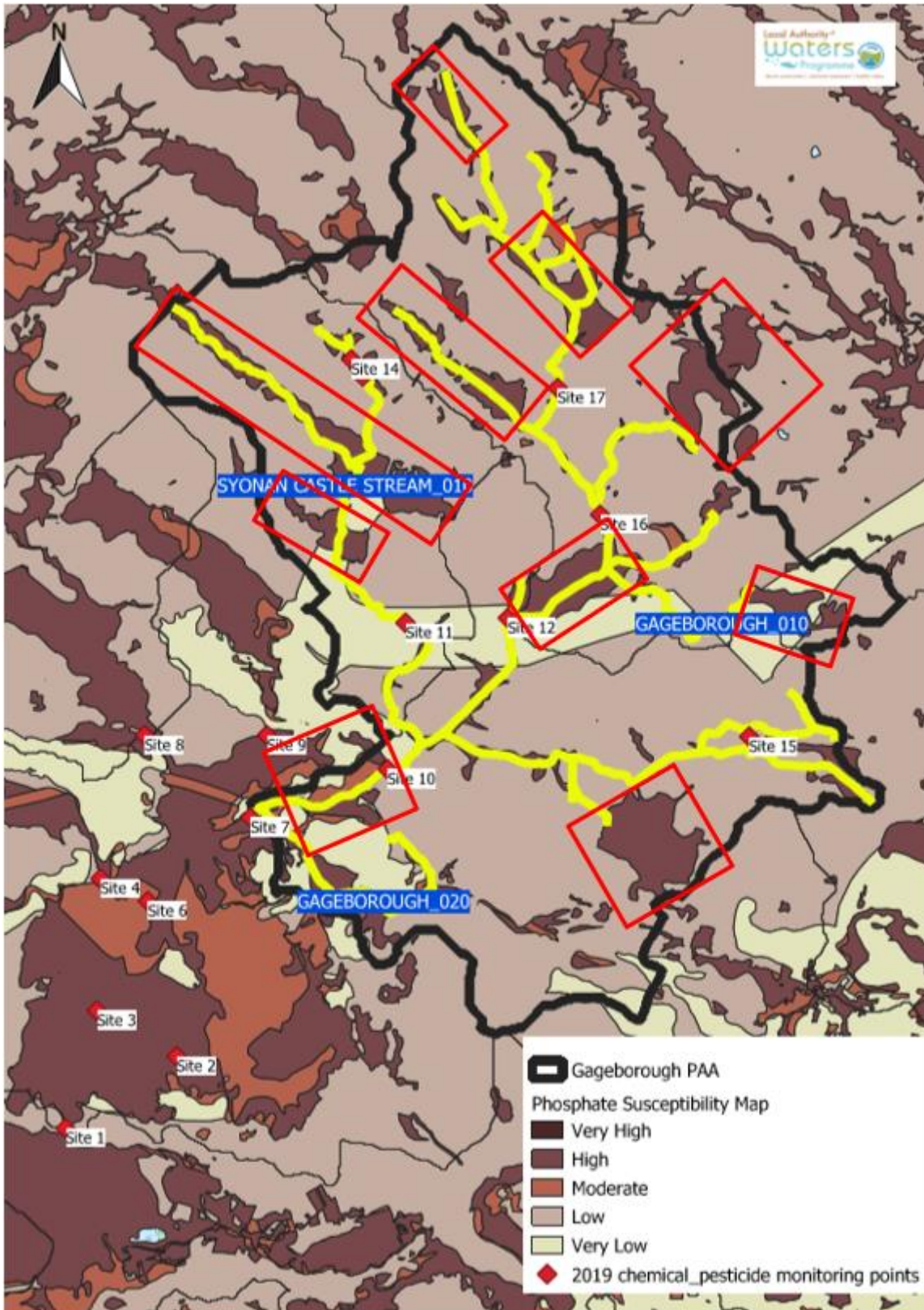


Figure 9: Phosphorus Susceptibility Map

Figure 9 above indicates areas which are susceptible to overland flow, this is based upon soil types, topography, combined with rainfall. If pesticides are sprayed within these areas during or before expected rainfall, pesticides can potentially be transported overland and into the receiving waters. These areas on the map in dark brown are potential hotspots for pesticide transport within the catchment. It is key that we take caution and educate professional and domestic users in these areas, whilst also providing information on good practise.

3.4 Conclusions on Significant issues

The 2017 biological Q-rating assessment has shown an improvement within the Gageborough_020 at the EPA monitoring station “Gageborough Bridge 1.2km South of Dunard” improving from Moderate to Good biological status. As there is only one monitoring station, this improvement has the potential to bring up the overall ecological status in the next iteration (2013-2018) of the waterbody from Moderate to Good status, therefore it is essential to maintain the status and prevent possible future deterioration. Although there has been an improvement at this monitoring location, this area will still require assessment, as the EPA biologists noted high eutrophication levels in the waterbody. This indicates nutrient loading and therefore pollutants entering the waterbody.

There has been a dis-improvement in water quality along the Syonan Castle Stream_010 at monitoring location “bridge North of Lisnagree (W of Streamstown Ho)”. This waterbody was moderate status in 2011, it improved in 2014 to Good status and dropped back down to Moderate most recently in 2017. There has been no change in biological status at the two monitoring stations along the Gageborough_010.

The EPA PIP maps indicate areas, which are most at risk for nitrate and phosphorus losses based on land type and stocking rates. Such high risk areas have been identified on all three waterbodies, this can be seen in Figures 15 and 16. Figure 15 identifies the areas which are most at risk of nitrate loss. Whilst figure 16 identifies areas most susceptible to overland flow, this creates a pathway for the transport of phosphorus and sediment.

Pesticides can be transported through point and diffuse pathways. Point sources may be as a result of poor practise for example incorrect storage or disposal of pesticides etc. Diffuse pathways can form due to overland flow over poorly draining soils. These pathways have the potential to transport pesticides overland and into receiving waters. Figure 9 identifies the area’s most at risk for overland flow and therefore pesticide transport. These vulnerable areas will need to be assessed during field assessment.

4 Significant pressure information

4.1 Initial EPA Characterisation

The significant pressures within each PAA were determined by the EPA during the initial characterisation process. In the Gageborough, agriculture and hydromorphology were the main pressures. The associated impacts from these pressures included altered habitat due to morphological changes and nutrient pollution. It was deemed by the EPA that although hydromorphology was identified as a pressure along the Gageborough_010 and Syonan Castle Stream_010 it was not significant.

WB name	Significant Pressures		Impact
	No.	Type	
Gageborough_010	2	Agriculture (Pasture)	Altered habitat due to Morphological changes and Nutrient Pollution
		Hydromorphology (Culverts)	not Significant
Gageborough_020	2	Agriculture (Pasture)	Altered habitat due to Morphological changes and Nutrient Pollution
		Hydromorphology (Culverts)	Altered habitat due to Morphological changes
Syonan Castle Stream_010	2	Agriculture (Pasture)	Altered habitat due to Morphological changes and Nutrient Pollution
		Hydromorphology (Channelisation)	Not Significant

Table 7: EPA Initial Characterisation

4.2 Agriculture

As per the Corine data the main land use in the catchment is agriculture. The area is dominated by permanent pasture (approx. 90%). The remainder has been assigned as land principally occupied by agriculture (e.g. buildings etc.). Several farmyards and dwellings are situated adjacent to the waterbody. As per aerial images and forestry mapping layers provided by the department there are also small pockets of forestry throughout the PAA, these are a mix of both public (Coillte) and private owned forestry.

4.3 Hydromorphology

To identify whether hydromorphology is an issue, at desk study stage historic maps were reviewed (Historic Map 25 inch (1888-1913)) and compared to current maps to aid in identifying changes if any to the natural course of the river. Any changes requiring further verification will be carried out during LCA.

Gageborough_010

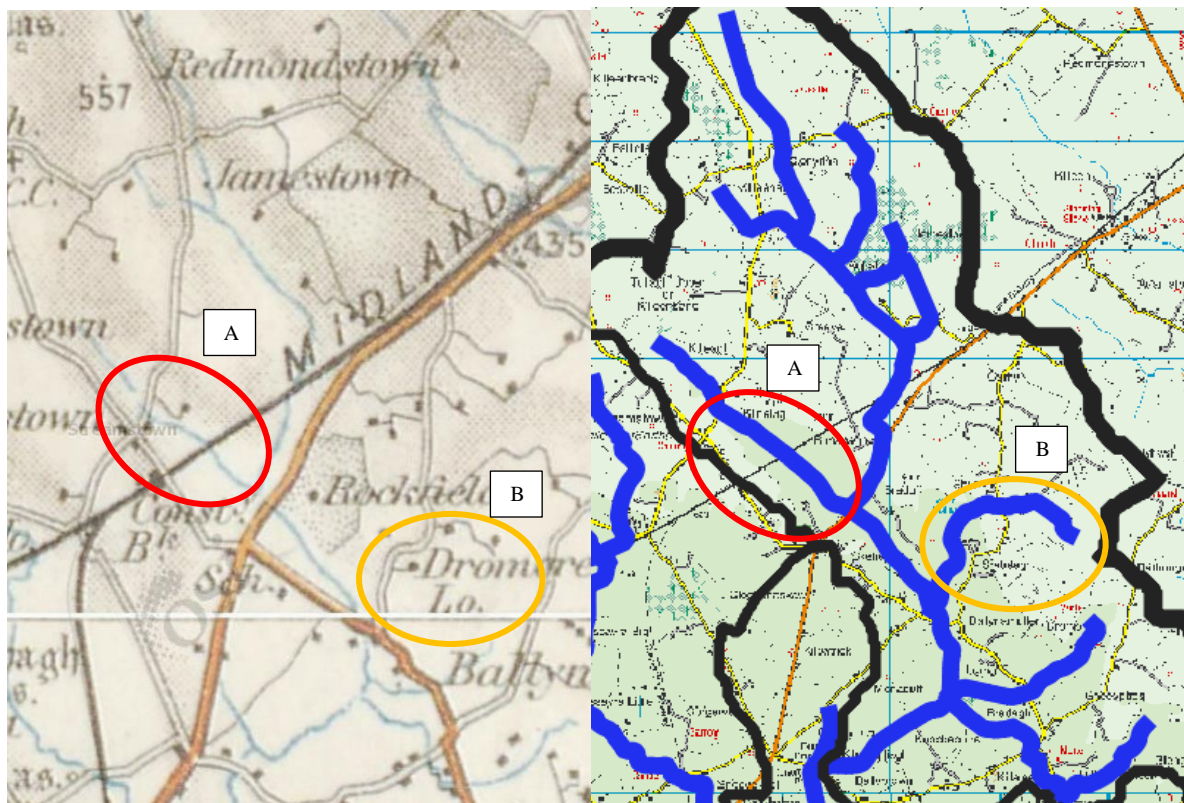


Figure 10: Historical map (left) and current map (right) of the Gageborough_010

The EPA deemed hydromorphology was a pressure within this waterbody however it was not classified as significant. Culverts were selected as the hydromorphological issue along the Gageborough_010. Figure 10 above does not indicate that culverts are present. Additional tributaries and straightened channels were identified by the historical maps. B above indicates an additional tributary has joined the main channel, this was not present historically. As per figure 10 A shows a section of the waterbody, which appears straightened when compared to the historical map.

Gageborough_020

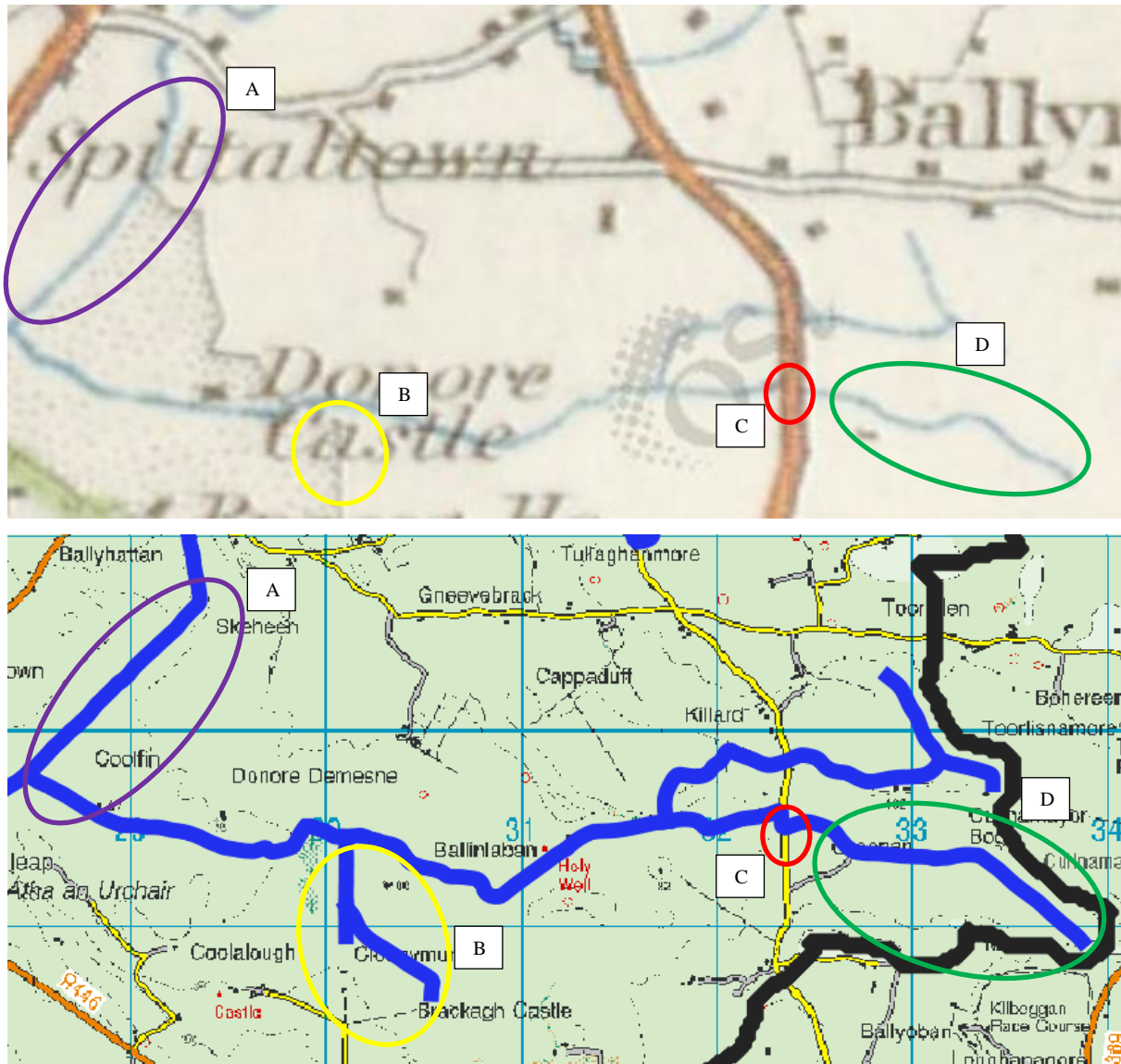


Figure 11: Historical map (top) and current map (bottom) of the middle reaches of the Gageborough_020

As can be seen from the 1888-1913 historic maps compared to our current QGIS layers the upper reaches of the Gageborough_020 have been significantly straightened (D as per figure 11 above). As can be seen at C the river seems to have been redirected across the road, this would suggest a culvert was installed. B shows a tributary has now joined the network. Finally, as per A above, a previously relatively straight channel has been completely channelised. This will require further assessment in the field to identify the impacts if any.

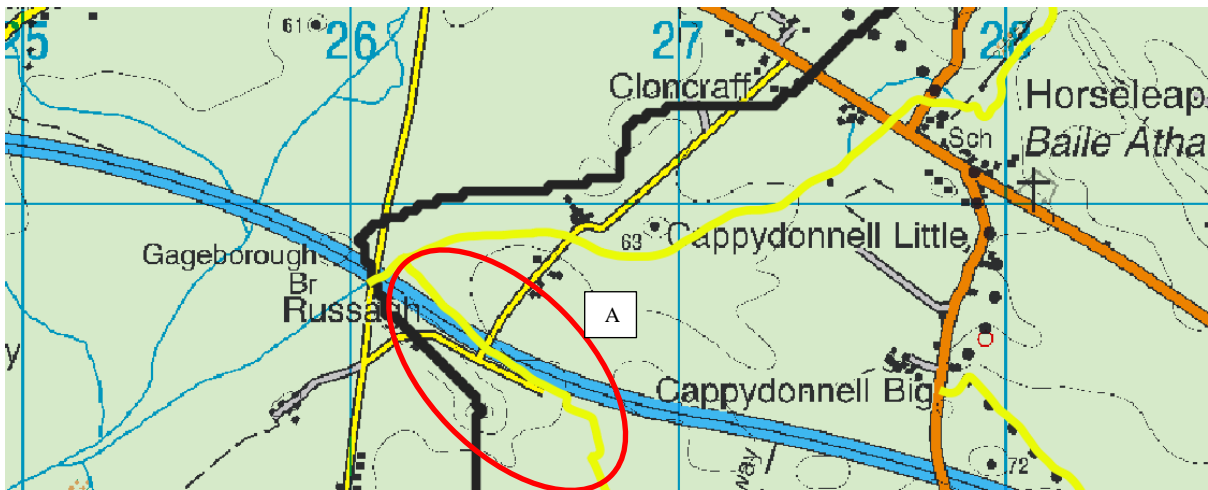
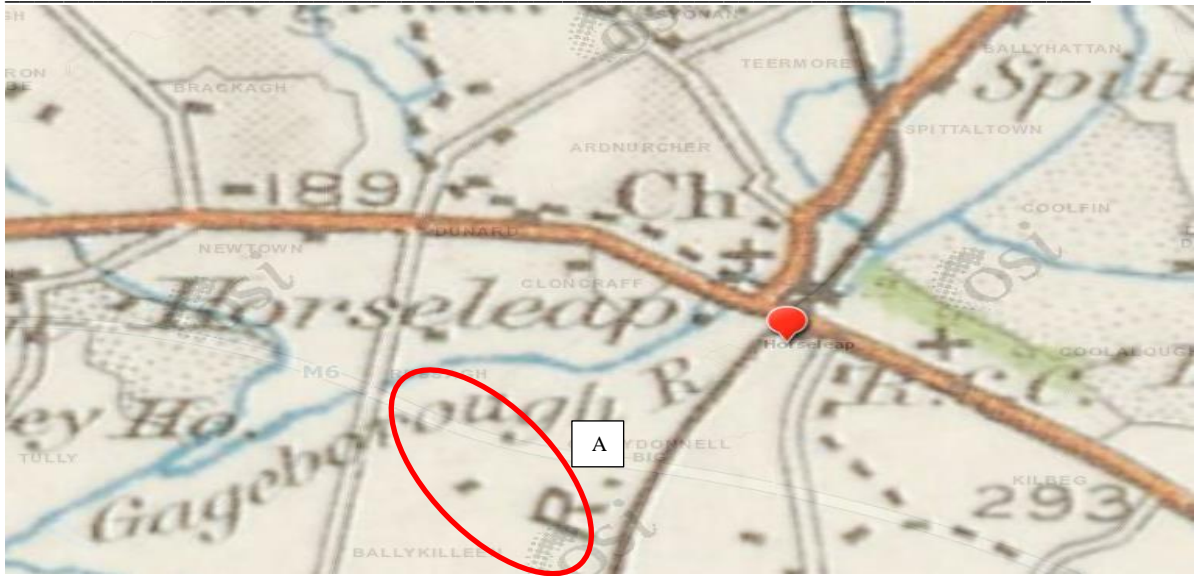


Figure 12: Historical map (top) and current map (bottom) of the lower reaches of the Gageborough_020

Figure 12 above shows the lower reaches of the Gageborough_020. There are no significant changes to the channel route and no signs of straightening. Due to the construction of the M6, it is likely the Gageborough river is culverted under the new motorway. As can be seen from the highlighted area A above there is an additional tributary which was not present historically.

Syonan Castle Stream_010

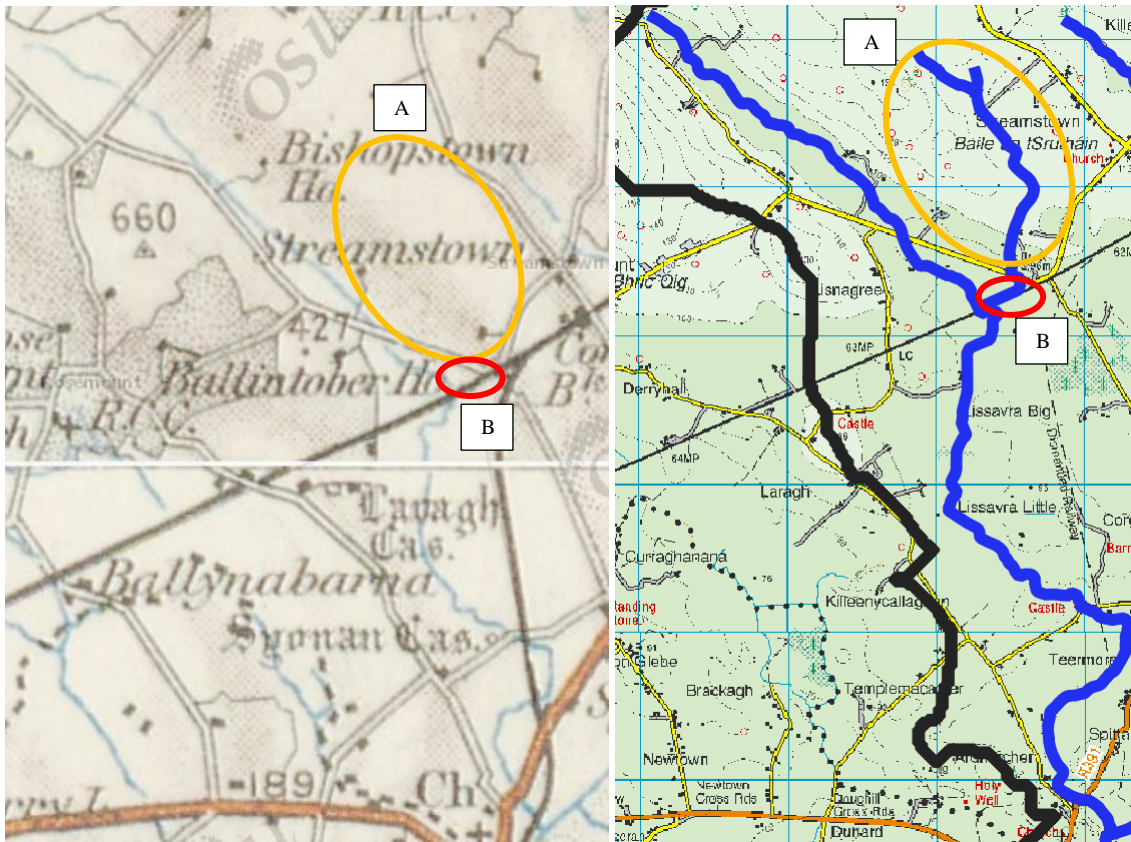


Figure 13: Historical map (left) and current map (right) of the Syonan Castle Stream_010

The Syonan Castle Stream_010 was selected for hydromorphology based upon channelisation. The historic map shows very little variation along the main channel. However as can be seen from A above (Figure 13) there is an additional tributary, which was not previously part of the channel. Also as per B this is running adjacent to the old railway line, which is now a green way, this section has been altered (channelised).

Between 1945 and 1995, under the Arterial Drainage Act (1945), the OPW completed 34 Arterial Drainage Schemes on river catchments, along with five estuarine embankment schemes (over 11,500km of channel and 730km of embankments). The OPW is statutorily obligated to maintain arterial drainage channels under the 1945 Arterial Drainage Act, and since their completion, maintenance of these Arterial Drainage Schemes has been ongoing, with the majority of channels maintained every five years. However, larger channels tend to be only maintained every ten years, on average.

The Gageborough is part of the OPW Brosna arterial drainage scheme. The OPW have a specific numbering system, which can be seen in Figure 14 below. The Gageborough_010 includes C18 (5) and C18 (1), Gageborough_020 includes C18 (4), C18 (4C) C18 (4B) C18 (1) and C17 (1) and the Syonan Castle stream_010 includes C18 (3) and C18 (3B). Each section has a specific maintenance schedule and the type of management is assigned accordingly.

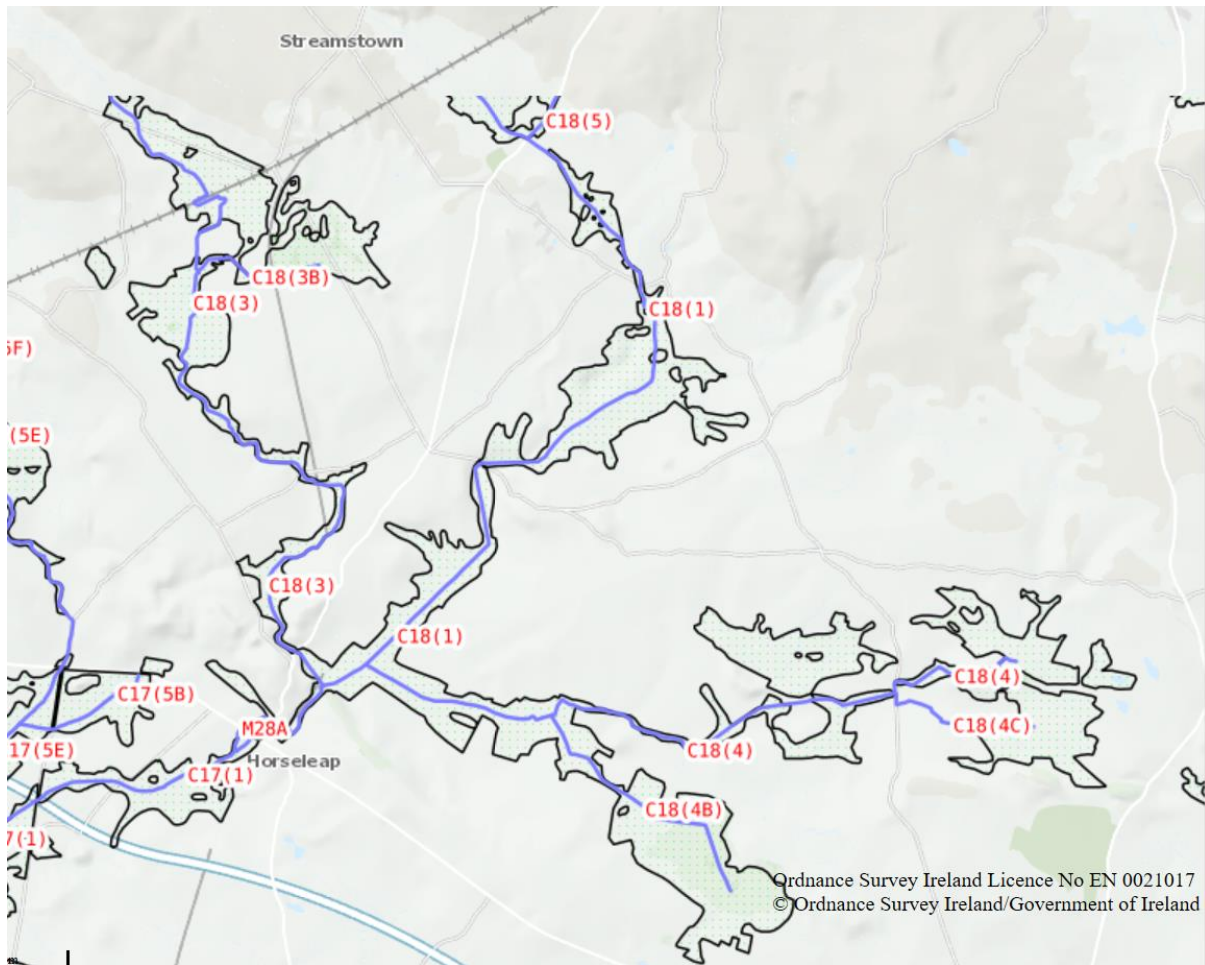


Figure 14: OPW arterial drainage map of the Gageborough PAA

4.4 Conclusions on Significant Pressures

Agriculture is deemed a significant pressure in all three waterbodies. Based upon the nitrate and phosphate PIP maps (Figures 15 & 16) there are both free draining and overland flow pathways for nutrient transport, specific nutrient hotspots as identified within this report will be verified during the local catchment assessments.

Hydromorphology was listed as a pressure in all three waterbodies, however, the EPA only deemed it was a significant pressure along the Gageborough_020. Culverts were the specific issue identified and from the review in section 4.3 above, there are likely culverts present, however, the impact cannot be determined without field assessment. It was also noted a large section of the Gageborough_020 had also been channelised (Figure 11), the impact of this will be assessed in the field.

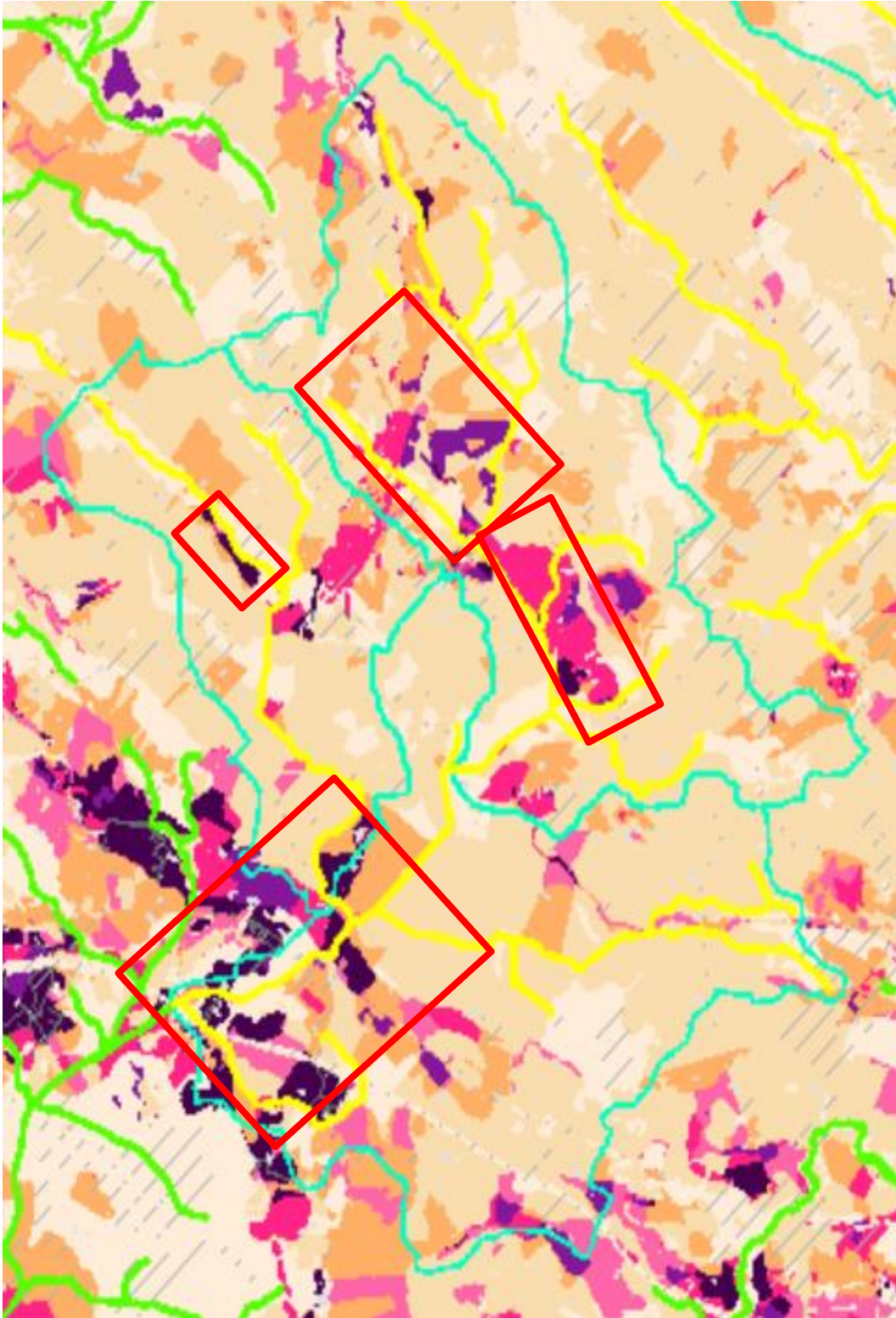


Figure 15: Pollution Potential Impact Map- Surface Water Receptor Nitrate PIP

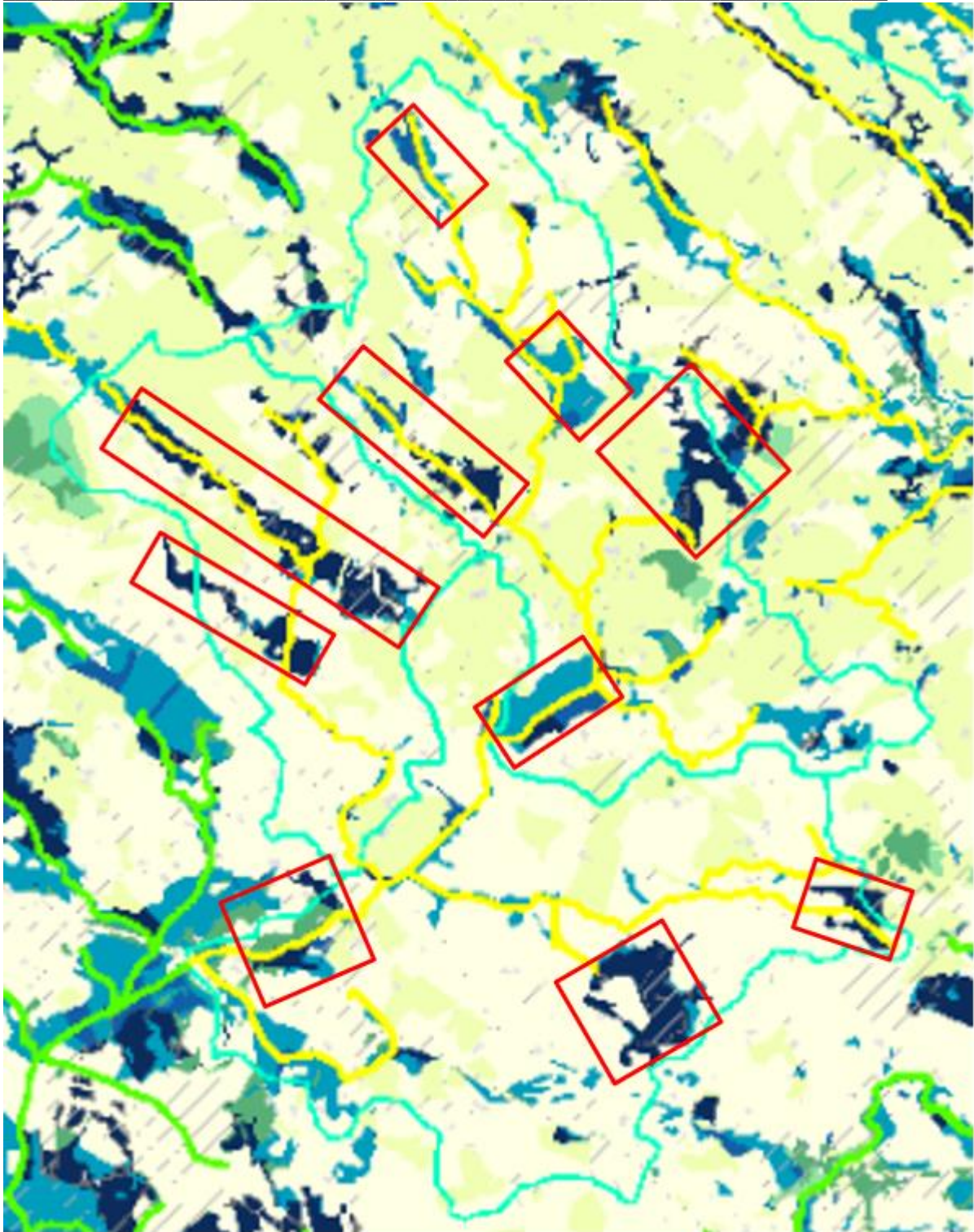


Figure 16: Pollution Potential Impact Map- Surface Water Receptor Nitrate PIP

5 Pathway information & analysis

Although there is no chemical data available for assessment, a conceptual model has been developed to aid in assessing any potential impacts associated with agricultural as this has been assigned as a significant pressure in each of the waterbodies within the PAA. Pollutants have the ability to move through the catchment based upon factors such as topography, geological, hydrogeological and pedological characteristics, these elements create pathways. For the Gageborough CM, as seen below, we assessed the bedrock, aquifer and soils types within the catchment to identify how pollutants could potentially enter the water column through diffuse sources. Pathways may occur as follows:

- Free draining soils can cause a potential Nitrate issue, leaching into the deep and shallow gw pathways and infiltrating into the surface waters elsewhere.
- Poorly draining soils and peat can distribute phosphorus due to overland flow pathways.
- Sediment transport can occur through overland flow pathways and cattle access points can impact bank stability.

Gageborough: Understanding the water pathways

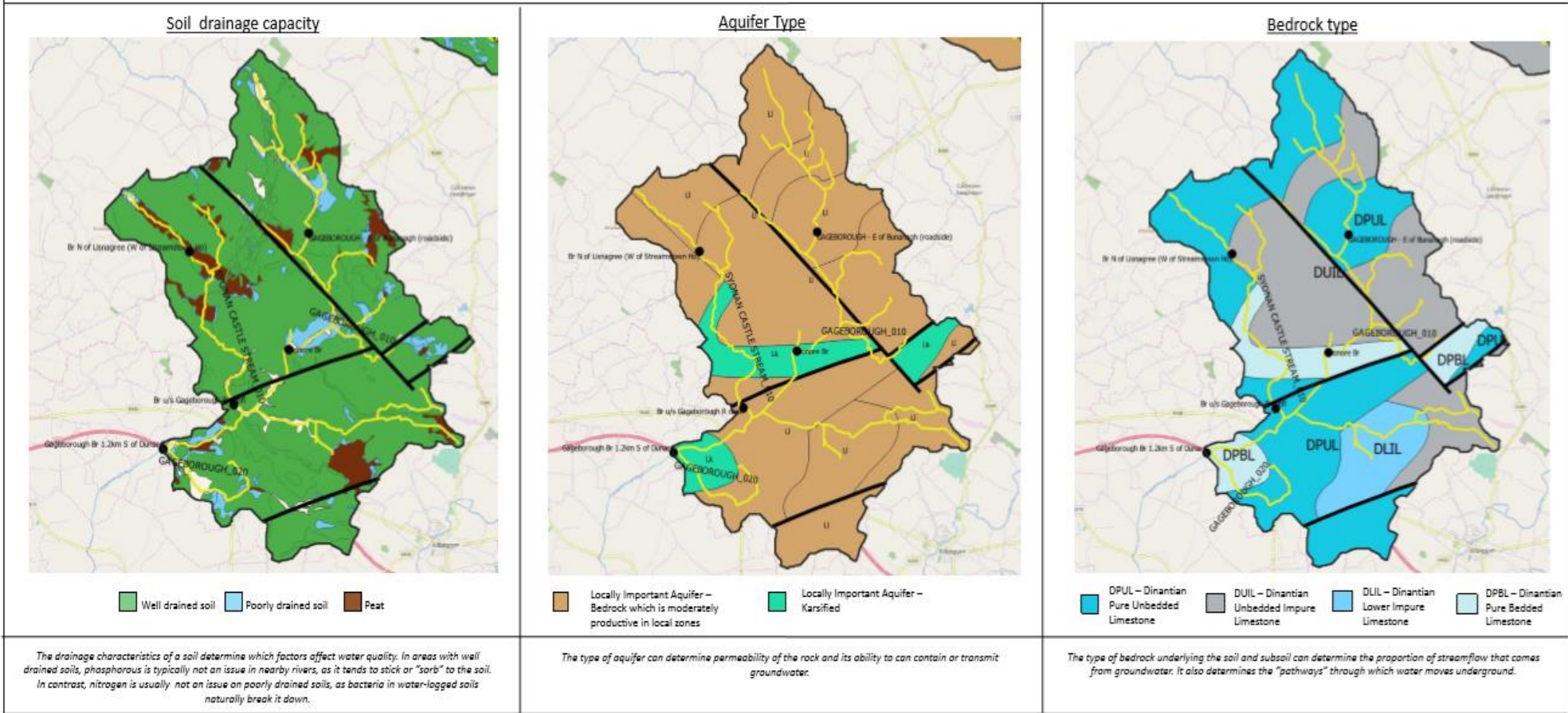


Figure 17: Diffuse pathway detection, based upon natural environs.

Water pathway zones

Within the drainage area of the river, information on soil and bedrock type was used to determine the water pathways within the catchment. Within this area, the likely pathways that water will take en-route to the river are as follows:

Gageborough Zone 1

In Gageborough Zone 1, the river flows through well drained soils.

Well drained soils

- Likely pathway : Underground (groundwater)
- Potential river issue: Nitrate

Gageborough Zone 2

In Gageborough Zone 2, the river flows through peat and poorly drained soils.

Poorly drained soils

- Likely pathway: Overland flow
- Potential river issue: Orthophosphate

Peat

- Likely pathway: Near surface flow & drains
- Potential river issue: Ammonium & sediment

Note you may find some enlarged fractures and maybe karst features in the pure limestone part.

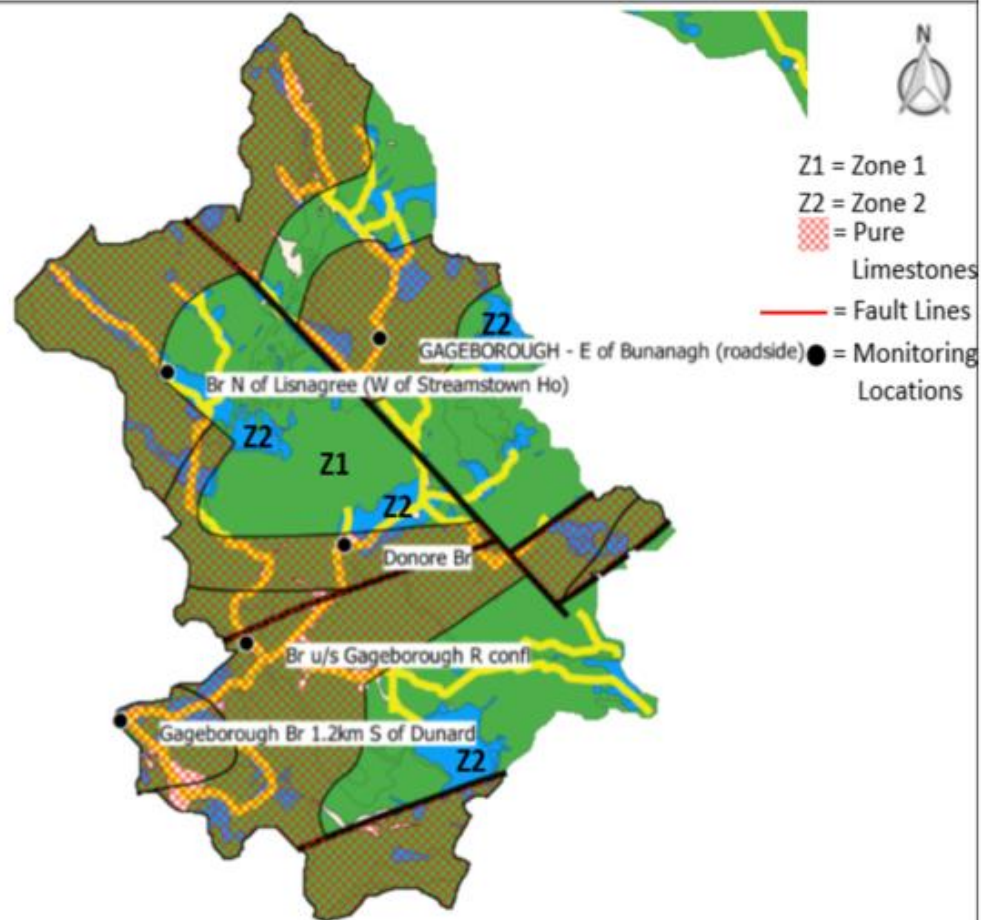


Figure 18: Pathways conceptual model for the Gageborough PAA

Gageborough - AFA0081

	Gageborough PAA	
	Zone 1	Zone 2
Topography	Gently sloping valley from North to South. Falls from the higher area at Killarechurch, Co. Westmeath (120m OD) to the lowest point of the catchment (63m OD) at Gageborough Bridge, Russagh, Co. Offaly.	
Soil	<ul style="list-style-type: none"> • BminSW • AlluvMin • BminDW • Lac 	<ul style="list-style-type: none"> • Fen Pt • Cut • BminPDPT • BminPD • BminSP • BminSRPT
Subsoil	<ul style="list-style-type: none"> • Tls- Till derived from Limestone • GLs – Gravels derived from Limestone • Rck – Bedrock outcrop or subcrop • BAsEsk – Eskers Composed of gravels of basic reaction • A – Alluvium 	<ul style="list-style-type: none"> • Rck – Bedrock outcrop or subcrop • Cut – cutover raised peat • GLs – Gravels derived from Limestone • Tls- Till derived from Limestone • L - Lac • Fen Pt - Fen Peat
Bedrock	<ul style="list-style-type: none"> • DUIL Dinantian Upper Impure Limestones • DPUL Dinantian Pure Unbedded Limestones • DLIL Dinantian Lower Impure Limestones • DPBL Dinantian Pure Bedded Limestones <p>All limestones with varying degrees of purity.</p>	
Aquifer	The aquifer is predominantly LI – Locally Important Aquifer – Bedrock which is moderately productive only in local zones; there are also small areas which are Lk – Locally Important Aquifer – Karsified.	

Gageborough - AFA0081

Groundwater vulnerability	Catchment dominated by highly and moderately vulnerable groundwater. There is a small percentage of the area which is either X- Extreme or extreme vulnerability.	
PIP PO4 to SW	Low throughout the catchment with the exception of the upper reaches of the Syonan Castle Stream_010 which is peat. A few small patches in the Gageborough_010 and Gageborough_020.	
PIP NO3 to SW	Predominantly low with a few small patches in the middle reaches of Gageborough_010 and the lower reaches of Gageborough_020	
Likely main pathway(s)	<ul style="list-style-type: none"> • Main pathway: Flow occurs along fractures, joints and major faults. Flows in the aquifer are typically concentrated in a thin approximately 15 m zone at the top of the rock although deeper groundwater flow in hydraulically isolated fault zones can occur. • Diffuse recharge occurs across most of the GWB (except for areas overlain by bogs), but particularly where rock outcrops or where subsoils are thin. Where the water table is close to the surface potential recharge may be rejected. 	Main Pathway: Overland flow
Possible S-P-R linkages	<p>Main SPR1: agriculture (N) – shallow GW flow/ occasional (faults) deeper GW flow/ subsoil flow – NO3 contribution to SW</p> <p>SPR2: agriculture (N and P) – bedrock outcrop/GW flow – NO3 / PO4 /pesticides contribution to SW</p> <p>SPR3: agriculture (P) – infiltration excess/ overland flow – PO4 / pesticide contribution to SW</p> <p>SPR4: agriculture/forestry (sediment) – infiltration excess/ overland flow/ drains – sediment contribution to SW</p>	

Table 8 : Pathway information for the Gageborough PAA.

6 Interim Conclusions on the Priority Area for Action based on the desk study

The PAA focuses on 3 water bodies in the upper reaches of the Gageborough catchment. The three water bodies include the Gageborough_010, Gageborough_020 and Syonan Castle Stream_010.

Gageborough_010 - IE_SH_25G010100

Gageborough_010 is *At Risk* of failing to meet the WFD objective of Good status, as the 2010-2015 ecological status is Moderate. There are two EPA monitoring stations along this waterbody Donore bridge (RS25G010100) and Gageborough - E of Bunanagh (roadside) (RS25G010045). The ecological status is driven by its Moderate biological status at Gageborough - E of Bunanagh (roadside). Donore bridge is at Good status, however as one monitoring locations status is failing to meet the WFD objectives along the waterbody it brings down the overall status, based upon the one out all out rule. The significant pressure associated with this waterbody is agriculture (pasture). There is no chemistry data available for the waterbody. As per the conceptual model (figure 17 and 18) the catchment area is predominantly well-draining soils, with a small portion of alluvium, poorly and peaty draining soils, typically located along the waterbody edge. The pathways associated with poorly draining and peaty soils are point sources and overland flow for the potential transport of phosphorus, sediment, ammonia and pesticides. Well-draining soils typically transport nitrates through the soils into the groundwater.

Agriculture is the dominant land use and both diffuse and point source pollution from agriculture will be the focus of the field assessment, as per the Surface Water Nitrate and Phosphorus PIP maps (figure 15 & 16) the areas of highest risk will be focused upon, biological monitoring, chemistry sampling and stream walks will be carried out where required.

Gageborough_020 - IE_SH_25G010300

Gageborough_020 is *At Risk* of failing to meet the WFD objective of Good status, as the 2010-2015 ecological status is Moderate. The ecological status is driven by its Moderate biological status at Gageborough Br 1.2km S of Dunard (RS25G010300). This monitoring station was assessed in 2017 and was classified as having Good biological status and therefore is likely to be assigned Good ecological status in the next iteration (2013-2018 data). Although the waterbody was meeting good biological status, the EPA biologists noted there was enhanced macrophyte and macroalgal growth, it is evident

there is nutrient loading occurring from a pressure along this stretch, this needs to be assessed to prevent potential future deterioration. The significant pressure associated with this waterbody is agriculture (pasture) and hydromorphology (culverts). There is no chemistry data available for the waterbody. As per the conceptual model (figure 17 and 18) the catchment area is predominantly well-draining soils, with a small portion of alluvium, poorly and peaty draining soils typically located along the waterbody edge. The pathways associated with poorly draining and peaty soils are point sources and overland flow for the potential transport of phosphorus, sediment, ammonia and pesticides. Well-draining soils typically transport nitrates through the soils into the groundwater.

Agriculture is the dominant land use and both diffuse and point source pollution from agriculture will be the focus of the field assessment, as per the Surface Water Nitrate and Phosphorus PIP maps (figure 15 & 16) the areas of highest risk will be focused upon, biological assessments, chemistry sampling and stream walks will be carried out where required.

Hydromorphological changes along this waterbody were compared to historic maps, channelisation, culverts and an additional tributary was recorded. The potential impacts of these alterations over time will be reviewed during the local catchment assessments.

Syonan Castle Stream_010 - IE_SH_25S040500

Syonan Castle Stream_010 is *At Risk* of failing to meet the WFD objective of Good status, as the 2010-2015 ecological status is Moderate. There are two EPA monitoring stations along this waterbody Bridge N of Lisnagree (W of Streamstown Ho) (RS25S040300) and Br u/s Gageborough confluence (RS25S040500). The ecological status is driven by its Moderate biological status at bridge u/s Gageborough confluence. The EPA monitored last in 2017 and recorded a deterioration at bridge N of Lisnagree (W of Streamstown House) going from Good status to Moderate. The significant pressure associated with this waterbody is agriculture (pasture). There is no chemistry data available for the waterbody. As per the conceptual model (figure 17 and 18) the catchment area is predominantly well-draining soils, with alluvium, poorly and peaty draining soils, typically located along the waterbody edge. Peaty soils are located in the upper stretches of the waterbody, however based upon aerial imagery it is likely this land has been reclaimed for agricultural purposes. The pathways associated with poorly draining and peaty soils are point sources and overland flow for the potential transport of phosphorus, sediment, ammonia and pesticides. Well-draining soils typically transport nitrates through the soils into the groundwater.

Agriculture is the dominant land use and both diffuse and point source pollution from agriculture will be the focus of the field assessment, as per the Surface Water Nitrate and Phosphorus PIP maps (figure 15 & 16) the areas of highest risk will be focused upon, chemistry sampling and stream walks will be carried out where required.

7 Work Plan

First step within this catchment is to carry out chemical analysis at the EPA biological monitoring stations which are not meeting the objectives. This may assist with identification of the issue within the waterbodies and steer the team towards the possible pressure source. Based upon the chemical findings a focused PAA plan will be generated, however below I have put together a brief action plan, this is subject to change:

Gageborough_010

Monitoring station East of Bunanagh is located in the upper reaches of the Gageborough_010. North of this location is dominated by agricultural land and a portion of forestry. There are 5 small tributaries converging to form this waterbody. A river walk is necessary here to identify any impacts, carry out visual checks of all tributaries and conduct SSIS as an elimination process where suitable. If the SSIS score indicates impact, chemical testing will be carried out if necessary, to aid identification of the potential pressure.

Monitoring station at Donore Bridge is located in the lower reaches of the waterbody. There are a number of tributaries flowing into this stretch in close proximity to the monitoring station. Walk the area upstream and carry out SSIS on the incoming tributaries where possible, then focusing on tributaries which are potentially delivering pollutants that could impact the status.

Gageborough_020

Although this waterbody improved from Moderate to Good status in 2017, the EPA biologists did indicate in their field notes that enhanced macrophyte and macroalgal growth continues to indicate some enrichment. To ensure this status is maintained, identification of this source of enrichment is necessary. There are two waterbodies (Syonan Castle Stream_010 and Gageborough_010) entering the main channel just upstream of monitoring station "bridge 1.2km S of Dunard", SSIS monitoring is required at both locations to assist in narrowing down impact.

Syonan Castle Stream_010

Bridge North of Lisnagree (W of Streamstown Ho) is located in the upper reaches of the river stretch and is surrounded by agricultural land. This monitoring station deteriorated in the EPA's 2017 monitoring event and therefore upstream requires focus. A stream walk will be carried out upstream of this monitoring location.

Bridge u/s Gageborough River confluence is the last monitoring station before entering Gageborough_020. A stream walk is required moving back upstream and conducting SSIS and chemical sampling where deemed necessary. Also, by focusing on rectifying the issues at the upper monitoring location depending on whether the issue is significant may improve the lower reaches.

As there is no chemical data for any of the EPA monitoring locations within the Gageborough available from the WFD app it is very difficult to identify potential pollution sources. By gathering chemical data for the waterbodies we aim to have a clearer picture of the cause of the status throughout the PAA.

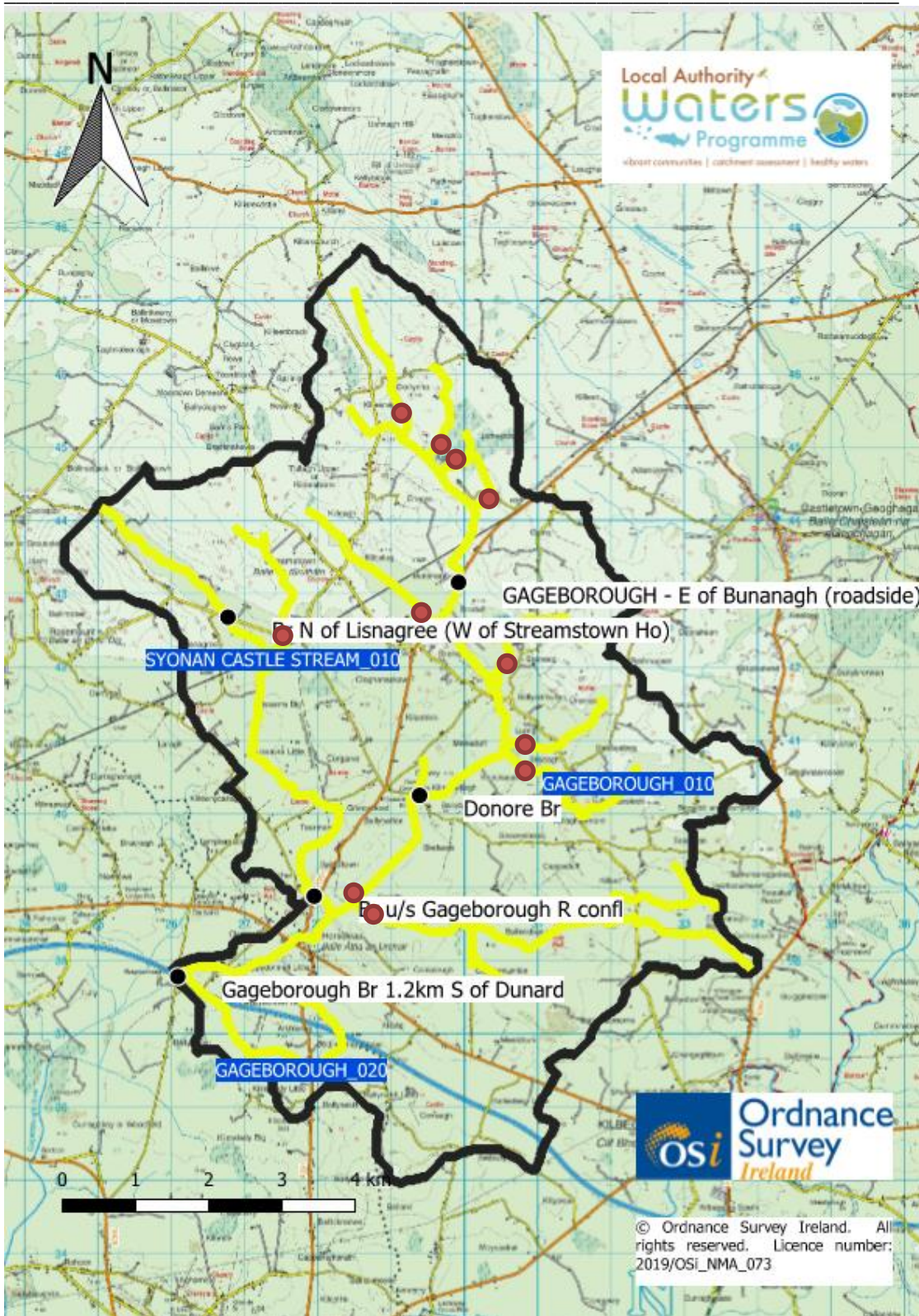


Figure 19: Proposed SSIS analysis sites in red, initial chemical analysis sites in black.

8 Review of Mitigation Options

Possible mitigation measures cannot be accurately assigned currently as the likely significant issues have not been identified due to lack of information, such as chemistry. Further data is required and field assessment, based upon these information sources potential mitigation measures can then be proposed.

9 Communications

9.1 Community Information Meetings

- Consulted with Basil Mannion LAWCO for the Westmeath/Offaly area.
- Public meeting was held in Horseleap Streamstown Community Centre, as this is located within 15 km of all communities located within the PAA.
- The community information meeting was held on the 12/02/2019 in the Horseleap Streamstown Community Centre, Streamstown, in County Westmeath. Number of attendees (excluding LAWPRO and ASSAP), were 39 representatives.