Lower Nanny Priority Area for Action

Desk Study Assessment

AFA0125

Lower Nanny PAA 0125

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Acknowledgements

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Non-technical Summary

The Lower Nanny PAA is situated near Duleek in Co. Meath. The Nanny_040 and the Nanny_050 are the two waterbodies included in Lower Nanny Priority Area for Action (PAA) and they are situated at the base of the catchment and discharge into the Nanny Estuary. The Nanny PAA is situated within the protected drinking water areas of Duleek, Bettystown, Realage & Donore. The Nanny Estuary is a Special Protected Area (004158) and is a habitat for a number of protected bird species. The Nanny Estuary enters the Irish Sea at Laytown which is a protected bathing area and shellfish area (Skerries and Balbriggan). Nanny_040 and Nanny _050 are both At *Risk,* as the 2013-2018 ecological status for the Nanny_040 is Moderate, driven by the biological status, failing Dissolved Oxygen (D.O.) and failing nutrient conditions and ecological status for the Nanny_050 is Poor, driven by the poor biological status, moderate fish status and failing nutrient conditions. Based on the review of the conceptual model for the Priority Area for Action, aerial imagery, and water quality data provided by the EPA, the main pathways for nutrients in the Nanny_040 and _050 were identified. The pathway for phosphate is overland flow in poorly drained areas or perched water tables where low permeable subsoil is occurring, and nitrogen is leached in the freely draining soils. There are also areas of extreme vulnerability to groundwater where all excess nutrients may enter the groundwater.

The significant pressures identified in the desk study for both the Nanny_040 and _050 are agriculture and hydromorphology. Focused stream walks and stream assessments will be used to identify Critical Source Areas (CSAs) and diffuse pathways for nutrient losses as well as small point sources from agriculture. A hydromorphological assessment will be carried out to establish if it is having a negative effect on water quality. Additionally, Urban Wastewater Treatment Plants (UWWTP) were identified as a pressure in the Nanny_040 and in its inputting waterbodies. The UWWTPs will be assessed to establish if they are point sources of nutrients and if they are having a significant impact on the water quality.

Flow data using the EPA Hydrotool was used to calculate to amount of nutrients that are entering all the waterbodies in order to focus on the appropriate issues and pressures within the PAA. This information will be used to build a targeted field plan. It will be used to inform stream walks, field assessments and chemistry sampling.

Introduction

1.1 Background to the Priority Area for Action (PAA)

The Midlands and Eastern catchment assessment workshops were held in Ballycoolin, Dublin from the 9th to 12th May 2017. They were attended by representatives of local authority staff (operational staff on all days and both operational and senior staff on 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 Marine, Bord na Mona, Waterways Ireland and EPA. The workshop was facilitated jointly by LAWCO and EPA.

Based on the draft River Basin Management Plan priorities, a set of agreed principles and the local priorities of the workshop attendees, 29 areas were recommended for action, of which the Lower Nanny PAA was one.

The Lower Nanny PAA was selected as a priority area for action in the 2nd Cycle. The EPA report includes the following reasons:

- The Nanny Meath River discharges into coastal waters which have both designated bathing (Laytown & Bettystown) and shellfish areas (Balbriggan & Skerries).
- Building on existing improvements by Irish Water (IW) at Duleek wastewater treatment plant.
- 1 deteriorated waterbody (Nanny_050)
- Pilot project to examine impact of tillage on poorly draining soils.

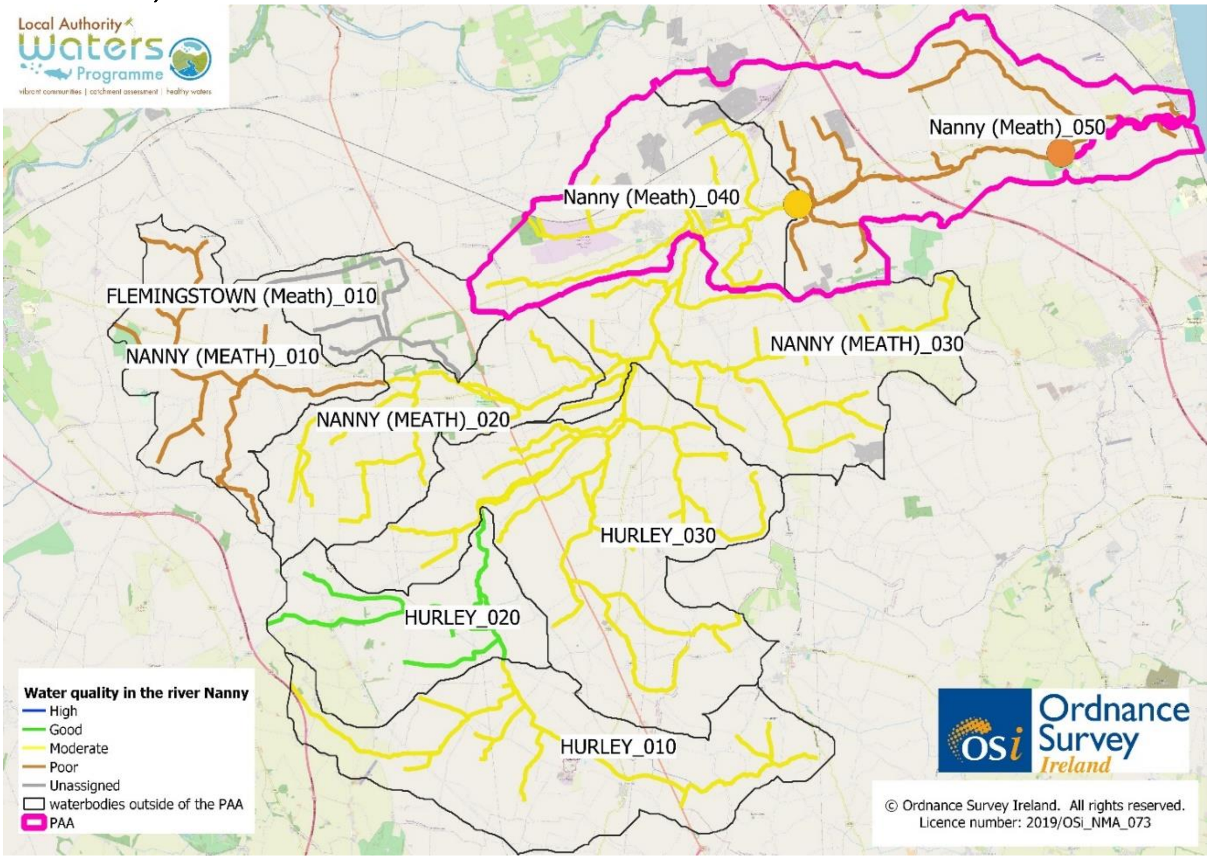

Figure 1 : Rivers in the Nanny catchment.

The lower Nanny PAA is comprised of two waterbodies, the Nanny_040 and the Nanny_050 (Figure 1). They are part of the Nanny-Devlin catchment, which enters tidal waters between Mornington Point and Sea Mount, Co. Dublin. They receive water from the following waterbodies (Nanny_010 (Poor), Flemmingstown_010 (unassigned), Nanny_020 (Poor), Hurley_030 (moderate), and the Nanny_030 (Moderate). The PAA is located within the protected drinking areas of Duleek, Bettystown, Realtage and Donore (Figure 2). The Nanny River discharges into coastal waters which both bathing (Laytown & Bettystown) and shellfish areas (Balbriggan & Skerries) (Figure 3). The EPA monitoring stations for the Nanny_040 and the Nanny_050 are located at the bridge northeast of Bellewstown and the bridge at Julianstown respectively.

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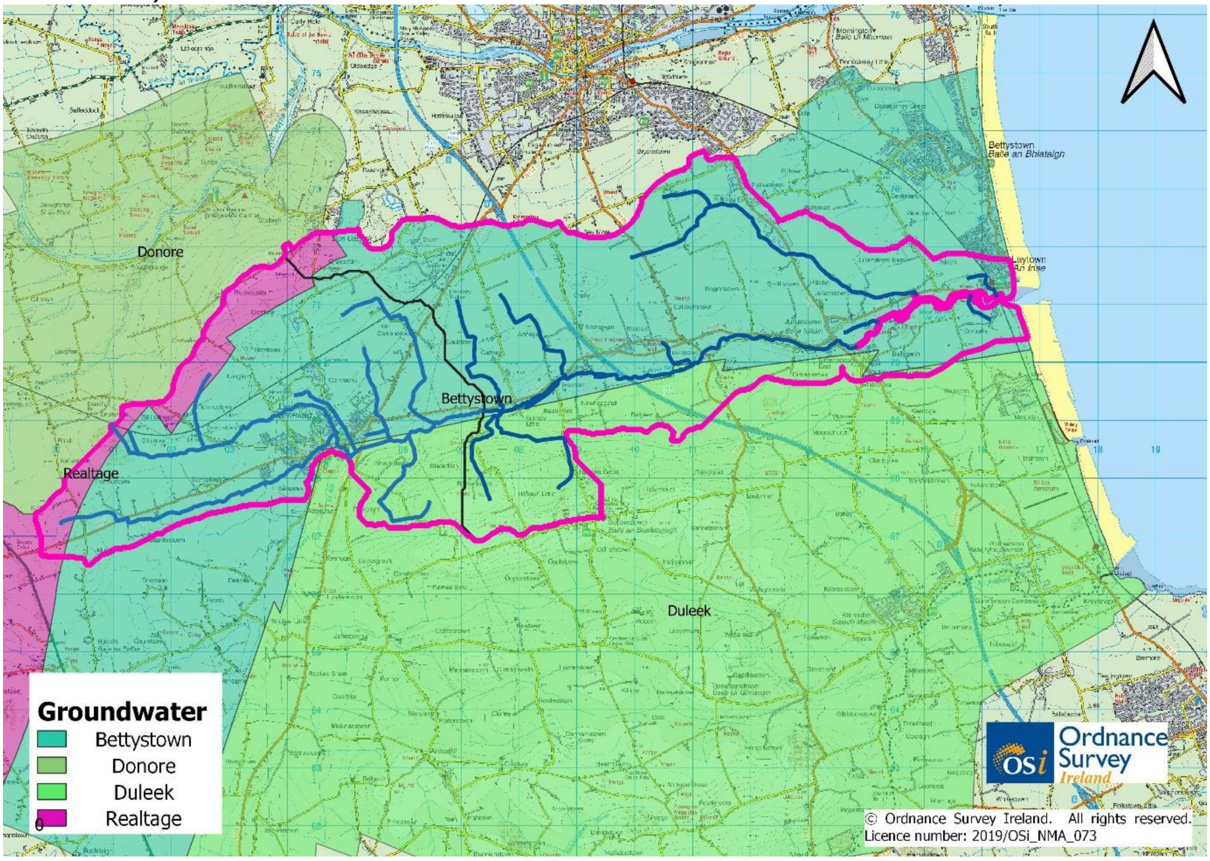

Figure 2 : Groundwater for protected drinking water supply

The Nanny_040 is 25.47km and the Nanny_050 is 27.25km in length and the PAA covers 5,863 ha. The European Union (EU) Co-Ordinated Information of the Environment dataset (Corine) 2018 data shows that the predominant land use in the PAA is pasture followed by tillage. The main town in the PAA is Duleek but there are once off housing throughout the PAA. There are four Section 4 licences related to quarries, one UWWTP (Duleek), one poultry unit and Irish Cement have a cement factory located in Platin. There are three UWWTPs located outside of the PAA but feed into waterbodies flowing into the Nanny_040. These are Ardcath, Skreen and Kentstown.

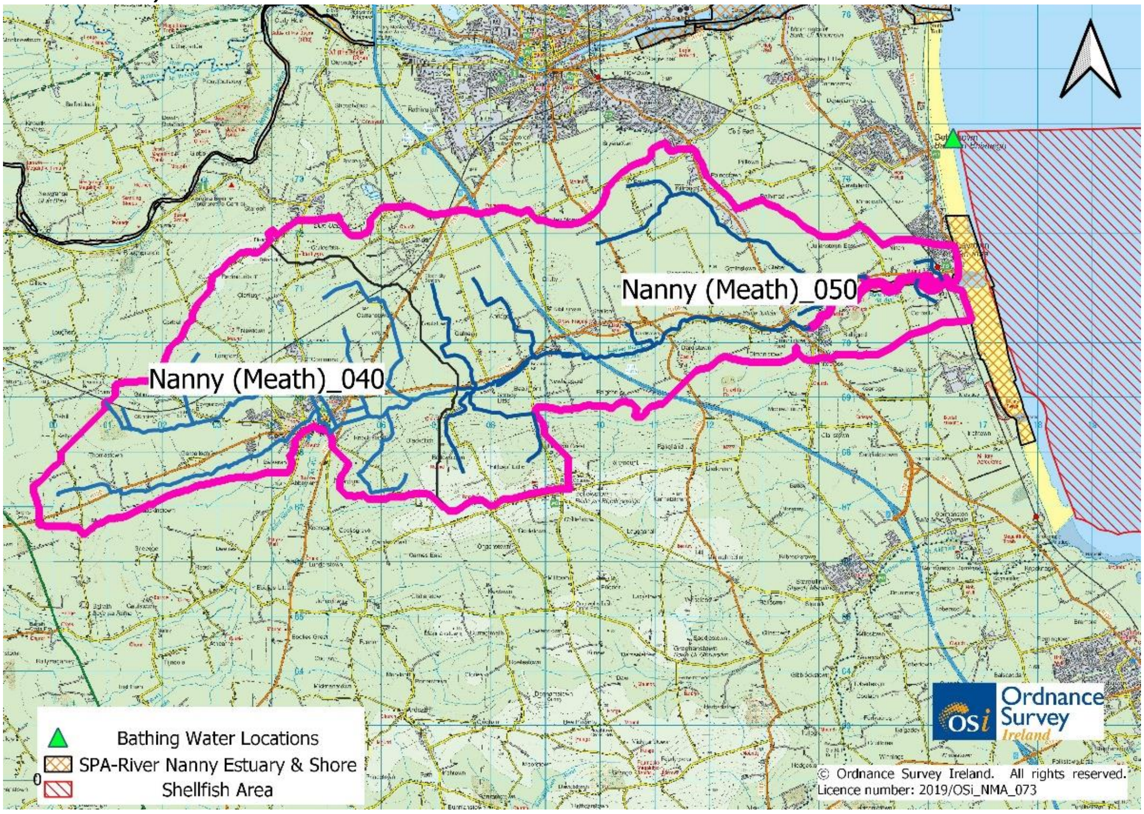

Figure 3 : Protected areas in the River Nanny Estuary and coast.

1.2 Information Sources Consulted

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

- Mobile Monitoring Unit (MMU) report 2008, 2011 & 2012.
- WFD web application – EPA characterisation data
- Meath County Council data
- OPW Flood Risk Management Plan (Nanny-Delvin) 2018
- Morphological Quality Index v1.08.01 (EPA Catchment Science and Management Unit)
- Irish Water (AER data)
- EPA licence data
- EPA Hydrotool
- EPA SAFER Data- Waters team

1.3 PAA Summary Information

A summary of risk, ecological status, known pressures and associated significance for the Lower Nanny PAA and waterbodies that feed into it are presented in (Table 1).

The Nanny_010 is the headwater for the Nanny River. It is *At Risk* and is currently at Poor status There are two monitoring stations, Folistown bridge and East bridge Kentstown. At Folistown bridge the Q-Values have been poor (1996-1998), bad (2001) and poor (2005-2017). Sediment was noted at the site during the last Q-Value assessment (2017). Downstream at the East bridge Kentstown monitoring station the Q-Value has been poor since 1988. Sediment was also noted at the most recent Q-Value assessment (2017).

The Flemingstown_010 is an unassigned waterbody that is in *Review*, that flows into the Nanny_20. No monitoring data has been collected for this waterbody since 2007.

The Nanny_020 is *At Risk* and is currently at Moderate status (2013-2018). The Q-Value has fluctuated over the years, poor (1988-1986), moderate (1998-2001), good (2005-2008), moderate (2010), poor (2014) and moderate with sediment present (2017*).

The Hurley_030 feeds into the Nanny_030. It is *At Risk* and is at Moderate status (2013-2018). The Q-Value has fluctuated extensively over the past 40 years. It was good (1978), poor (1980), bad (1981), moderate (1984-1988), poor (1991), moderate (1996-1998), poor (2001), good (2005) and moderate (2008-2017*). Sediment was also noted in the most recent assessment (2017).

The Nanny_030 is *At Risk* and is currently at Moderate status (2013-2018). The previous Q-Value was recorded in 1991 and it was poor.

The Nanny_040 is one of the two waterbodies within the PAA. It is *At Risk* and is currently Moderate status (2013-2018). The Q-Values have fluctuated over the years: poor (1974), bad (1974), poor (1978-1980), moderate (1982-1986), poor (1988), moderate (1991), poor (1996), moderate (1998-2005), poor (2008) and moderate (2010-2018).

The Nanny_050 is the second waterbody with the PAA. The Nanny_050 is At Risk and is currently at poor status (2013-2018). The Q-Values have fluctuated over the years between poor and moderate: moderate (1974), poor (1978), poor (1980), moderate (1982-1988), poor (1991), moderate (1996-1998), poor (2001), moderate (2008), poor (2010), moderate (2014) and poor (2017-2018).

Table 1: Summary of Risk, Q values, pressures and actions in the Nanny River catchment.

WB Code	WB name	Risk	High status obj.	2009	2012	2015	2018	No of pressures	Pressure Category	Pressure Subcategory	Pressure name	Significant Pressure (Y/N)	LCA	Responsible Agency
IE_EA_08F050930	Flemmingtown (meath_010)	Review	no	U	U	U	U	2	Agriculture	Agriculture		Yes	IA1	EPA
									Industry	IE	Knockharley Landfill	Yes	IA1	EPA
IE_EA_08N010110	NANNY_010	At risk	No	P	P	P	P	4	Agriculture	Agriculture		yes	IA1	Meath County Council
									Hydromorphology	Channelisation		yes	IA7	Meath County Council
									Urban Wastewater	Agglomeration PE of 500-1000	Kentstown	yes	IA7	Meath County Council
									Domestic Waster Water	Wastewater discharge		yes	IA7	Meath County Council
IE_EA_08N010280	NANNY_020	At risk	No	M	M	P	M	3	Urban Wastewater	Agglomeration PE of 500-1000	Kentstown	yes	IA7	Meath County Council
									Agriculture	Pasture		yes	IA7	Meath County Council
									Hydromorphology	Channelisation		yes	IA7	Meath County Council
IE_EA_08H010400	Hurley_030	At risk	No	M	M	M	M	5	Agriculture	Agriculture		yes	IA1	Meath County Council
									Agriculture	Farmyards		yes	IA1	Meath County Council
									Waste	Illegal Dumping		yes	IA7/IA1	Meath County Council/EPA
									Urban Wastewater	Agglomeration <PE 500	Ardcath	yes	IA1	Irish Water
									Hydromorphology	Channelisation		yes	IA1	EPA
IE_EA_08N010400	NANNY_030	At risk	No	U	U	U	M	5	Agriculture	Farmyards		yes	IA7	Meath County Council
									Hydromorphology	Channelisation		yes	IA1	EPA
									Urban Wastewater	Agglomeration PE of 500-1000	Kentstown	yes	IA7	Meath County Council
									Industry	Section 4		yes	IA7	Meath County Council
									Agriculture	Agriculture		yes	IA7	Meath County Council
IE_EA_08N010500	NANNY_040	At risk	No	P	M	M	M	7	Industry	IE	P0887-01	No	IA7	LAWPRO
									Urban Wastewater	Agglomeration PE of 500-1000	Kentstown	yes	IA7	LAWPRO
									Industry	IE	P0030-06	No	IA7	LAWPRO
									Hydromorphology	Channelisation		yes	IA1	EPA
									Urban Wastewater	Agglomeration PE of 2,001 to	Duleek	no	IA7	LAWPRO
									Agriculture	Agriculture		yes	IA7	LAWPRO
									Urban Wastewater	Agglomeration PE < 500	Ardscath	yes	IA7	LAWPRO
									Urban Wastewater	Agglomeration PE < 500	Skreen	yes	IA7	LAWPRO
IE_EA_08N010700	NANNY_050	At risk	No	M	P	P	P	2	Hydromorphology	Channelisation		yes	IA1	EPA
									Agriculture	Agriculture		yes	IA7	LAWPRO

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The initial characterisation sub-catchment assessment by the Environmental Protection Agency (EPA) recommended that the following actions be undertaken:

Nanny_040:

- IA7 Multiple Sources in Multiple Areas: (LAWPRO)
  Local catchment assessment needed, focussing upstream first before Duleek to determine if issue is diffuse rural and work downstream. Elevated nutrients in both upper and lower station. However, prioritize investigation in Subcatchment 8_4 before undertaking any IAs in this subcatchment.
- IA1 Provision of Information: (EPA)
  Consider within hydromorphological risk assessment

Nanny_050:

- IA7 Multiple Sources in Multiple Areas (LAWPRO)
  Local catchment assessment to be carried out and focussed on diffuse agriculture, sediment, and ortho-P sources, as well as buffer strips.
- IA1 Provision of Information (EPA)
  To consider upper part of the water body as part of the hydromorphological assessment (Channel drainage district)

Receptor information & assessment

1.4 Context and Setting

The Lower Nanny was selected as PAA because the Nanny discharges into coastal waters which have both designated bathing (Bettystown & Laytown) and shellfish areas (Balbriggan & Skerries). One of the waterbodies (Nanny_050) has deteriorated in status and to build on the existing improvements by Irish Water at the Duleek UWWTP (Nanny_040). The topography of the PAA is low lying and flat. The land use is predominantly agriculture, with a mixture of grassland and tillage crops. The town of Duleek is situated at the top of the Nanny_040.

1.5 Protected Areas

There are three proposed Natural Heritages Areas (pNHAs), Thomastown bog, Duleek common and the Laytown dunes/ Nanny estuary within the PAA. The River Nanny and Shore Special Protected Area (SAC 004158) is located at the estuary of the Nanny_050. The site is a SPA under the E.U. Birds Directive, of special conservation interest for the following species: Oystercatcher, Ringed Plover, Golden Plover, Knot, Sanderling and Herring Gull. The site includes the estuary of the River Nanny and sections of the shoreline to the north and south of the estuary approximately 3 km in length. The estuary is narrow and well sheltered with both saltmarsh and freshwater marsh/wet grassland habitat present. The site is most important as roost area for the birds but also provides a feeding habitat. Factors that can adversely affect the SPA are anthropogenic disturbances or environmental modifications that alter the natural habitat. Under the Water Framework Directive, the Nanny estuary is unassigned. As nitrogen is usually the limiting nutrient in an estuary the limit of 2.6 N mg/l is used at the threshold for nitrogen in the Nanny PAA.

There are four protected drinking water supplies located in the Lower Nanny PAA, Duleek, Bettystown, Realtage and Donore, which supplied by both ground water and surface water sources (Figure 2 & Table 2).

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Table 2 Waterbodies contributing to drinking water supplies

Waterbody name	Duleek drinking water supply	Bettystown drinking water supply	Realtage drinking water supply	Donore drinking water supply
Delvin_010	x			
Delvin_020	x			
Delvin_030	x			
Delvin_040	x			
Mosney_010	x			
Hurley_020		x		
Hurley_030	x	x		
Nanny_010			x	
Nanny_020		x	x	
Nanny_030	x	x		
Nanny_040	x	x	x	x
Nanny_050	x	x		
Duleek groundwater	x	x		
Trim groundwater		x	x	x
Lusk Bog of the Ring groundwater		x	x	
Bettystown groundwater		x	x	
Realtage groundwater		x	x	x
Drogheda groundwater		x	x	
Donore groundwater			x	x
Hill of Tara			x	
Boyne_170				x
Boyne_180				x
Mattock_030				x
Betaghstown_010		x		
Flemingtown_010			x	
Roughgrange_010				x

1.6 WFD Information

The surface waterbodies in Table 4 are arranged in chronological order, from upstream to downstream. The Lower Nanny PAA only comprises of the Nanny_040 and Nanny_050. However, the water quality of the inputting waterbodies can have a significant impact on the water quality in the PAA. Table 4 presents a summary of risk, WFD status and of available high level water quality trends for all the waterbodies in the river Nanny and Hurley. This includes biological Q scores up to 2018, and annual average for orthophosphate (PO_4^+), nitrate (NO_3^-) and ammonium ($NH4^+$) concentrations versus Good status thresholds.

There are two EPA monitoring stations in the Lower Nanny PAA. The monitoring station at the bridge north east of the Bellewstown is located at the base of the Nanny_040. The monitoring station located at the bridge at Julianstown is located approximately 1km inland from the estuary (Figure 4).

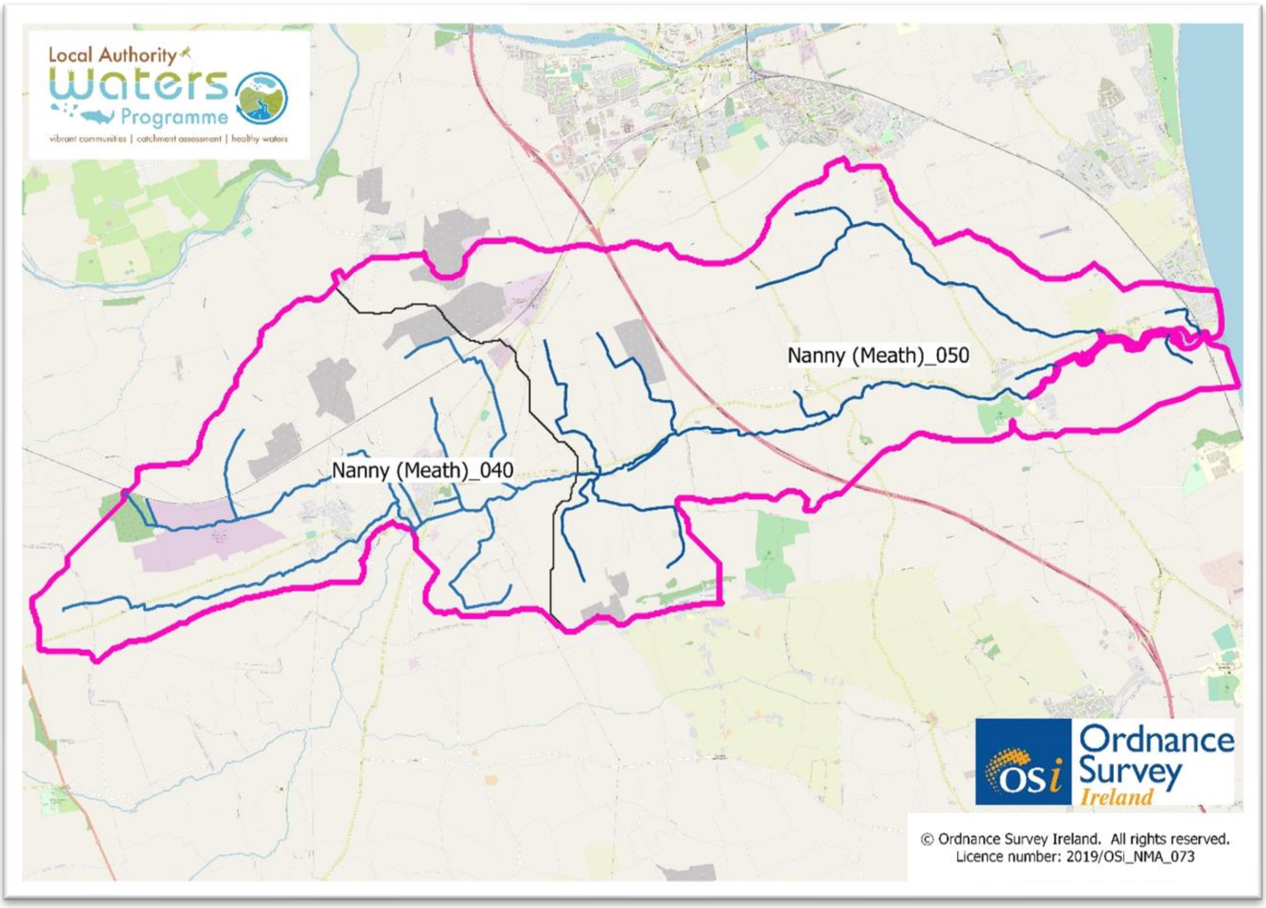
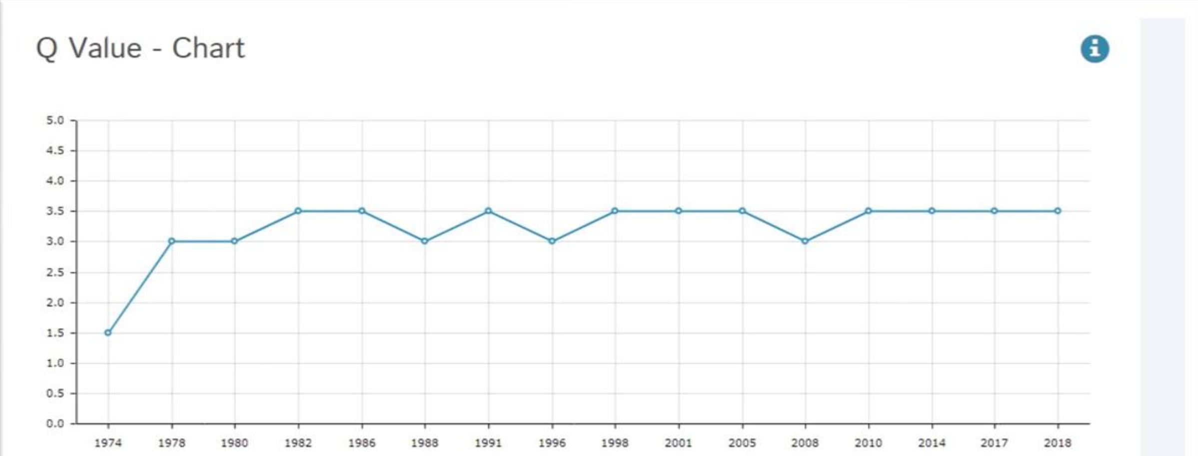


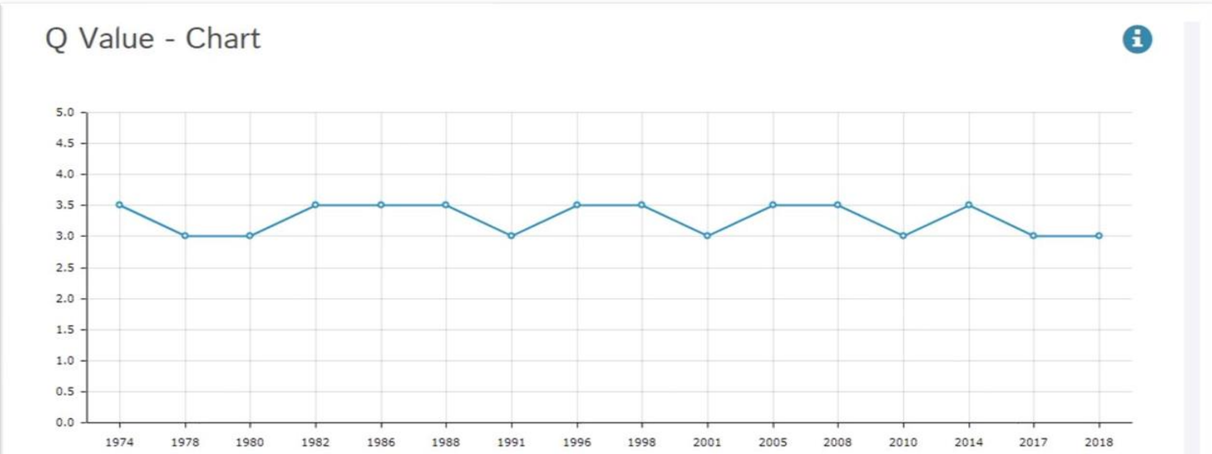
Figure 4 : EPA monitoring station locations in the Lower Nanny PAA.

Nanny_040 (Figure 5) water quality has improved from bad (Q-value 1-2) in 1974 to fluctuating between poor and moderate q-values until 2010 where is has remained moderate (Q-value 3-4). Its current ecological status is Moderate (2013-2018). The status is being driven by the waterbody's moderate biological status, and its failing Dissolved Oxygen (DO) and nutrient status. Since 1974, the Nanny_050 has alternated between moderate or poor water quality. Currently it has poor biological status (Figure 6). Its ecological status is Poor (2013-2018), this is being driven by poor biology and failing nutrients.



	1974	1978	1980	1982	1986	1988	1991	1996	1998	2001	2005	2008	2010	2014	2017	2018
Result	1.5	3	3	3.5	3.5	3	3.5	3	3.5	3.5	3.5	3	3.5	3.5	3.5	3.5
Classification	Bad	Poor	Poor	Moderate	Moderate	Poor	Moderate	Poor	Moderate	Moderate	Moderate	Poor	Moderate	Moderate	Moderate	Moderate
Q-Value	1-2	3	3	3-4	3-4	3	3-4	3	3-4	3-4	3-4	3	3-4	3-4	3-4	3-4

Figure 5 : Q-values in the Nanny_040.



	1974	1978	1980	1982	1986	1988	1991	1996	1998	2001	2005	2008	2010	2014	2017	2018
Result	3.5	3	3	3.5	3.5	3.5	3	3.5	3.5	3	3.5	3.5	3	3.5	3	3
Classification	Moderate	Poor	Poor	Moderate	Moderate	Moderate	Poor	Moderate	Moderate	Poor	Moderate	Moderate	Poor	Moderate	Poor	Poor
Q-Value	3-4	3	3	3-4	3-4	3-4	3	3-4	3-4	3	3-4	3-4	3	3-4	3	3

Figure 6 : Q-values in the Nanny_050

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The water quality entering the Lower Nanny PAA from the Nanny_030 is Moderate status (2013-2018). The EPA chemistry monitoring data shows that the Nanny_030 is bad for phosphate, and moderate for ammonium and Total Oxidised Nitrogen (TON). It is Moderate status is being driven by its failing nutrients and D.O..

The ground waterbodies in the Lower Nanny PAA are Bettystown, Donore, Duleek and Realtage (Figure 2). These waterbodies are a water source for the drinking water supplies in the PAA. The water quality in Bettystown is Poor Status (2013-2018) and is *At Risk* (Table 3). Bettystown is failing to achieve Good Status due to deteriorating chloride. Nutrients, ammonium, phosphate, and nitrogen are achieving good status. Duleek, Realtage and Donore are all at Good Status (2013-2018) and *Not at Risk.* They are not monitored for nutrients and other parameters.

Kiltrough/Bettystown (2300PUB2041) is the drinking water scheme that the groundwater supplies in the Lower Nanny PAA. The drinking water scheme annual monitoring programme (2016-2019) did not record any exceedances for nutrients. In 2018, the drinking water sample results exceeded the limits for fluoride and taste. [1]

Table 3 : Groundwater status and risk category

Waterbody code	Waterbody name	Status (2013-2018)	Risk Category
IE_EA_G_016	Bettystown	Poor	At Risk
IE_EA_G_012	Duleek	Good	Not at Risk
IE_EA_G_020	Realtage	Good	Not at Risk
IE_EA_G_021	Donore	Good	Not at Risk

[1] **Water_Team, E.** "**Drinking Water Monitoring Results and Water Supply Details for Ireland - Year 2017-2019**". Datasets Available At: Secure Archive for Environmental Research Data managed by Environmental Protection Agency Ireland

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Table 4 : High level summary of water quality, and biological status arranged from the headwaters to the estuary

Waterbody		Nanny_010	Nanny_010	Nanny_010	Flemmington Meath 10	Nanny_020	Hurley_010	Hurley_010	Hurley_020	Hurley_030	Nanny_030	Nanny _040	Nanny_050
Risk Category		At risk	At risk	At risk	Review	At risk	At risk	At risk	Review	At risk	At risk	At risk	At risk
Monitoring station		Folistown Br	East Bridge, S. of Brownstown	East Br Kentstown	Unassigned	Br d/s Nanny Br.	Br S of Borranstown Hous	Br at Painestown	Rathfeigh Old Bridge	Just u/s Nanny R confl	Upstream Bridge, Duleek	Br NE of Bellewstown Ho	Br at Julianstown
Monitoring station type		Operational	PreWFD	PreWFD	Operational	Operational	PreWFD	Operational	Operational	Operational	Operational	Operational	Surveillance
Biological Status													
Variations/trends in Q values	*2009*									3-4			
	2010	3				3-4		3	4			03-Apr	3
	2011												
	2012												
	2013												
	2014	3				3		3-4	4	3-4		3-4	3-4
	2015												
	2016												
	2017	3*				3-4*		3-4*	4	3-4*		3-4	3
	2018											3-4	3
Water chemistry													
PO_4^+	*2010*		0.116	0.125		0.100	0.000	0.067		0.089	0.073	0.078	0.04
	2011		0.088	0.128		0.115	0.000	0.082		0.092	0.091	0.096	0.04
	2012		0.079	0.091		0.082	0.053	0.048		0.076	0.072	0.084	0.02
	2013		0.073	0.153		0.093	0.143	0.059		0.072	0.068	0.063	0.035
	2014		0.050	0.136		0.087	0.168	0.068		0.070	0.085	0.079	0.047
	2015		0.074	0.085		0.054	0.130	0.055		0.058	0.082	0.079	0.043
Ecological Threshold	*2016*		0.122	0.133		0.085	0.090	0.074		0.079	0.090	0.081	0.064
0.035	*2017*		0.083	0.104		0.061	0.142	0.048		0.057	0.141	0.131	0.058
mgP/l	*2018*		0.070	0.080		0.047	0.190	0.054		0.049	0.130	0.1	0.035
	2019		0.070	0.090		0.070	0.110	0.080		0.080	0.100	0.09	0.02
Baseline PO4+			**0.074**	**0.091**		**0.059**	**0.147**	**0.061**		**0.062**	**0.124**	**0.107**	**0.038**
NH4+	*2010*		0.097	0.591		0.075	0.000	0.058		0.069	0.045	0.036	0.038
	2011		0.088	0.752		0.048	0.000	0.068		0.067	0.043	0.055	0.022
	2012		0.095	0.281		0.050	0.033	0.266		0.467	0.101	0.104	0.028
	2013		0.105	0.619		0.063	0.068	0.119		0.049	0.038	0.039	0.032
	2014		0.098	0.105		0.074	0.073	0.111		0.090	0.044	0.079	0.033
	2015		0.061	0.146		0.055	0.088	0.092		0.056	0.071	0.07	0.044
Ecological Threshold	*2016*		0.071	0.105		0.034	0.045	0.022		0.031	0.025	0.034	0.028
0.065	*2017*		0.067	0.077		0.033	0.044	0.025		0.017	0.179	0.122	0.052
mgN/l	*2018*		0.070	0.160		0.033	0.068	0.192		0.054	0.385	0.23	0.042

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Waterbody		Nanny_010	Nanny_010	Nanny_010	Flemmington Meath 10	Nanny_020	Hurley_010	Hurley_010	Hurley_020	Hurley_030	Nanny_030	Nanny _040	Nanny_050
	2019		0.070	0.160		0.050	0.090	0.050		0.060	0.050	0.08	0.09
Baseline NH4+			**0.069**	**0.132**		**0.039**	**0.067**	**0.089**		**0.044**	**0.205**	**0.144**	**0.061**
NO_3^-	*2010*		2.435	2.638		2.785	0.000	2.208		2.210	2.813	2.87	3.09
	2011		2.315	2.845		2.845	0.000	3.833		2.313	2.543	2.78	2.81
	2012		2.943	3.240		3.440	1.353	1.918		2.540	3.763	3.81	3.51
	2013		2.570	2.778		3.130	1.125	2.518		2.655	2.867	2.78	3.36
	2014		3.300	3.930		3.978	1.013	2.915		3.450	4.510	4.49	4.44
	2015		2.777	3.795		3.183	1.605	3.255		3.267	3.205	3.19	3.81
Ecological Threshold	*2016*		1.884	2.980		2.560	1.460	1.560		1.940	2.500	2.62	3.08
2.6	*2017*		2.060	2.780		2.600	1.810	1.812		2.018	2.880	2.82	3.25
mgN/l	*2018*		2.054	2.880		2.960	2.080	1.666		3.120	3.500	3.64	3.88
	2019			4.120		4.120	1.730	2.720		3.940		4.84	5.4
Baseline NO3-			**1.999**	**3.260**		**3.227**	**1.873**	**2.066**		**3.026**	**3.190**	**3.767**	**4.177**
EPA Biologist comments	The Nanny River was unsatisfactory along the entire length when surveyed in 2017. Since the 2014 survey, there has been a slight improvement at Station 0280, but a slight decline in quality at Station 0700. The Nanny River still had unsatisfactory ecological conditions at stations 0500, 0550 and 0700 in August 2018.												

Lower Nanny PAA 0125

1.6.1 High level water quality trends.

The Lower Nanny PAA comprises of the last two waterbodies of the river Nanny before it enters the sea at Laytown, Co. Meath. Consequently, the water quality entering the Nanny_040 waterbody from upstream will have a positive or negative impact on the PAA depending on its nutrient content. Unfortunately, the waterbodies upstream of the Lower Nanny PAA are exceeding the threshold for some nutrients (Table 4). The two headwaters of the river Nanny are the Nanny_010 and the Hurley_010. The Hurley river joins the Nanny river in the Nanny_030. Plotting the annual average phosphate and nitrate concentrations in the different waterbodies in the river Nanny shows any temporal patterns present (Figure 7). Identifying temporal patterns in the data is useful to narrow down the locations of the significant pressures.

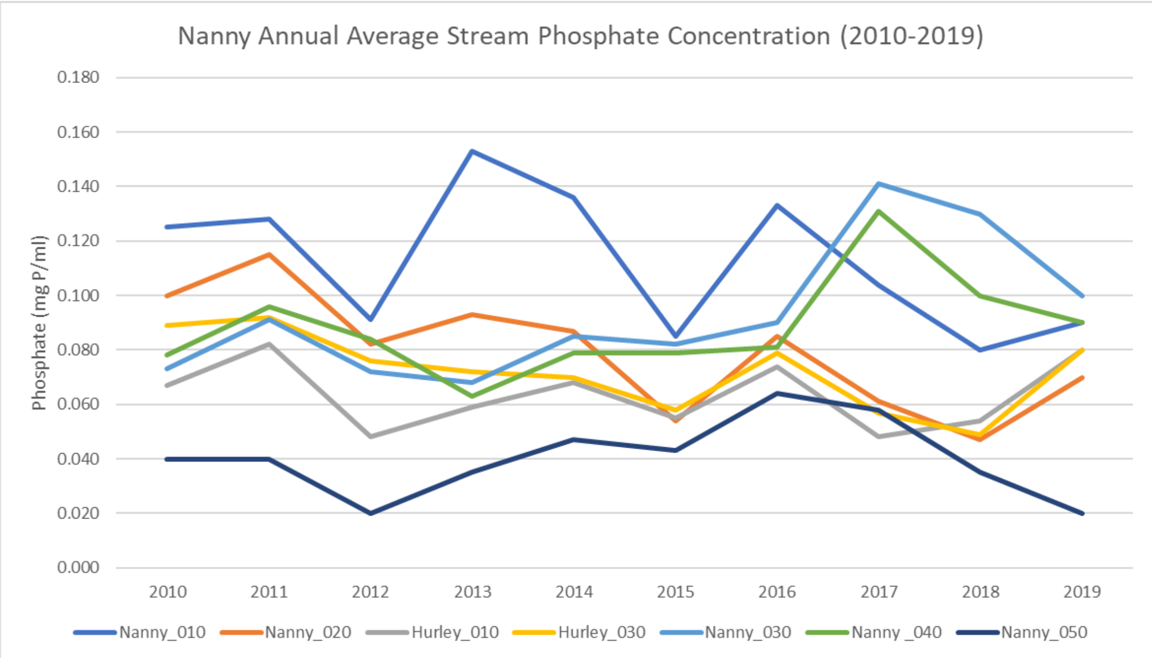

Figure 7 : Annual average phosphate concentrations in the river Nanny (2010-2019)

1.6.1.1 Phosphate concentrations

- There is a decrease in phosphate concentration each year from the Nanny_010 to the Nanny_020 (Figure 30). The temporal patterns are very similar for both waterbodies i.e., they both have the same peaks in data. The decrease in the phosphate concentrates downstream of the Nanny_010 shows that the source of the phosphate is in the Nanny_010.
- In 2014, there is a change in the phosphate concentration trends. The average phosphate concentration in the Nanny_030 increases and is higher than the Nanny_020 (2014-2019).

- The Hurley_030 joins the river Nanny in the Nanny_030 and contributes approximately 20% of the total water in the river Nanny (Table 5). The annual phosphate contribution in the Hurley_030 is decreasing (Figure 7). Since 2014 the annual phosphate concentration in the Nanny_030 is increasing and is decreasing in the Hurley_030, therefore there is a significant pressure in the Nanny_030 and it is entering the water after the Hurley_030 confluence. The temporal patterns of the phosphate concentrations are very similar in the Nanny_030 and Nanny_040 (Figure 8).

- Since 2013, the Nanny_040 phosphate concentrations have been lower than the Nanny_030 and the Nanny_040 is diluting the phosphate concentrations in the river. The average phosphate concentrations in the Nanny_050 have consistently been lower than the concentrations in the Nanny_040 (Figure 9). Therefore, there are none or low phosphate contributions occurring the Nanny_050 and the waterbody is having a diluting effect on the phosphate concentrations.

- Therefore, phosphate is an issue in the Nanny_040 and the Nanny_050 but the sources of the phosphate are upstream of both waterbodies.

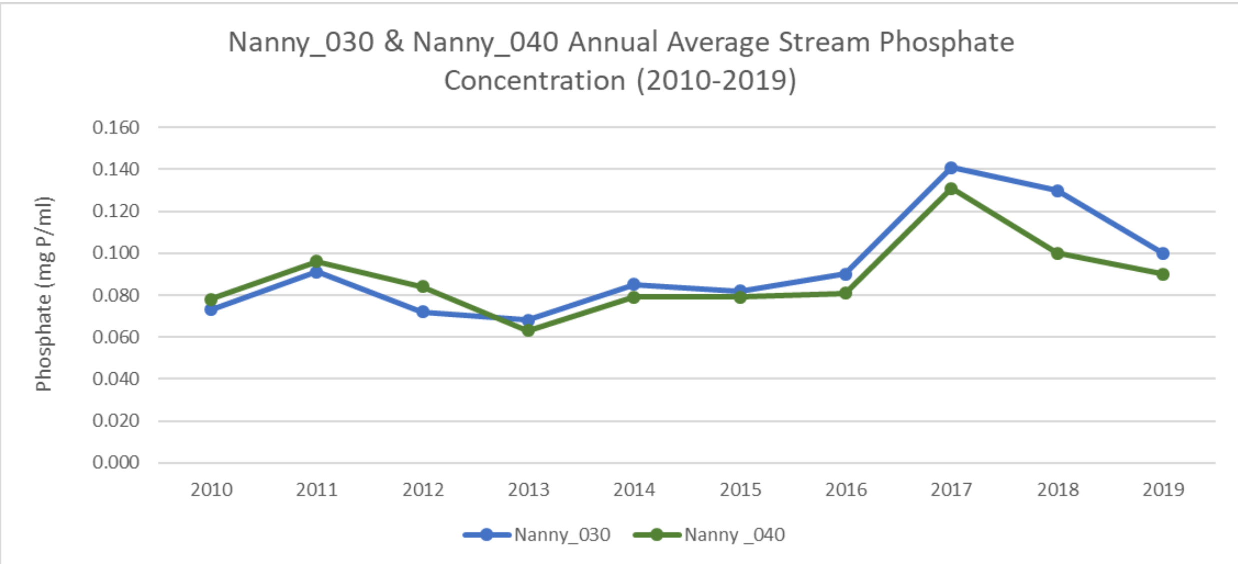

Figure 8 : Annual average phosphate concentrations in the Nanny_030 and Nanny_040 (2010-2019)

Lower Nanny PAA 0125

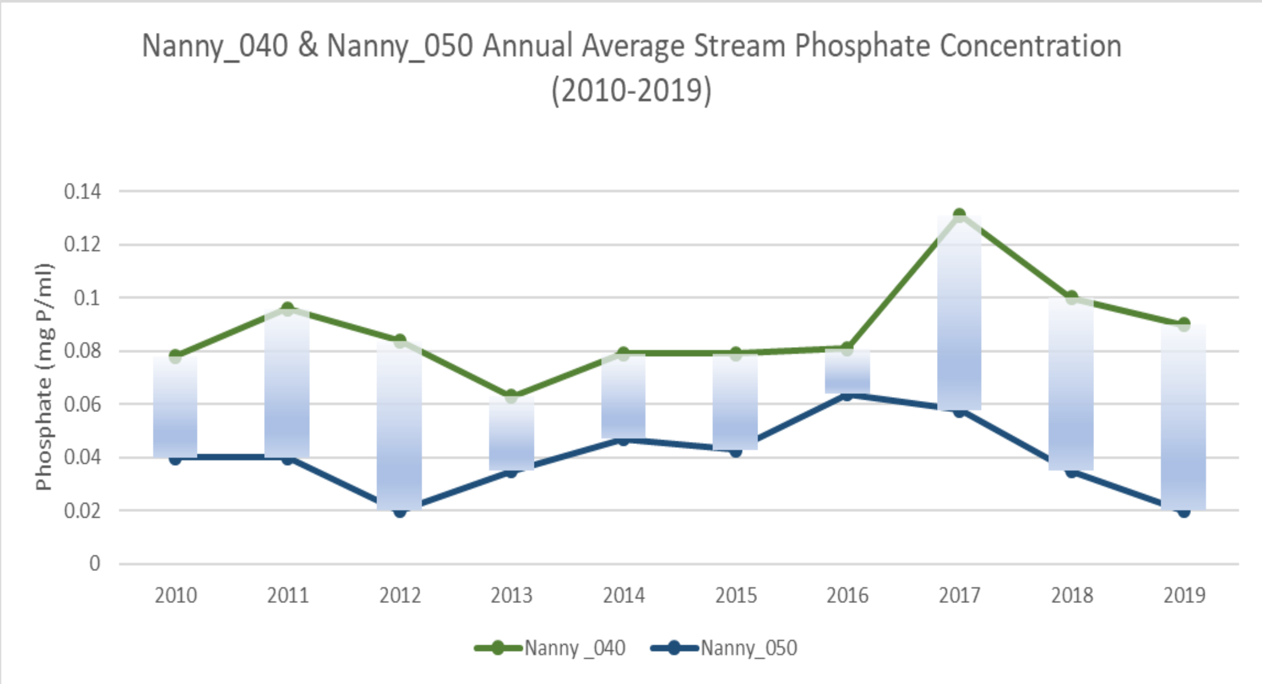

Figure 9 : Annual average phosphate concentrations in the Nanny_40 and Nanny_050

1.6.1.2 Nitrate Concentrations

- The temporal patterns in the nitrate concentrations in the different waterbodies are similar (Figure 10). Overall, the Hurley_10 and Hurley_30 have the lowest annual average nitrate concentrations and the Nanny_040 and Nanny_050 have the highest.

- The temporal pattern in the Nanny_030 and Nanny_040 is very similar which indicates that the nitrate in the Nanny_040 is coming from upstream.

- In the Nanny_050 the nitrate concentrations are the highest in the river Nanny. This suggests that while there is nitrate entering the waterbody from the upstream waterbodies, there is also nitrate entering the river in this waterbody as well.

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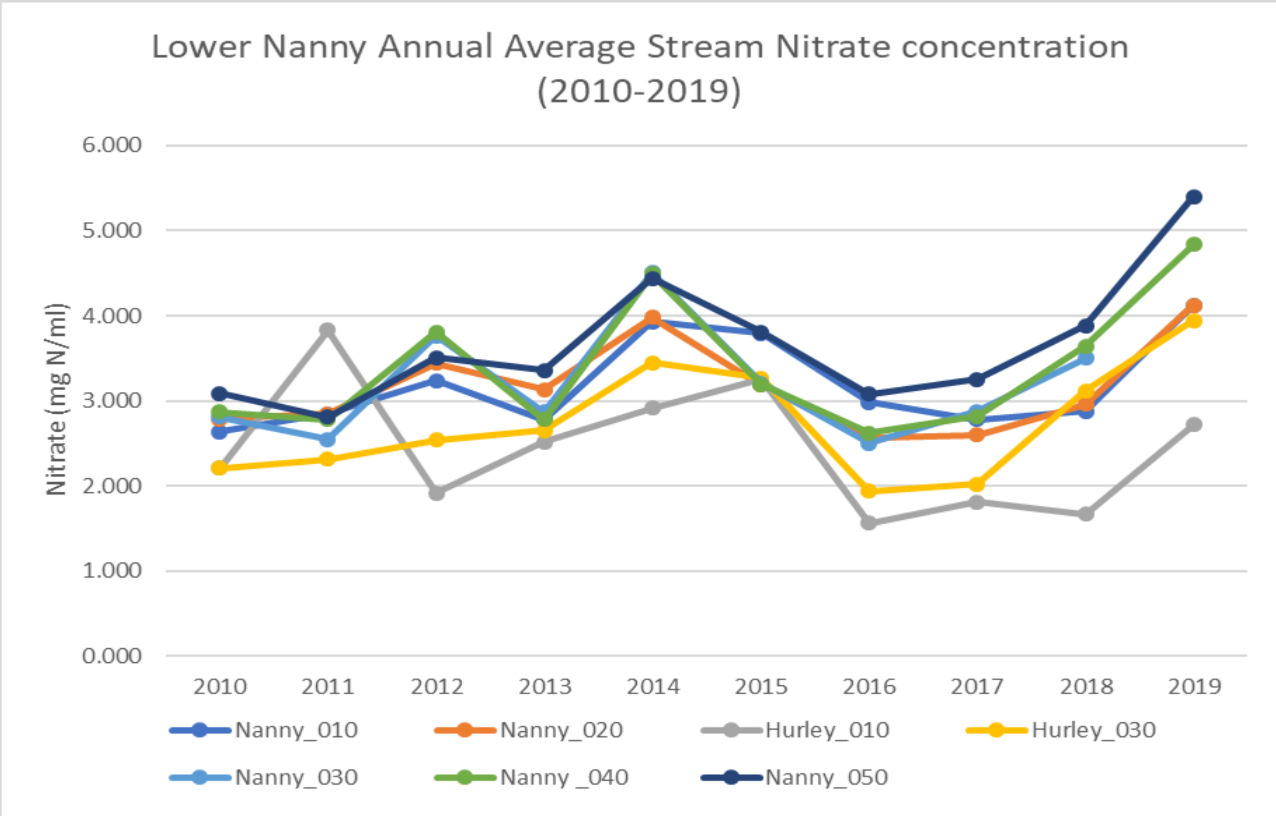

Figure 10 : Annual average nitrate concentrations in the river Nanny (2010-2019)

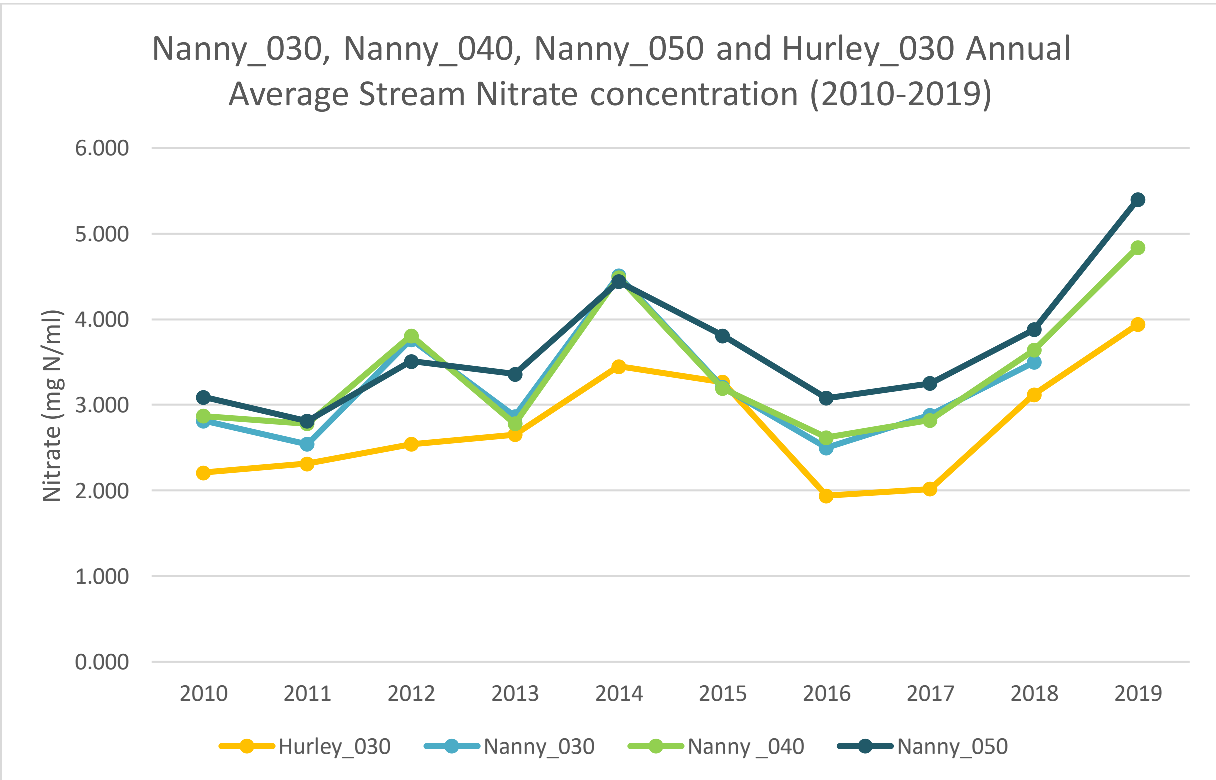

Figure 11 : Annual average nitrate concentrations in the Hurley_030, Nanny_030, Nanny_040 and Nanny_050

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1.6.2 Nutrient Loads and Loads Reduction Targets

Load calculations are a useful method to characterise the relative contribution of different waterbodies to the overall nutrient load in the river. Calculating the nutrient load reduction required to meet the Good Status annual average concentration in your waterbody helps target the Local Catchment Assessment (LCA) fieldwork. Suitable targeted mitigation measures in areas with a high nutrient load will result in a greater reduction of nutrients than mitigation measures applied broadly to the catchment.

Phosphate is a significant issue in the Nanny River. However, the source of the phosphate is entering the river upstream of the PAA. Nitrate is also a significant issue in the river, but the nitrogen sources are located with the PAA.

Table 5 shows the catchment areas, estimated flows and nutrient loads in the Lower Nanny catchment for 2017, 2018 and 2019. The catchment areas were derived using the Flood Studies Update (FSU) portal. The nutrient load was calculated by area of subcatchment (FSU) by effective rainfall (Met Eireann) by annual average nutrient concentration (Eden). The total catchment area includes eight waterbodies that are outside of the Lower Nanny PAA. On average 50% of the water in the Lower Nanny PAA is arising from waterbodies outside of the PAA. These waterbodies have been included in the analysis as their nutrient loads are having a significant negative impact on the two waterbodies (Nanny _040 and Nanny_050) within the PAA. The projected loads reduction required for each of the waterbodies is based on the estimated flows and loads which were calculated for three years (2017-2019). Therefore, the final load reduction figures are not absolute but will be used to inform which waterbodies are having a significant negative impact on water quality and therefore will be the focus of the LCA.

Currently, phosphate is exceeding the Environmental Quality Standard (EQS) for good status in the Nanny_040 at the EPA monitoring point. However, the load contribution of phosphate from the Nanny_040 catchment area is negligible (2017-2019) (Figure 12), and concentrations appear to be diluted by the waterbody itself (Table 5). The Nanny_050 is also having a diluting effect and is not contributing to the phosphate levels in the river. This is supported by the fact that the Nanny_050 is compliant with the EQS for good status for phosphate. Potential sources for phosphate within the Nanny catchment include agricultural activity, UWWP, and industry.

Ammonium is failing to comply with the EQS for good quality in the Nanny_040 except in 2016. In 2017 and 2018, the net contribution of ammonium for the Nanny_040 and the Nanny_050 was low. The majority of the ammonium load was entering the river upstream of the Lower Nanny PAA (Figure

13). However, in 2019, 58% of the ammonium total load was from the Nanny_040 and Nanny_050. Potential sources for ammonium within the Nanny catchment include agricultural activity, UWWP, and industry.

The nitrogen contribution from the Nanny_040 and the Nanny_050 accounts for 33%-54% (2017-2019). In2017 and 2018, the Hurley River accounted for approximately 23% of the nitrogen in the catchment and in 2019, it accounted for 28% of the total kilograms of nitrogen. The Hurley River makes up less than 20% of the total catchment area of the Nanny river. The annual nitrate load per hectare for the entire catchment area varies from 12.50 kg N/ha/yr (2017) to 29 kg N/ha/yr (2019). A reduction in the nitrogen contribution from the Hurley River will be necessary to reduce the overall nitrogen in the Lower Nanny PAA. In 2017, the Nanny_030 contributed 24% of the total nitrogen load in the Nanny River. In 2018, it contributed 17% of the total nitrogen load. Chemistry samples were not collected for nitrogen in the Nanny_30 in 2019. Approximately, 50% of the total nitrogen load in the Nanny River is entering the watercourse upstream of the Nanny PAA (Figure 15). Potential sources for nitrogen within the Nanny catchment include agricultural activity, UWWP, and industry.

Rivers are typically P limited and estuaries are nitrogen limited. The nitrogen concentration in the Nanny estuary is unknown as the estuary is unassigned. However, with the known nitrogen load entering the estuary from the Nanny catchment it is reasonable to assume that the nitrogen load is impacting on the estuary. Nutrient source mitigation measures should focus on the rivers with the highest load inputs.

Ground waterbodies are also vulnerable to nutrients entering their system and in turn entering the drinking water supply. Phosphate and ammonium can reach ground waterbodies in areas of extreme ground water vulnerability. Nitrogen can enter a ground waterbody where the soil is free draining or areas with extreme ground water vulnerability.

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Table 5: Summary of monitoring point catchment area, calculated river flows and nutrient loads.

Effective Rainfall (0.383m) 2017	Monitoring Point	WB Catchment Area (km2)	Mon Point Flow (litres/Yr)	Phosphate Load (KgP/Yr)	Waterbody Phosphate Load Kg/Yr	Ammonium Load (KgN/Yr)	Waterbody Ammonium (KgN/Yr)	Nitrate Load (KgN/Yr)	Waterbody Nitrate (KgN/Yr)	Percentage contribution of flow at Monitoring Pt. of total catchment area
NANNY_10	East Br Kentstown	21	7891734150	821	821	631	631	21939	21939	2
Flemingstown_10	no WQ data	11	4233082044			0		0		1
NANNY_20	Br d/s Nanny Br	21	20022588918	1221	401	601	-31	52059	30120	6
HURLEY_10	Br at Painestown	32	12184286444	610	610	600	600	52058	52058	4
HURLEY_20	Rathfeigh Old Br (WQ 2015)	17	26591125048			0		0		8
HURLEY_30	Just u/s Nanny R confl	44	35509963155	2131	915	710	224	71730	-176771	10
NANNY_30	Upstream Bridge, Duleek	31	67581425696	9529	613	12165	10854	194635	70846	20
NANNY_40	Br NE of Bellewstown Ho	23	76247125981	9988	459	9150	-3015	216542	21907	22
NANNY_50	Br at Julianstown	36	90038769661	5222	-4766	4502	-4648	293526	76985	26
Total			**352430955865**		**-342**		**4502**		**293526**	
reduction required to achieve good status at Nanny_40				7624 kg/yr		5413 kg/yr		reduction required to achieve good status at Nanny_50		50323 kg/yr
Effective Rainfall (0.389m) 2018	**Monitoring Point**	**WB Catchment Area (km2)**	**Mon Point flow (litres/Yr)**	**Phosphate Load (KgP/Yr) 2018**	**waterbody Phosphate load Kg/Yr**	**Ammonium Load (KgN/Yr) 2018**	**waterbody Ammonium (KgN/Yr)**	**Nitrate Load (KgN/Yr) 2018**	**waterbody Nitrate (KgN/Yr)**	**% contribution at Monitoring Pt. total catchment area**
NANNY_10	East Br Kentstown	21	8015364450	641	641	12825	12825	23084	23084	2
Flemingstown_10	no WQ data	11	4299396646			0		0		1
NANNY_20	Br d/s Nanny Br	21	20336258719	1017	376	6101	-6724	60195	37111	6
HURLEY_10	Br at Painestown	32	12375162995	619	619	23513	23513	20543	20543	4
HURLEY_20	Rathfeigh Old Br (WQ 2015)	17	18986198574			0	0	0	0	6
HURLEY_30	Just u/s Nanny R confl	44	36066255006	1803	1185	18033	-5480	112527	91984	11
NANNY_30	Upstream Bridge, Duleek	31	68640142547	9610	6789	144144	120010	240240	67518	20
NANNY_40	Br NE of Bellewstown Ho	23	77441597928	7744	-1865	178116	33971	281887	41647	23
NANNY_50	Br at Julianstown	36	91449298689	3658	-4086	36580	-141536	401462	119575	27
Total		**235**	**337609675553**		**3658**		**36580**		**401462**	

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reduction required to achieve good status at Nanny_40				5420 kg/yr		13160 kg/yr		reduction required to achieve good status at Nanny_50		138620 kg/yr
Effective Rainfall (0.555m) 2019	**Monitoring Point**	**WB Catchment Area (km2)**	**Mon Point 2019 flow (litres/Yr)**	**Phosphate Load (KgP/Yr) 2019**	**waterbody Phosphate load Kg/Yr**	**Ammonium Load (KgN/Yr) 2019**	**waterbody Ammonium (KgN/Yr)**	**Nitrate Load (KgN/Yr)**	**waterbody Nitrate (KgN/Yr)**	**% contribution at Monitoring Pt. total catchment area**
NANNY_10	East Br Kentstown	21	11435802749	1032	1032	1830	1830	47116	47116	2
Flemingstown_10	no WQ data	11	6134100613							1
NANNY_20	Br d/s Nanny Br	21	29014456526	2031	999	1451	-379	119540	72424	6
HURLEY_10	Br at Painestown	32	17656080880	1416	1416	883	883	48025	48025	4
HURLEY_20	Rathfeigh Old Br (WQ 2015)	17	27088278171							6
HURLEY_30	Just u/s Nanny R confl	44	51456996217	3880	2464	3087	2205	202741	154716	11
NANNY_30	Upstream Bridge, Duleek	31	97931308776	10146	4235	4897	358			20
NANNY_40	Br NE of Bellewstown Ho	23	110488655142	10054	-91	8839	3943	534765	212485	23
NANNY_50	Br at Julianstown	36	130473935148	3131	-6923	11743	2904	704559	169794	27
Total			**481679614221**		**3131**		**11743**		**704559**	
reduction required to achieve good status at Nanny_40				6740 kg/yr		2210 kg/yr		reduction required to achieve good status at Nanny_50		309368 kg/yr

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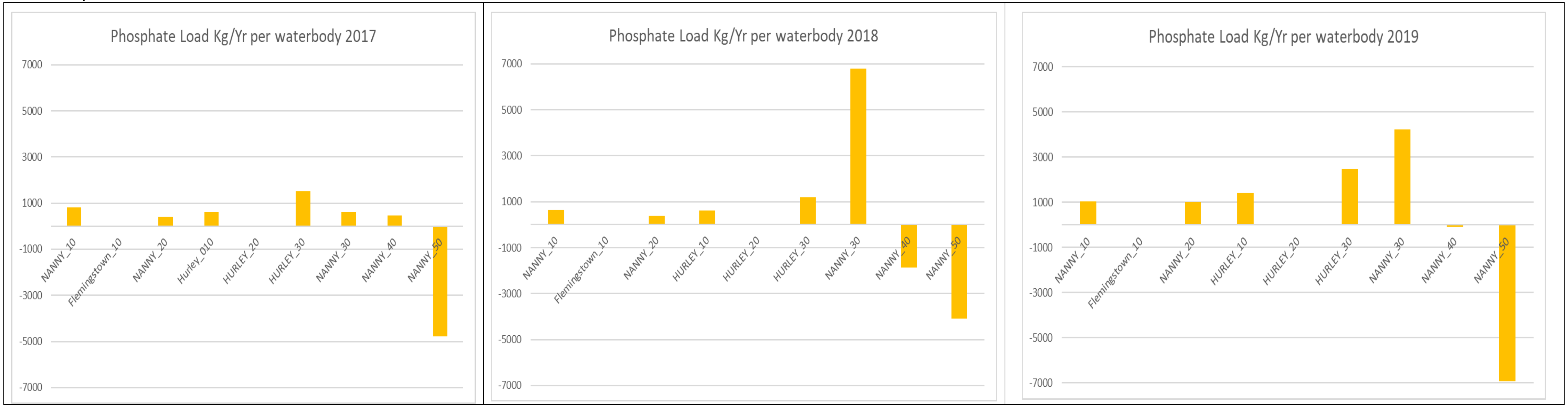

Figure 12 : Phosphate load per waterbody (2017-2019)

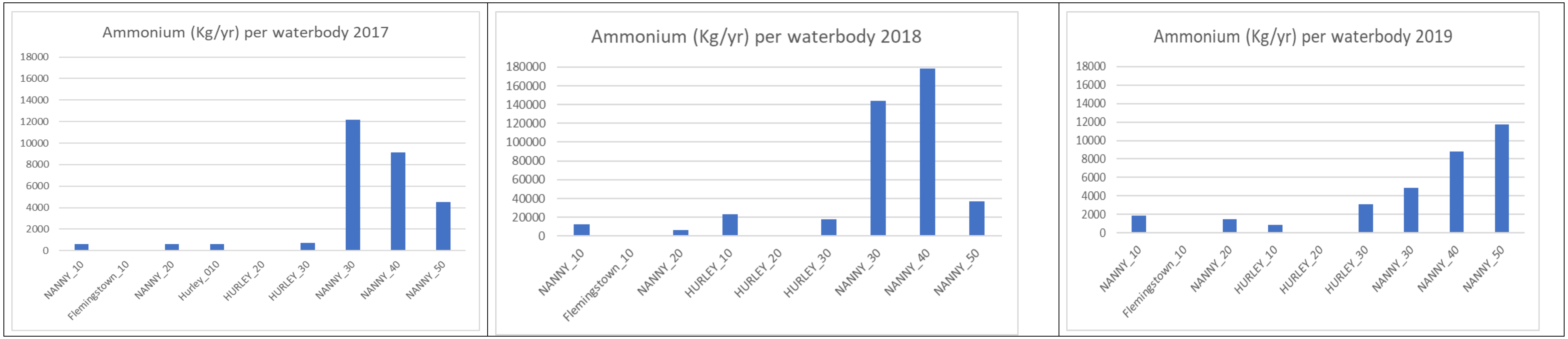

Figure 13 : Ammonium load per waterbody (2017-2019)

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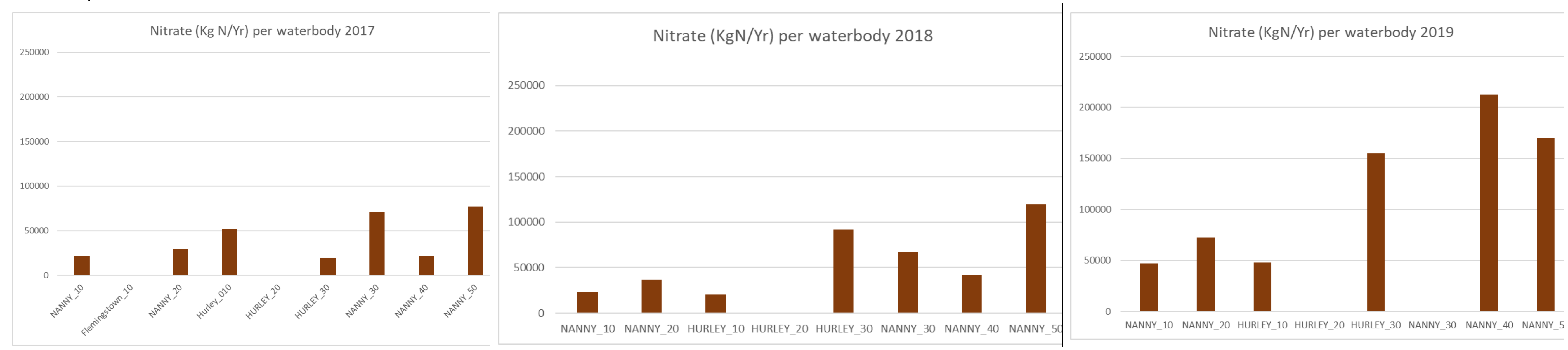

Figure 14 : Nitrate load per waterbody (2017-2019) * (TON not recorded in Nanny_030 in 2019)

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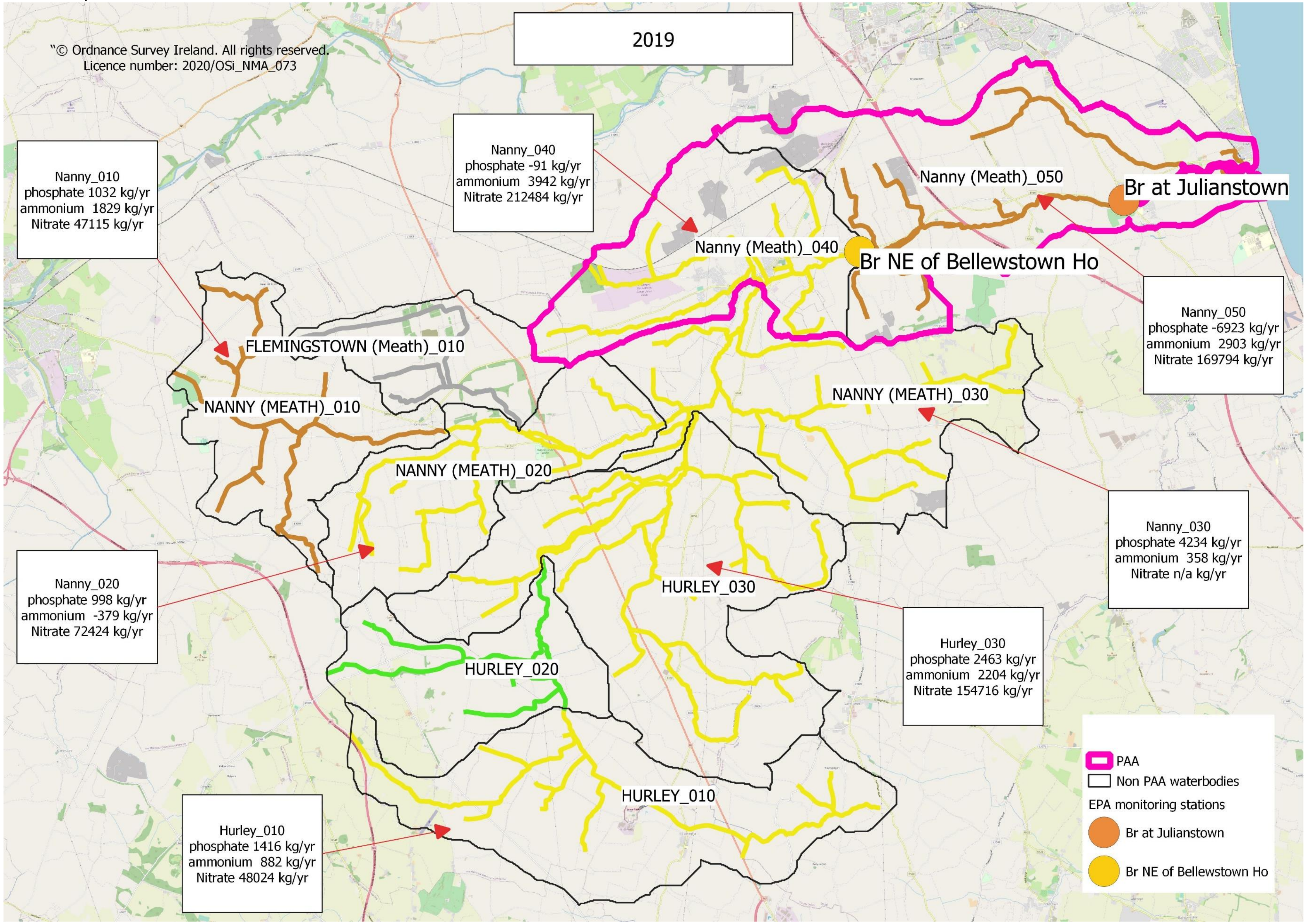

Figure 15 : Nutrient loads in the Nanny catchment in 2019.

1.6.3 Nutrient chemistry temporal trends

Water quality samples are typically collected 12 times a year by the Local Authorities on behalf of the EPA.

Since 2010, The Nanny_040 chemistry data (Table 4) shows that phosphate (Figure 16) has failed the EQS of 0.0325mgP/L annually. In 2017, a phosphate sample was recorded as 0.17 mg/l which caused the annual average to be the highest between 2010-2019.

Between 2010-2018, TON has fluctuated above and below the EQS (Figure 17) and the current data trend is upwards but not significantly (EPA).

Similarly, ammonium is fluctuating above and below the EQS of 0.065 mg/l annually and the current trend is upwards but not significantly according to EPA (Figure 18). In 2017, one ammonium sample was recorded as 1.13 mg N/l, and two sample in 2018 were 1 mg N/l and 1.05 mg N/l. These high results increased the annual average.

The EPA biologist report (2017) show that the kick sample for the Q-value was taken in a suitable habitat (typical riffle-glyde). There were no sensitive mayfly or stoneflies recorded in the sample. *Simuliidae* (common), *Gammarus* (dominant) and *Baetis rhodani* (numerous) were recorded. These are pollutant tolerant species and can be an indicator of nutrient pollution. *Cladophera* and filamentous algae were recorded as covering 60% (extensive) of the habitat at the time of the kick sample. *Cladophera* is an indicator of inorganic phosphate and nitrogen These results show that nutrients are having an impact on the invertebrate community which are at moderate ecological status. A reduction in nutrients is needed for the sensitive mayfly and stonefly taxa to repopulate in the river. An increase in diversity and numbers of taxa will improve the ecological status to good.

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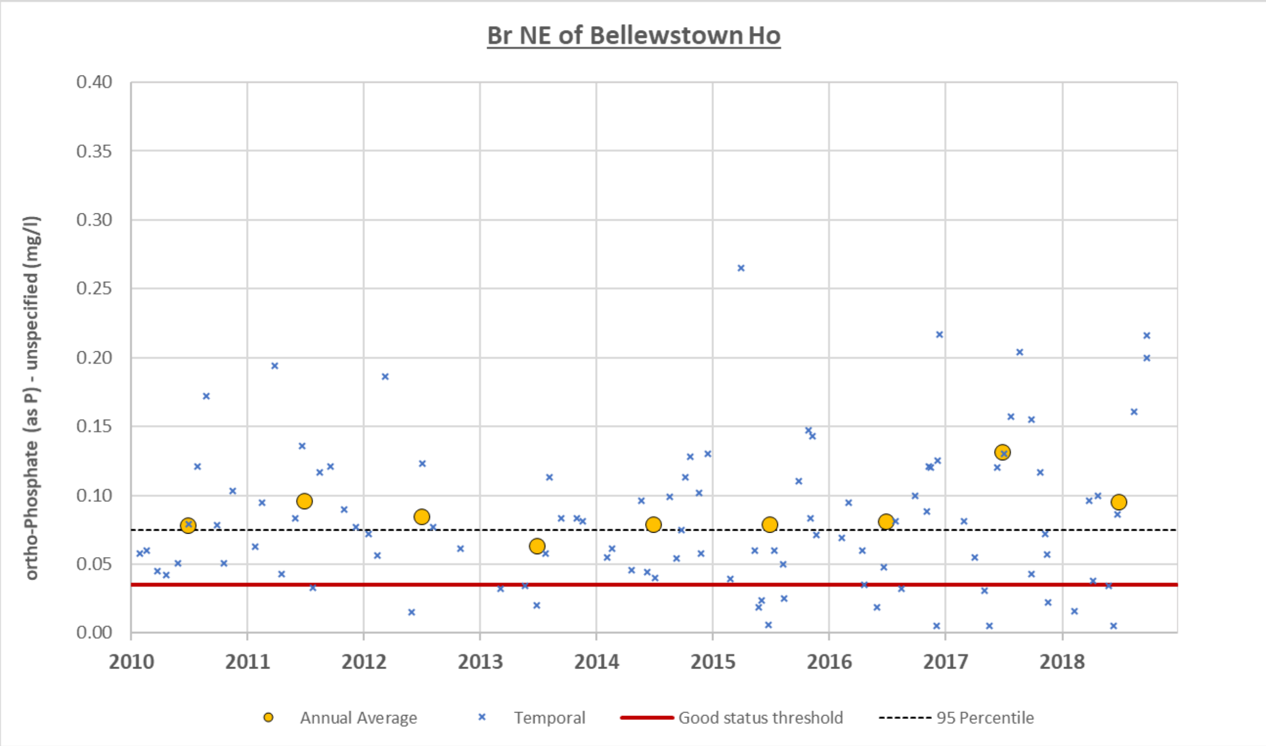

Figure 16 : ortho-Phosphate in the Nanny_040 (2017 one sample omitted (0.718 mg/L) to show other samples proximity to threshold)

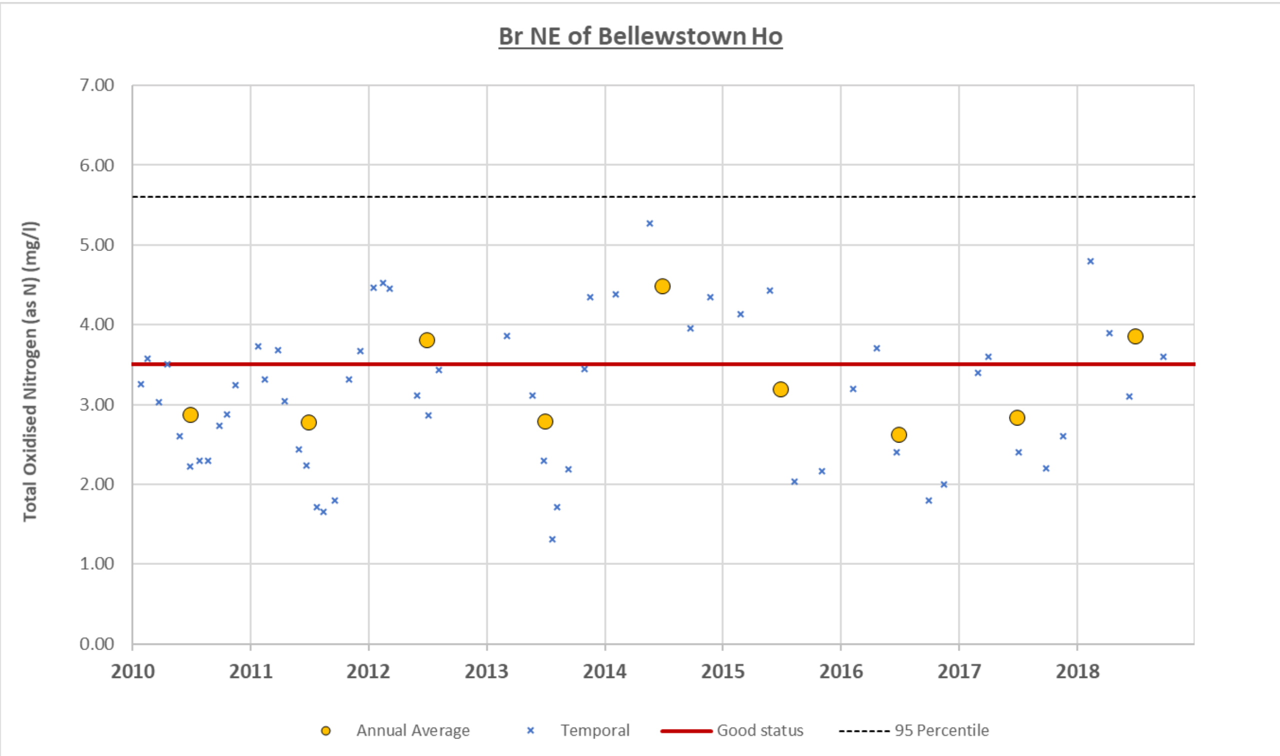

Figure 17 : Total Oxidised Nitrogen in the Nanny_040.

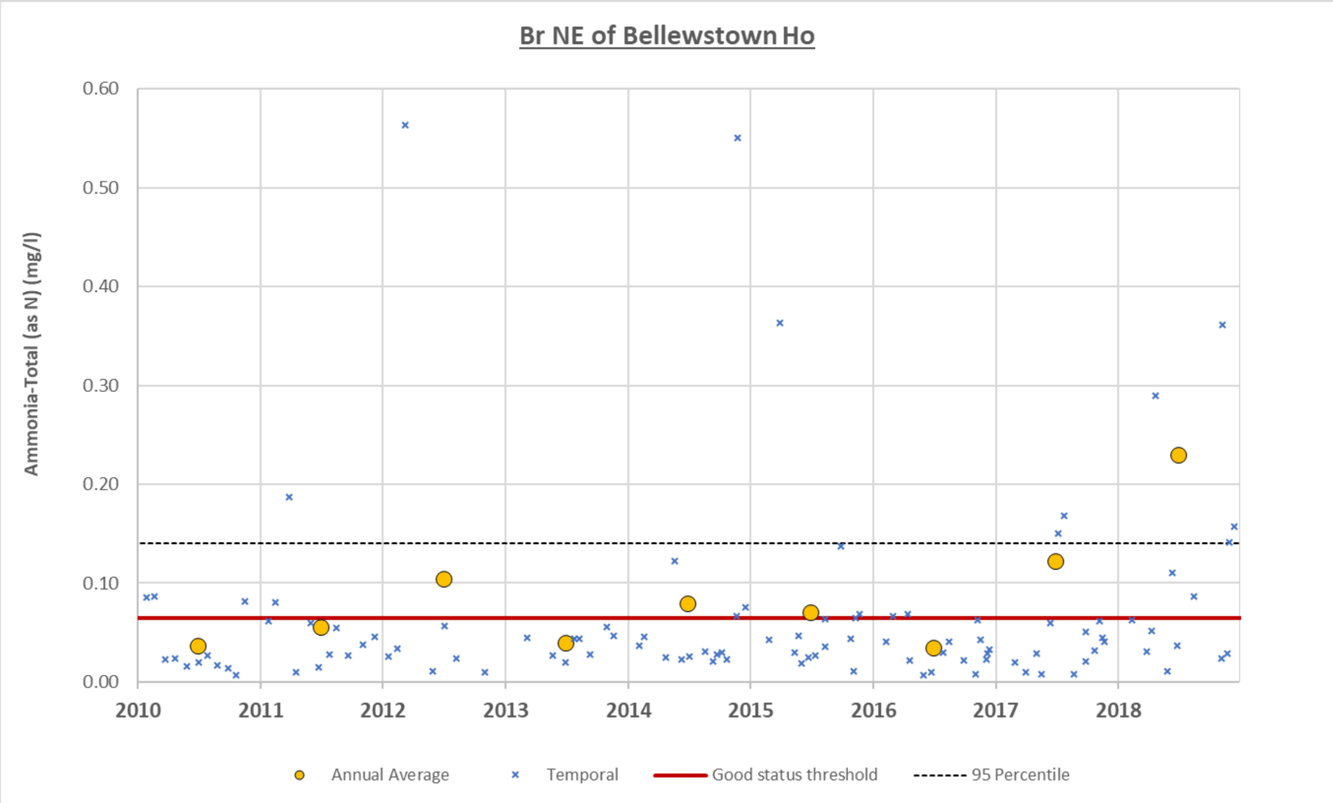

Figure 18 : Total Ammoniacal N in the Nanny_040. (1 sample 2017 (1.13 mg/l), & 2 samples 2018 1mg/lg and 1.05mg/l omitted to show other samples proximity to threshold)

The chemistry data for the Nanny_050 shows that phosphate (Figure 19) is also an issue in this waterbody. Ammonium is below the EQS and is not an issue in this waterbody (Figure 29). Similar to the Nanny_040, TON is fluctuating above and below the EQS (Figure 17). Currently it is on a downward trend but that isn't statistically significant.

The EPA biologist report (2017) show that the kick sample for the Q-value was taken in a suitable habitat (typical riffle-glyde). There were no sensitive mayfly or stoneflies recorded in the sample. *Simuliidae* (common), *Gammarus* (excessive) and *Baetis rhodani* (numerous) were recorded. These are pollutant tolerant species and can be an indicator of nutrient pollution. *Cladophera* was also present but in a low amount (<10%). Similarly, to the Nanny_040, a reduction in nutrients in the Nanny_050 will improve the invertebrate community and ecological status of the waterbody.

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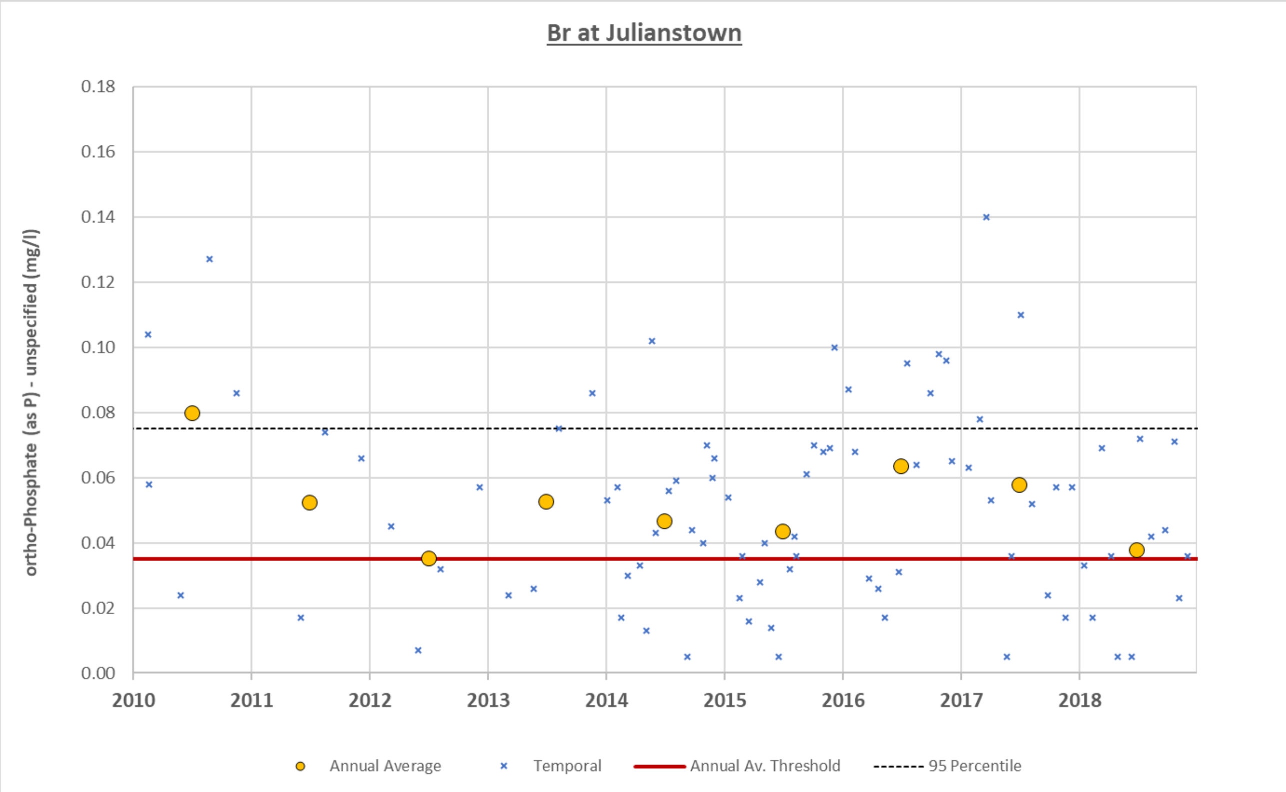

Figure 19 : ortho-Phosphate in the Nanny_050.

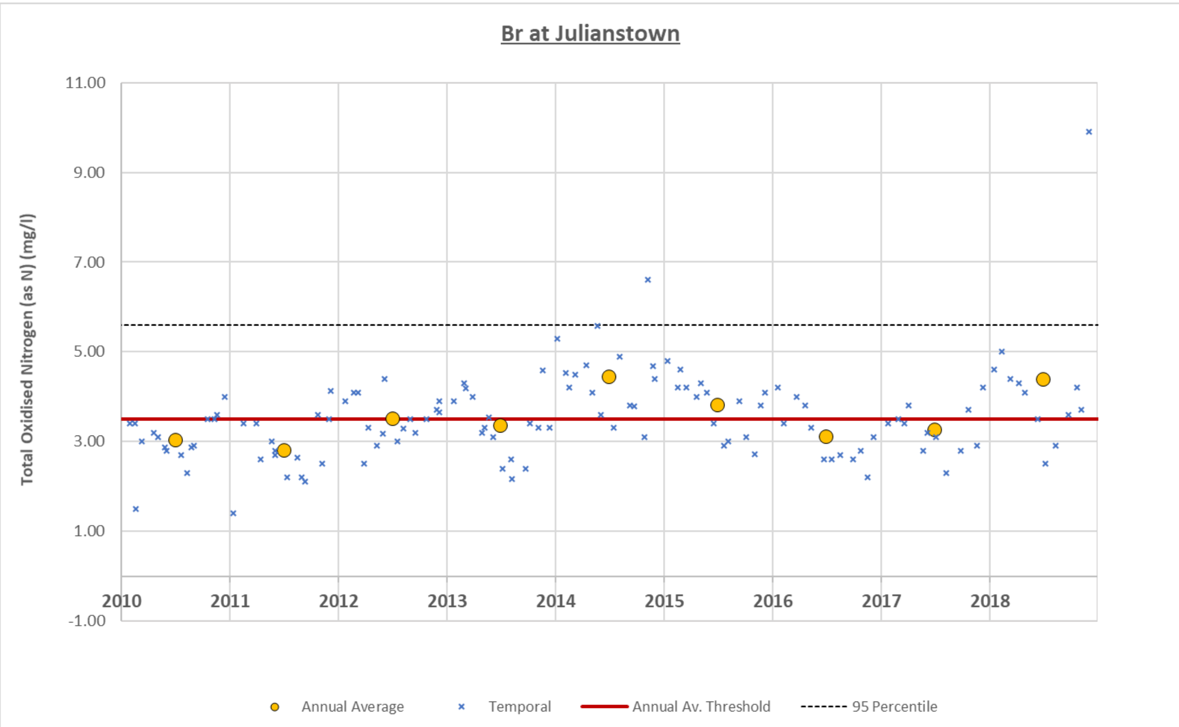

Figure 20 : TON in the Nanny_050.

1.7 Supplementary Information

The Mobile Monitoring Unit (MMU) carried out investigative work in the Nanny_010 in 2008. The waterbody was surveyed upstream from Folistown bridge to the start of the stream. Several rounds of chemistry samples were taken and a few of them were exceeding the EQS for the phosphate and ammonium. The MMU identified several sources of nutrients including farmyard runoff, overland flow of nutrients from agricultural land, failing septic tanks and land drains.

In 2011, the MMU carried out investigative work in the Hurley_010 which feeds into the Nanny River outside of the Lower Nanny PAA. They carried out a stream walk upstream of the EPA monitoring station (Bridge south of Borranstown House). They assessed 5.7km and recorded 72 individual cattle access points. In 2011, chemistry data was not being collected at this monitoring point. Since 2012, EPA chemistry data has been collected at this location and it shows that phosphate is exceeding the EQS (2012-2018).

The MMU carried out investigative work in the Lower Nanny in 2012. A 9 km stretch of river was the focus of the MMU investigation between downstream of Duleek town and Dardistown bridge. Two Small Stream Risk Surveys (SSRS) were carried out at both locations and both SSRS were “at risk”. The MMU investigated the results, based on the SSRS results and initial visit determined that local pressures posed no risk to the water quality. The river is of order five and therefore small improvements in the catchment are unlikely to make an impact on water quality. The MMU concluded, in order to improve water quality, future work should be focused on the river in the upper part of the catchment.

1.8 Conclusion on Significant issues

Nanny_040

Phosphate is a significant issue in this waterbody (Figure 12), and it has continuously failed the EQS since 2010. However, several significant pressures with potential sources of phosphate are located upstream of the PAA. The phosphate load upstream of the waterbody is exceeding the EQS and the Nanny_040 is diluting the concentration.

Ammonium is an issue in the river (Figure 13), it fluctuates above and below the EQS. The chemistry data (Table 4) shows that there is an increasing trend in ammonium. In 2019, the load analysis (Table 5) of the Nanny catchment shows that approximately 33 % of the ammonium load is entering the water from within the Nanny_40. Targeted LCA will be carried out to locate these sources in order for appropriate mitigation measures to be recommended to the relevant agencies.

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Nitrate is a significant issue within the PAA (Figure 14). The chemistry data (Table 4) shows that TON trending upwards. The Load analysis (Table 5) shows that the nitrate load contribution from the Nanny_040 has been increasing (2017-2019). As the Nanny estuary is N limiting, an increase in the N load entering it is of concern. The LCA will focus on assessing potential sources of nitrogen and appropriate mitigation measures will be recommended to the relevant agencies

Nanny_050

Phosphate is a significant issue in the Nanny_050 and has been exceeding the EQS continuously since 2014 (Table 4). However, several significant pressures with potential sources of phosphate are located upstream of the PAA. The phosphate load upstream of the waterbody is exceeding the EQS and the Nanny_050 is diluting the concentration.

Ammonium (Figure 13) is compliant with the EQS for good status and is not an issue in this waterbody.

Similarly, to the Nanny (Meath)_040 nitrate (Figure 14) is the significant issue in this waterbody. TON has fluctuated (2007-2018) but has always exceeded 2.6 N mg/l. The Load analysis (Figure 14) illustrates that Nitrogen is a significant issue in the waterbody.

Nutrients are the significant issue, and this is supported by the EPA biologists Q-value notes (2017) showing that only pollutant tolerant species were present in the kick sample. A reduction in the nutrient load contribution from the waterbodies upstream of the Lower Nanny PAA is required. Without this reduction, a decrease in the nutrient contribution from the waterbodies within the PAA will not be sufficient to achieve good status objective. Meath County Council have started to carry out investigative field work in the waterbodies outside of the Lower Nanny PAA. These waterbodies are proposed as Local Authority Areas for Action for inclusion in the third cycle of the River Basin Management Plan. In order to simultaneously improve the water quality in both the PAA rivers and the Nanny estuary, mitigation measures must focus on decreasing N loads reaching the catchment rivers and eventually the estuary.

Significant pressure information

1.9 Initial EPA Characterisation

The EPA identified Urban UWWTP, agriculture, and hydromorphology as significant pressures (Table 6) in the Lower Nanny PAA.

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Table 6 : Initial Characterization of significant pressures in the Lower Nanny PAA.

Waterbody Name	Waterbody code	Category	Subcategory	Name	Significant	Pressure & Impact details
Nanny_040	IE_EA_08N010500	Urban Wastewater	Agglomeration PE 2001-10,000	Duleek	No	
		Agriculture	Agriculture		Yes	Nutrients & altered habitat due to hydromorphology
		Hydromorphology	Channelisation		Yes	altered habitat due to hydromorphology
		Industry	IE	P0887-01	No	
		Urban Wastewater Treatment Plant	Agglomeration PE<500	Ardcath	Yes	Nutrient & organic pollution
		Urban Wastewater Treatment Plant	Agglomeration PE<500	Skreen	Yes	Nutrient & organic pollution
		Urban Wastewater Treatment Plant	Agglomeration PE of 500 to 1000	Kentstown	yes	Nutrient & organic pollution
Nanny_050	IE_EA_08N010700	Agriculture	Agriculture		yes	Nutrients & altered habitat due to hydromorphology
		Hydromorphology	Channelisation		Yes	altered habitat due to hydromorphology

1.10 Hydromorphology

The Nanny-Delvin catchment is part of the Eastern Catchment Flood Risk Assessment and Management (CFRAM) study. The Duleek Flood Relief Scheme was built between 1997-1998. The scheme consists of flood defence walls and embankments along the Nanny River and Paramadden stream and a storm pumping station. These are intended to protect properties against a 100-year fluvial flood. Laytown is situated at the mouth of the Nanny River and is vulnerable to floods. A flood relief scheme consisting of embankments and flood walls.

The Lower Nanny PAA is part of a drainage district. Typically, drainage districts cover the flattest land areas. Drainage districts were developed by the OPW from 1842 to the 1930s to improve land for agriculture and to mitigate flooding. Channels and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified, and various other work was carried out. The purpose of the schemes was to improve land for agriculture, by lowering water levels during the growing season to reduce waterlogging on the land beside watercourses. Today, local authorities' area responsible for the maintenance of the drainage districts. OSI 6" maps (1837-1842) show that the main channel has been historically straightened over a 100 years ago (Figure 21 & Figure 22). Changes in the natural watercourse can have negative effect on habitat, flow and exaggerate sediment losses.

The Morphological Quality Index (MQI) is a tool provided by the EPA Catchment Science and Management unit to provide an overview of the hydromorphological condition of rivers. The MQI (version 1.08.01) for the Lower Nanny (Figure 23) is predominantly good or high hydromorphological quality. LCA will be to assess the impact on ecology from the hydromorphological changes and to confirm if hydromorphology is a significant pressure in the PAA.

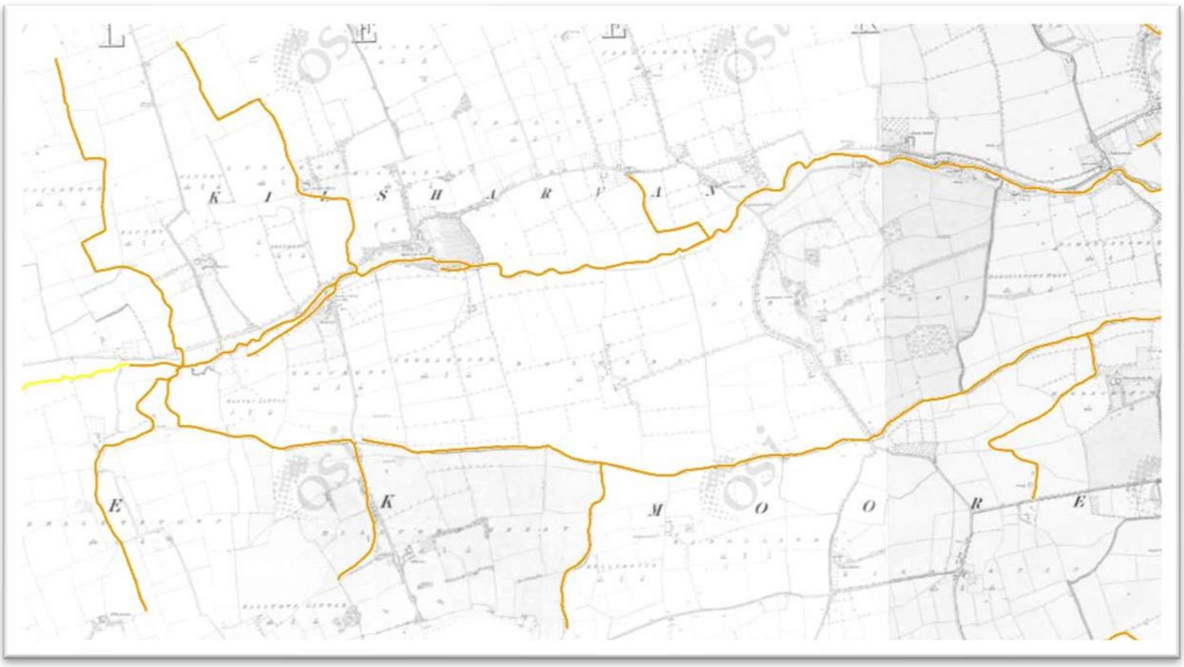

Figure 21 : Nanny_040 over laid on OSI 6"map (1837-1842) (source Geohive)

Lower Nanny PAA 0125

Figure 22 : Nanny_050 over laid on OSI 6" map (1837-1842) (source Geohive)

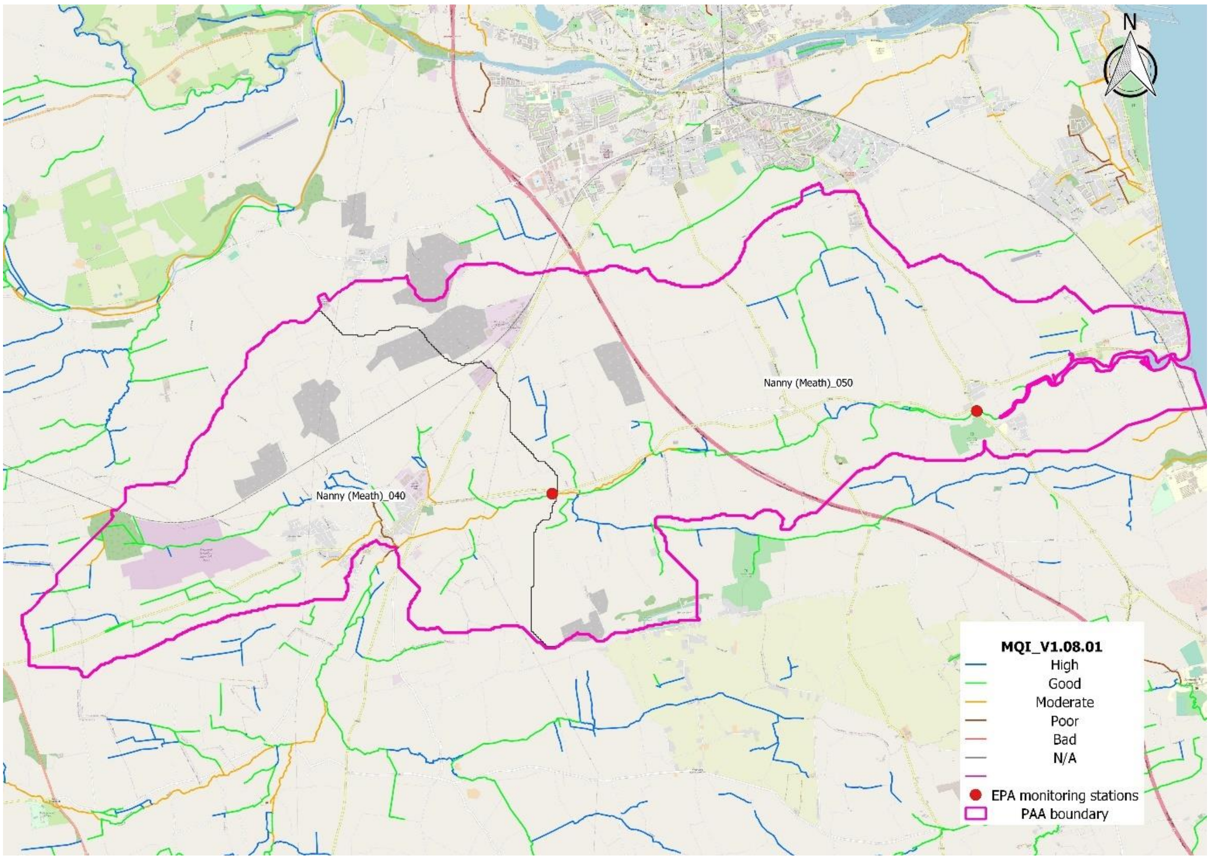

Figure 23 : Morphological Quality Index V1.08.01 for the Lower Nanny PAA

1.11 Agriculture

The majority of the Lower Nanny PAA is comprised of agricultural land. The main farming enterprises are dairy and tillage. Approximately 50% of the land is under a variety of tillage crops and 50% under permanent pasture. Agriculture, through farming practices is a potential source for ammonium, phosphate, and nitrogen e.g. slurry and fertilizer spreading and silage.

1.12 Urban Wastewater Treatment Plants (UWWTP)

There are three UWWTP identified as significant pressure on the Nanny_040. UWWTP can be a source of nutrients if they are exceeding their design capacity, are overloaded periodically or not functioning correctly. There are Ardcath, Kentstown and Skreen and are situated outside of the Lower Nanny PAA (Figure 24). The UWWTP in Duleek is identified as a pressure but not deemed a significant pressure during the initial characterisation.

A desk top assessment and an assimilative capacity calculation for each of the WWTP is carried out using data from the WWTP Annual Environmental Report (AER) and other reports available on the EPA website. An AER is submitted by Irish Water to the EPA for WWTP with an agglomeration of greater than 500-person equivalent (p.e.). A standardised approach using calculations and estimates to assess WWTP impact is used as it can be difficult to separate the pressure from the other potential significant pressures in the waterbody. The desk study calculations put the discharge into context in terms of relative impact on the waterbody.

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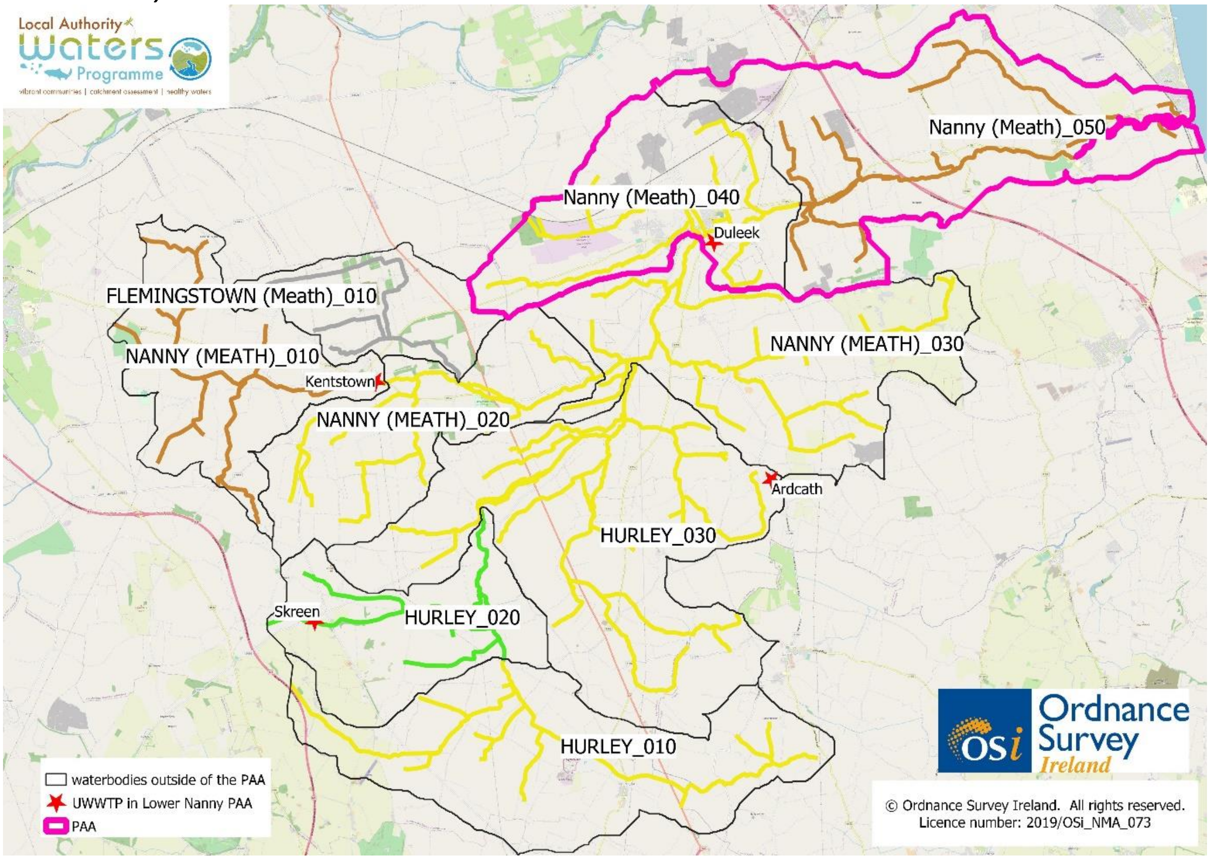

Figure 24 : Location of Waste Water Treatment Plants near the PAA Lower Nanny.

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1.12.1 Ardcath (A0017-01)

WWTP information	Ardcath A0017-1
Located in WB	Hurley_030
Plant capacity	60
Current collected load	*60*
Treatment	• Primary treatment (conventional septic tank) • Secondary treatment (peat percolation)
Discharges	*Discharge to groundwater*
1. Was UWW identified as a significant pressure (SP) in the EPA initial characterisation?	Yes
WFD Action	IA7: local catchment assessment needed, focussing upstream first before Duleek to determine if issue is diffuse rural and work downstream. Elevated nutrients in both upper and lower station. However, prioritize investigation in Subcatchment 8_4 before undertaking any IAs in this subcatchment.
2. Does the desk study assessment confirm that UWW is a SP?	
a) UWW nutrient loading	• WWTP discharging to groundwater
b) Assessment of pollution risk using receiving water assimilative capacity	• Load reduction of 1.66 kg/day of phosphate required (2018) at WFD monitoring station (Just u/s Nanny R. conflu).
c) Proximity of the discharge to the WFD monitoring point	• Approx. 7.8km u/s
d) Storm overflow pressure	• No storm water overflow
3. Does the desk study assessment indicate that the UWW is not/ is no longer a SP? ie no assimilative capacity issue, no nutrient loading issue, no proximity risk, no concern re SWO's	• Yes-discharging to groundwater • IW to confirmed that there is no surface water discharge.
Comment	• WWTP discharges to ground water.

In the 2018 SVA, the caretaker referred to the possibility that there was a surface water discharge. Irish Water confirmed the location of the percolation to ground and that there is no surface water discharge either from the UWWTP or the percolation area.

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1.12.2 Kentstown (D0479-01)

WWTP information	Kentstown (D0479-01)
Located in WB	Nanny_010
Plant capacity	800 pe (2019 AER)
Current collected load	1089 pe (2019 AER)
Treatment	Preliminary Treatment (screening) Secondary Treatment (Diffused Aeration & settlement) Nutrient Removal (Ferric dosing)
Discharges	primary discharge and storm water overflow
1. Was UWW identified as a significant pressure (SP) in the EPA initial characterisation?	Yes
WFD Action	IA7: Local catchment assessment needed, focussing upstream first before Duleek to determine if issue is diffuse rural and work downstream. Elevated nutrients in both upper and lower station. However, prioritize investigation in Subcatchment 8_4 before undertaking any IAs in this subcatchment.
2. Does the desk study assessment confirm that UWW is a SP?	
UWW nutrient loading	EPA monitoring station (East bridge Kentstown) d/s, ammonium & phosphate exceed EQS (good status). (2018)
Assessment of pollution risk using receiving water assimilative capacity	EPA monitoring station u/s East Bridge South of Brownstown, phosphate, ammonia not achieving EQS good status (2018& 2019). Headroom assessment: BOD (26%), Phosphate (59%) and ammonium (50%) (2018 AER). Headroom assessment: BOD (36%), phosphate (2156%) and ammonium (33%) (AER 2019)
Proximity of the discharge to the WFD monitoring point	Approximately 200m u/s of monitoring station East Bridge Kentstown
Storm overflow pressure	Not monitored
3. Does the desk study assessment indicate that the UWW is not/ is no longer a SP? i.e., no assimilative capacity issue, no nutrient loading issue, no proximity risk, no concern re SWO's	Load reduction required at monitoring station (East bridge Kentstown) to achieve EQS good status for phosphate (2.3kg/day) and ammonium (3 kg/dy). (2019)
Comment	WWTP is exceeding its capacity.

	Phosphate exceeding EQS u/s of WWTP Kentstown WWTP was upgraded in 2018.

1.12.3 Skreen (A0055-01)

WWTP information	Skreen A0055-01
Located in WB	Hurley_020
Plant capacity	80
Current collected load	80
Treatment	Primary treatment (conventional septic tank) Secondary treatment (percolation) 1 load/month being tankered out
Discharges	Discharge to Hurley_020
1. Was UWW identified as a significant pressure (SP) in the EPA initial characterisation?	Yes
WFD Action	IA7: local catchment assessment needed, focussing upstream first before Duleek to determine if issue is diffuse rural and work downstream. Elevated nutrients in both upper and lower station. However, prioritize investigation in Subcatchment 8_4 before undertaking any IAs in this subcatchment.
2. Does the desk study assessment confirm that UWW is a SP?	
UWW nutrient loading	Using the SVA 2019, the WWTP is exceeding BOD d/s (0.264 mg/L). Headroom used by BOD, Ammonium & phosphate is less than 1% of the rivers capacity.
Assessment of pollution risk using receiving water assimilative capacity	In 2015, phosphate exceeded EQS d/s at monitoring station (Rathfeigh Old bridge). No chemistry collected since 2015.
Proximity of the discharge to the WFD monitoring point	Approx. 6.1 km u/s
Storm overflow pressure	Per 2009 application form no SWO
3. Does the desk study assessment indicate that the UWW is not/ is no longer a SP? ie no assimilative capacity issue, no nutrient loading issue, no proximity risk, no concern re SWO's	Yes: no assimilative capacity issue, nutrient loading from WWTP. No proximity risk. No SWO

Comment	WWTP located at distance from monitoring point. No chemistry collected at d/s monitoring station (Rathfeigh Old bridge) since 2015. Monitoring station good status (2013-2018)

1.13 Other issues and pressure not identified as significant.

1.13.1 Duleek (D0133-05)

WWTP information	Duleek (D0133-01)
Located in WB	Nanny_040
Plant capacity	7000 PE
Current collected load	5005 PE – AER 2019
Treatment	Preliminary Treatment (screening and grit removal) Secondary Treatment (SBR) Nutrient Removal (Ferric dosing)
Discharges	primary discharge and storm water overflow
1. Was UWW identified as a significant pressure (SP) in the EPA initial characterisation?	
WFD Action	IA7: local catchment assessment needed, focussing upstream first before Duleek to determine if issue is diffuse rural and work downstream. Elevated nutrients in both upper and lower station. However, prioritize investigation in Subcatchment 8_4 before undertaking any IAs in this subcatchment.
2. Does the desk study assessment confirm that UWW is a SP?	Yes
UWW nutrient loading	WFD operational monitoring station (Br. NE of Bellewstown Ho) d/s of WWTP Load reduction required for BOD, ammonium & phosphate.
Assessment of pollution risk using receiving water assimilative capacity	2018 AER used as ammonia omitted from 2019 AER. Used notional clean as WFD mon. point u/s (Upstream bridge Duleek) impacted. 86% of headroom used for ammonia 44 % of headroom used for BOD 43% of headroom used for phosphate

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Proximity of the discharge to the WFD monitoring point	Approx. 2km u/s
Storm overflow pressure	SWO is not monitored
3. Does the desk study assessment indicate that the UWW is not/ is no longer a SP? i.e. no assimilative capacity issue, no nutrient loading issue, no proximity risk, no concern re SWO's	No- Nutrient loading: BOD, Phosphate & ammonium exceeding EQS. Headroom utilised >50% for ammonium and BOD SWO not monitored.
Comment	Monitoring station impacted d/s 2019 AER ammonium omitted. 2019 Ammonium increased d/s at monitoring station, potentially issues with WWTP

1.13.2 Poultry Licence (PO0887-01)

Planning permission for two broiler houses in Garballagh, Duleek was granted in 1990. The licenced facility is located outside of the Lower Nanny PAA, in the Nanny_030. As the broiler houses have a total capacity for 53,000 broilers an EPA license is required. The licensed facility is located approximately 290 metres from the Nanny_040. Information on licence compliance has been obtained from the EPA website (http://www.epa.ie/licensing/). The facility rear day-old chickens to market weight over a 6-8 week period and then two weeks empty. After emptying the broiler house, it is washed down, and the wash water is contained in two underground tanks. The washed water is applied to the land adjoining the facility. All the bedding from the houses is gathered and exported of the facility. The only emission to surface water is uncontaminated storm water from gutters on building roofs. According to the EPA a site visit (SV17290) was carried out on the 13/09/2019. The licensee was found to be non-compliant with weekly surface water visual inspections and records and is required to install a surface water inspection chamber. Also, the monitoring results for 2019 didn't included analysis for nitrate and total ammonia as required by the EPA licence.

1.13.3 Industry Licence ((P0030-06)

The Irish Cement factory in Platin, Duleek was established in 1972. It is licenced to discharge treated effluent from the site into the Nanny_040. According to the AER (2019), the water being discharged by the plant comprises of storm water (18%), treated wastewater from their WWTP (0.14%), and ground water from the quarry dewatering activity (81%). LCA will carried out to establish if the licence facility is a significant pressure to the Lower Nanny PAA.

1.14 Conclusion on Significant Pressures

Agriculture is the predominant land use in the Lower Nanny PAA and is therefore a significant pressure on the waterbodies. The Pollution Impact Potential (PIP) for phosphate (Figure 25), surface water nitrate (Figure 26) maps shows the areas most vulnerable to the nutrient losses. Phosphate and ammonium losses occur on the poorly drained soils located at the start of Nanny_040 and most of the Nanny_050. Surface water nitrate losses are most likely to occur in the southern area of the Nanny_040 where the soil is free draining. Nitrates losses to surface and ground water potentially are occurring in the Nanny_050 near the mouth of the river. However, this area is downstream of the monitoring station at Julianstown and therefore is not being captured in the EPA water chemistry.

Based on available information from Irish Water and EPA, Ardcath WWTP is not a significant pressure to surface water as it discharges to ground water. The Kentstown WWTP is a significant pressure, as it is exceeding its capacity and is located with 200 metres of the WFD monitoring station, which is exceeding the EQS for phosphate and ammonium. This will be discussed further with the EPA and Irish Water as it is located outside of the PAA. The Skreen COA was not determined to be a significant pressure. The WFD monitoring station downstream is good status (2013-2018). The Headroom used by BOD, Ammonium & phosphate from the COA is less than 1% of the river's capacity. The Duleek WWTP is a significant pressure on the Nanny_040. In 2018, it's utilising 86% of the headroom for ammonia and 44% for BOD. It is located approximately 2 km from the downstream EPA monitoring station. It is evident that it is having a negative environmental impact, but it is unclear if it is having a significant impact on the water quality status.

Channelisation is identified as a significant pressure in both waterbodies in the Lower Nanny PAA. The historic maps show that the river's natural course has been altered nearly 200 years ago. The over straightening and deepening of a river can a negative effect on the macro invertebrates, flow, and habitats. It can also accelerate sediments losses which can also impact on water quality. During the LCA an assessment will be made to establish if hydromorphology (channelisation) is a significant pressure in this PAA.

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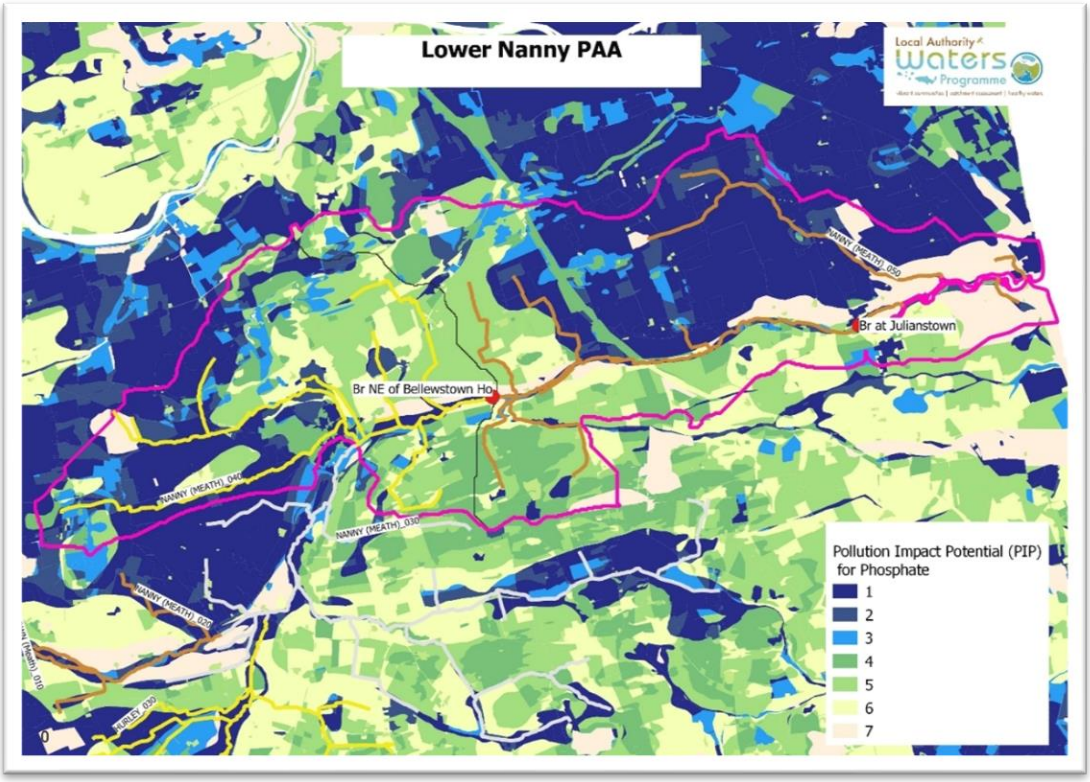

Figure 25 : Pollution Impact Potential for phosphate in the Lower Nanny PAA.

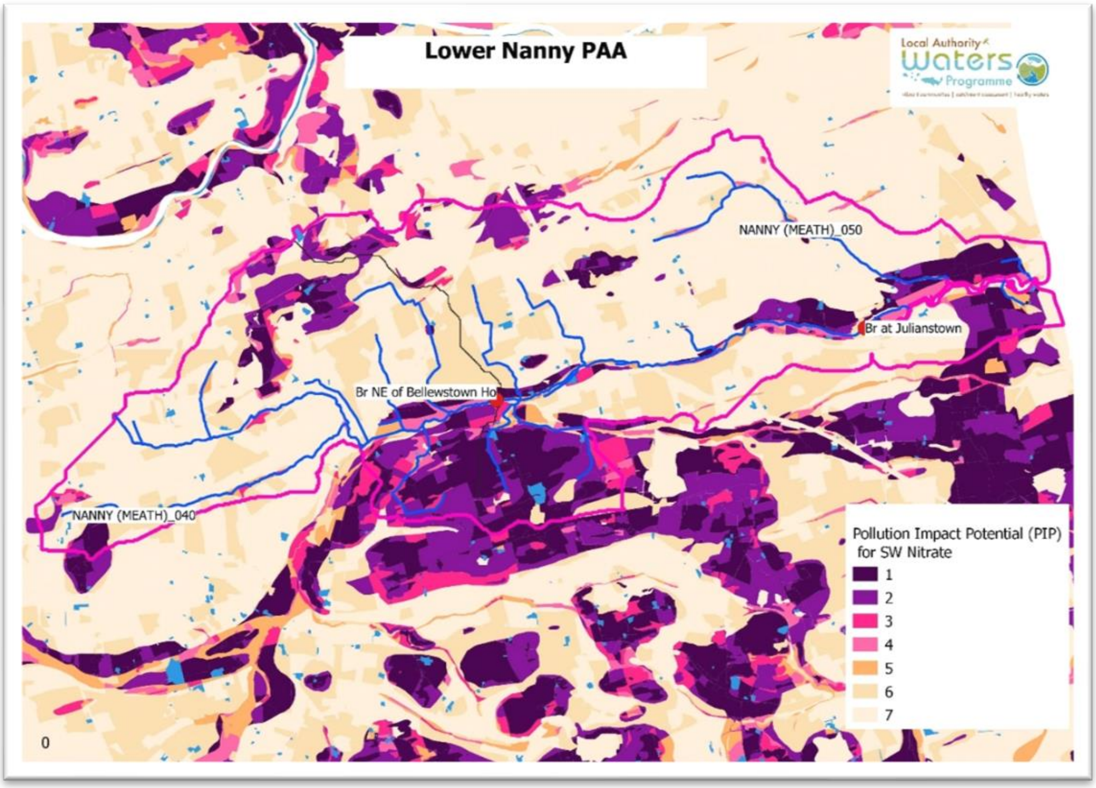

Figure 26 : Pollution Impact Potential for surface water nitrate in the Lower Nanny PAA.

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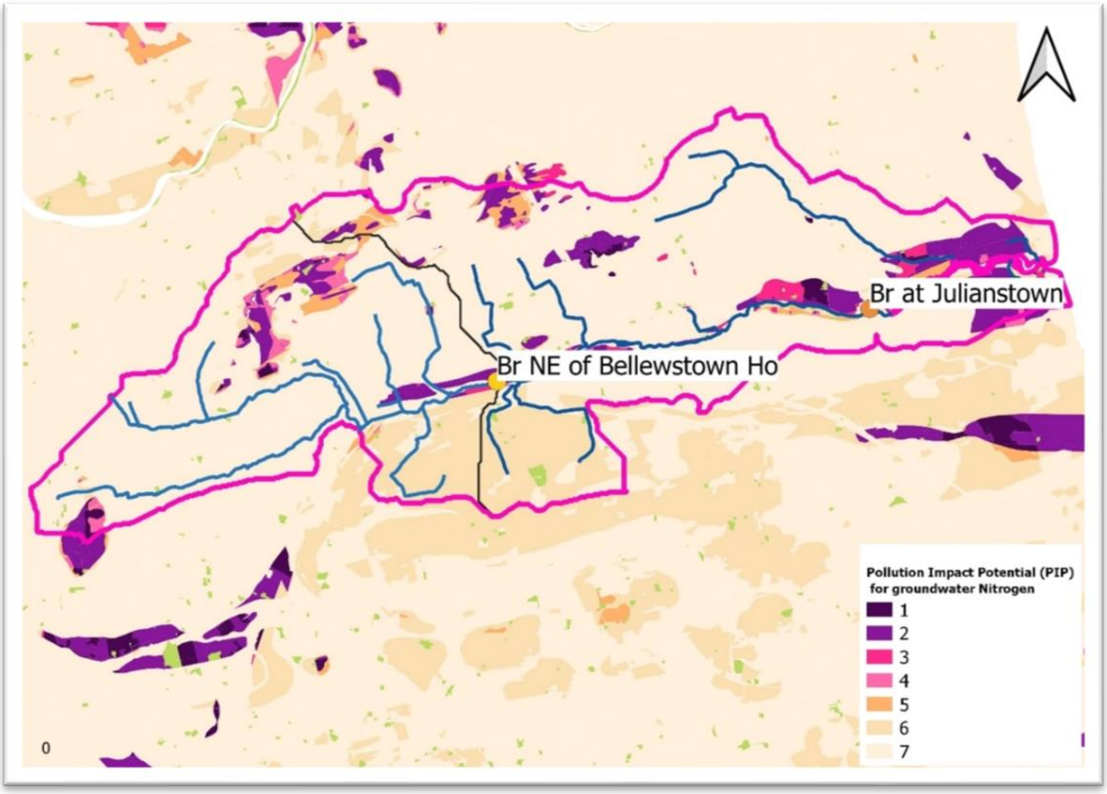


Figure 27 : Pollution Impact Potential for ground water nitrate in the Lower Nanny PAA.

Pathway information & analysis

Several data layers including aquifer properties, soils and subsoils, bedrock and land use were used to inform the building of the conceptual model to identify the significant pathways of pollutants. The conceptual model for the Lower Nanny PAA is shown in Figure 28. Table 7**Error! Reference source not found.** summarises the factors affecting the nutrient pathways and outlines the possible Source-Pathway-Receptor pathway. The monitoring station (Br NE of Bellewstown House) for the Nanny_040 has elevated phosphate and ammonium (compartment C1b & C2b) and nitrate (C2a). The water chemistry at the Nanny_050 monitoring station at Julianstown is elevated for phosphate (C1a &C1b) and nitrate (C1a & c2a).

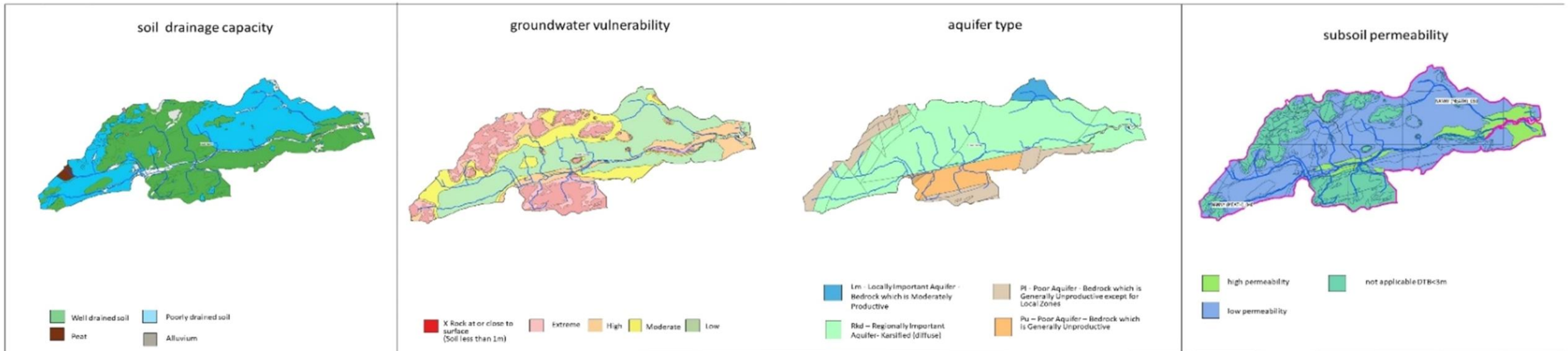
Table 7 : compartments of the conceptual model

		Compartment 1a	Compartment 1b	Compartment 2a	Compartment 2b
Pathway Information	**Source**	Diffuse	Diffuse/Point	Diffuse/Point	Diffuse
	Aquifer	Regionally Important Aquifer (Rkd)	Regionally /Locally Important Aquifer (Rkd &Lm)	Locally Important Aquifer (Ll), Poor Aquifer (Pl & Pu)	Pl
	Topography	Flat	Flat	Sloped	Flat
	Soil	Well drained	Poorly drained	Well drained	Poorly drained
	Subsoil	Limestone till, Shale and sandstone till (Namurian), Karstified limestone bedrock at surface	Limestone till, Sandstone and shale till (Lower Palaeozoic) with matrix of Irish Sea Basin origin	Limestone till, Sandstone and shale till	Shale and sandstone till (Namurian),
	Subsoil permeability	Low permeability Pockets of high perm	Low permeability	N/A DTB <3m Pockets of low perm	N/A DTB <3m
	Rock Unit	Dinantian Pure Bedded Limestones	Dinantian Pure Bedded Limestones, Dinantian Upper Impure Limestones,	Ordovician metasediment, Ordovician Volcanics, Devonian Old Red Sandstone, Granite & other Igneous Intrusive rocks	Namurian Undifferentiated
	Groundwater Vulnerability	Low, moderate, high, extreme	low	Rock at or near Karst surface, extreme	Extreme, Rock at or near Karst surface.

	PO_4 Susceptibility	moderate	High	moderate	high
	NO_3 Susceptibility	Low to high	Very low	low	Very low
	PO_4 PIP	Moderate (Rank 5/6)	High (rank 1-2)	Moderate (rank 4-5)	Moderate-High (1-4)
	NO3 PIP	Low (rank 6-7) small area of high (rank 1-3)	Low (rank 6-7)	High (rank 1-3)	Low (rank 6-7)
	Flow paths	In C1a**,** most of the rivers flow through well drained soils Likely pathway: Underground (groundwater) Potentially perched water table in areas with low permeable subsoil Potential river issue: Nitrate & Phosphate	In C1b, the rivers flow mainly through poorly drained soils Likely pathway: Overland flow Potential river issue: orthophosphate, ammonium, sediment	In C2a, the rivers flow mainly through well drained soils Thin subsoil, less than 3metres to bedrock Likely pathway: underground Potential river issue: Nitrate	In C2b the river flows mainly poorly drained soils Thin subsoil, less than 3 metres to bedrock Like pathway: overland Potential river issue: phosphate, ammonium, sediment.
	Location of Monitoring Point	Bridge at Julianstown	Br NE of Bellewstown Ho /Bridge at Julianstown	Br NE of Bellewstown Ho /Bridge at Julianstown	Br NE of Bellewstown Ho
	Significant Pressures	Agriculture/ hydromorphology	Agriculture/ Hydromorphology/UWWTP	Agriculture/ Hydromorphology/UWWTP	Agriculture/ hydromorphology

In the compartments where the soil is free draining, nitrate can leach from the soils and enter into the groundwater below. The groundwater then feeds the surface waterbodies, and the nitrate enters the river. In poorly drained areas, phosphate and ammonium flow over ground and enter the surface waterbodies.

Lower Nanny: understanding the water pathways



The drainage characteristics of a soil determine which factors affect water quality. In areas with well drained soils, phosphorous is typically not an issue in nearby rivers, as it tends to stick or "sorb" to the soil. In contrast, nitrogen is usually not an issue on poorly drained soils, as bacteria in water-logged soils naturally break it down.

The vulnerability of groundwater to contamination depends upon soil/subsoil thickness and type. Where soils are absent or thin, groundwater is most vulnerable. Groundwater is least vulnerable where a thick layer of clayey soils are present.

An aquifer is an underground layer of permeable rock which can store and transmit water. The rock type underlying the soil and subsoil can determine the proportion of streamflow that comes from groundwater. It also determine the "pathways" through which water moves underground.

Subsoil permeability is a measure of the subsoil to let water flow through it. There is great variability in the subsoils capacity in Ireland to transmit water.

Water Pathway Zones

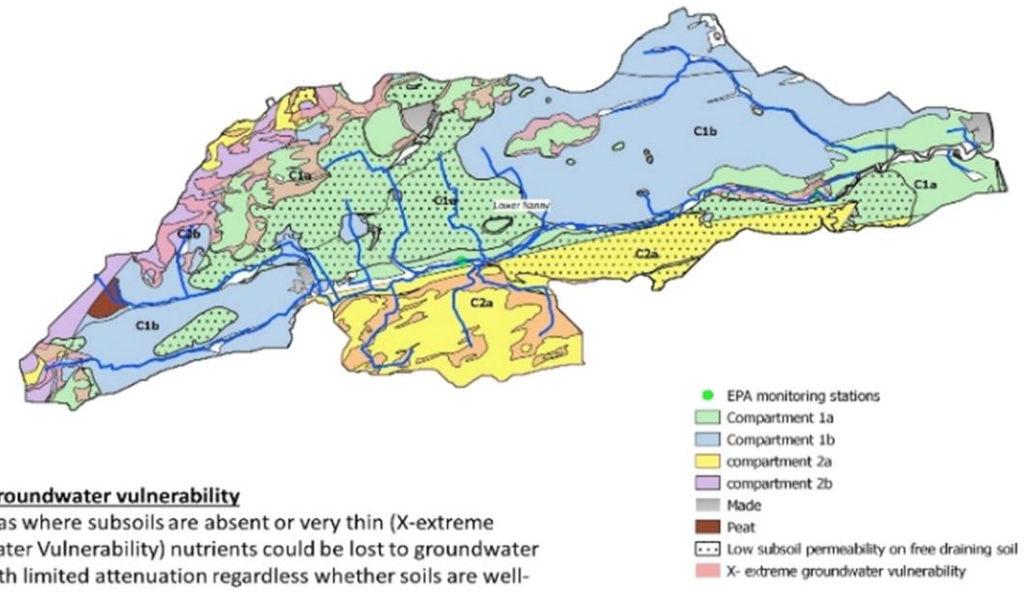
Within the drainage area of the river, information on soil and bedrock type was used to split the area into different water pathway zones. Within these zones, the likely pathways that water will take en-route to the river are as follows:

Compartment 1a
- In C1a, the majority of the rivers flow through well drained soils
- Likely pathway : Underground (groundwater)
- Potentially perched water table in areas with low permeable subsoil
- Potential river issue: Nitrate & Phosphate

Compartment 1b
- In C1b, the rivers flow mainly through poorly drained soils
- Likely pathway: Overland flow
- Potential river issue: Orthophosphate, sediment

Compartment 2a
- In C2a, the rivers flow mainly through well drained soils
- Thin subsoil, less than 3metres to bedrock
- Likely pathway: underground
- Potential river issue: Nitrate

Compartment 2b
- In C2b the river flows mainly poorly drained soils
- Thin subsoil, less than 3 metres to bedrock
- Like pathway: overland
- Potential river issue: phosphate, ammonia, sediment.



X-Extreme groundwater vulnerability
- In the areas where subsoils are absent or very thin (X-extreme Groundwater Vulnerability) nutrients could be lost to groundwater rapidly with limited attenuation regardless whether soils are well-drained or poorly drained.
- Likely pathway: potential of groundwater flow and shallow subsoil flows
- Potential river issue: Nitrate and Orthophosphate

Figure 28 : Conceptual model for Lower Nanny PAA.

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Interim story of the Priority Area for Action based on the Desk study

Nanny_040

The Nanny_040 is one of the two waterbodies in the Lower Nanny PAA. It has been classified as *At Risk* of achieving its WFD environmental objective of Good status by 2027. Currently, its Ecological Status is Moderate (2013-2018). This is being driven by failing Dissolved Oxygen and moderate nutrient conditions. The significant issues in this waterbody are ammonium and nitrate. The EPA further characterisation assessment identified agriculture, hydromorphology and UWWTP as the significant pressures in this waterbody. The UWWTP is a point source for nutrients but diffuse pathways are also an important source for nutrients in this waterbody. Critical Source Areas (CSAs) in poorly drained soils are vulnerable to overland flow of ammonium. The potential pathways are identified in conceptual model as Compartment 1b and Compartment 2b. Nitrate is easily leached through permeable soils and subsoils. High nitrate concentrations in the water are associated with free draining soils. The potential pathway for nitrate pathways is identified in Compartment2a. Agriculture is the dominant land use and both diffuse and point source pollution from agriculture will be the focus of the LCA, as per the nitrate and phosphate PIP maps the areas of highest risk will be focused upon, chemistry sampling and stream walks will be carried out where required. The UWWTPs and licenced facilities that feed into this waterbody will be assessed to see if they are a significant pressure. During the LCA, a hydromorphological assessment will be completed to ascertain in channelisation is also a significant pressure on the water quality.

Nanny_050

The Nanny_050 has been classified as *At Risk* of achieving its WFD environmental objective of Good status by 2027. Currently, its Ecological Status is Poor (2013-2018). This is being driven by failing nutrient conditions and moderate fish status. The significant issues in this waterbody are ammonium, and nitrate. The EPA further characterisation assessment identified agriculture and hydromorphology as the significant pressures in this waterbody. The CSAs vulnerable to overland flow of ammonium are identified in Compartment 1a and Compartment 1b. Similarly, to the Nanny_040, agriculture is the dominant land use and both diffuse and point sources will be the focus of the LCA, and the nitrate and phosphate PIP maps will be used to inform the locations of the LCA. During the LCA, a hydromorphological assessment will be completed to ascertain in channelisation is also a significant pressure on the water quality.

A reduction in the nutrient contributions from the Nanny_040 and Nanny _50 will have a positive effect on the water quality in the PAA. However, as the Lower Nanny PAA is located at the base of the

Nanny River a reduction in the nutrient load from the inputting water will be needed to achieve Good Status.

Workplan

Flow data has been used to calculate the nutrient load that is entering the PAA and what the waterbodies within the PAA are contributing to the load. This has identified what nutrients are a significant issue in the Lower Nanny PAA only. The field work plan using the loadings, conceptual model and PIP maps will be used to target the areas that are vulnerable to that nutrient loss.

During the LCA, a hydromorphological assessment will be completed to ascertain in channelisation is also a significant pressure on the water quality.

Based on the desk study, the Duleek WWTP will be referred to Irish Water as a significant pressure. Kentstown, Skreen and Ardcath WWTP are located outside of the Lower Nanny PAA.

Table 8 : Planned LCA field work

Waterbody name	Further Characterisation Action	Responsible agency	Recommended Action
Nanny_040	IA7 Multiple sources in multiple areas	LAWPRO	Stream walks and assessments in targeted areas to identify sources of nutrients-agriculture. Assess the COAs & UWWTP to see if they're a significant pressure.
	IA1 Provision of Information	EPA	Consider within hydromorphological risk assessment
Nanny_050	IA7 Multiple sources in multiple areas	LAWPRO	Stream walks and assessments in targeted areas to identify sources of nutrients-agriculture.
	IA1 Provision of Information	EPA	Consider within hydromorphological risk assessment

Review of mitigation options

Potential actions which will be confirmed following a field assessment of the PAA and agricultural mitigation will be confirmed following discussion with ASSAP advisors. Example of mitigation measures for nitrate are in Table 9.

Table 9 : Nitrate mitigation measures for agriculture

Pathway Interception	Source Control	Mobilisation Control
Woodland planting	Informing and educating farmers	Avoid application at high risk times
Establish/preserve wetlands	Implementation of Nutrient Management Plan	Avoid application at high risk places (CSA's)
	Nitrification inhibitors (Protected Urea)	Adopt latest manure application techniques
	Use of clover	Precision application of nutrients at correct rate
	Batch storage or composting of solid manure	Winter – plant cover or catch crops
	Improved management of collection and storage of farm wastes	Adopt spring cultivation
	Additional storage for farm wastes required	Appropriate use of feeders/troughs/out-wintering
	Separation of clean, grey, soiled and dirty water in farmyard	Appropriate use of feeders/troughs/out-wintering
		Appropriate re-seeding management

Communications

1.15 Community information meeting

Community information meeting held on the 26/08/2020 as a virtual meeting. Number of attendees excluding LAWPRO and ASSAP representatives: 4

Any significant problem arising: No, comments and questions mainly focused on coastal/tidal queries.

1.16 Supplementary communications:

Farmers meeting held on 17/12/2020

Date of completion of Desk Study: 29/01/2021

Appendix

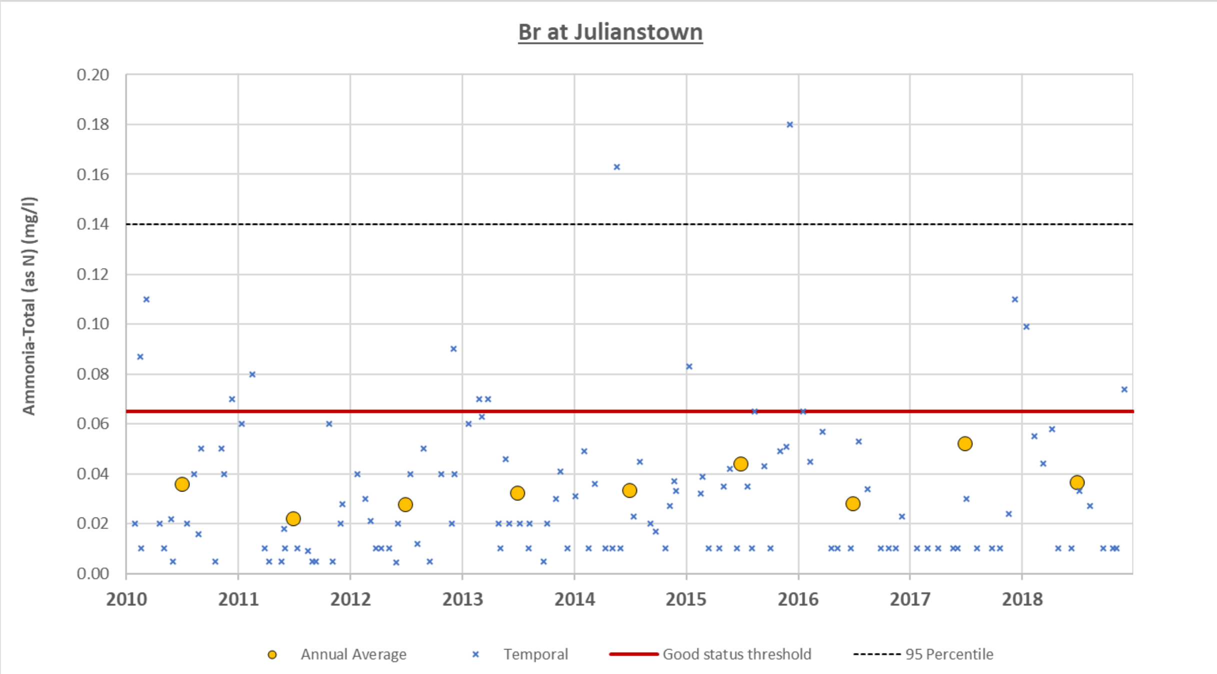

Figure 29 : Ammonium in the Nanny_050.

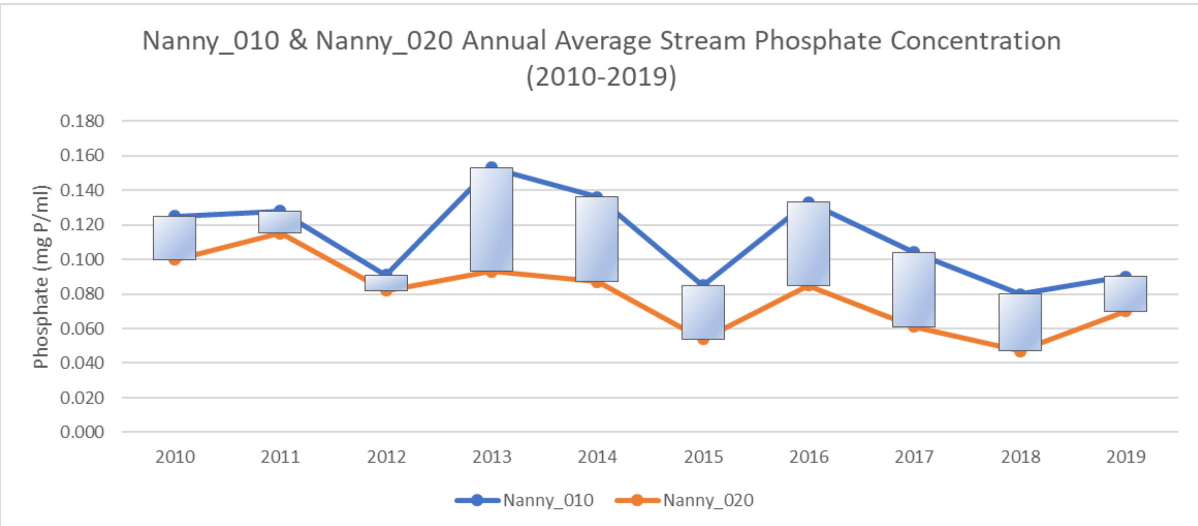

Figure 30 : Annual average phosphate concentrations in the Nanny_010 and Nanny_020 (2010-2019)

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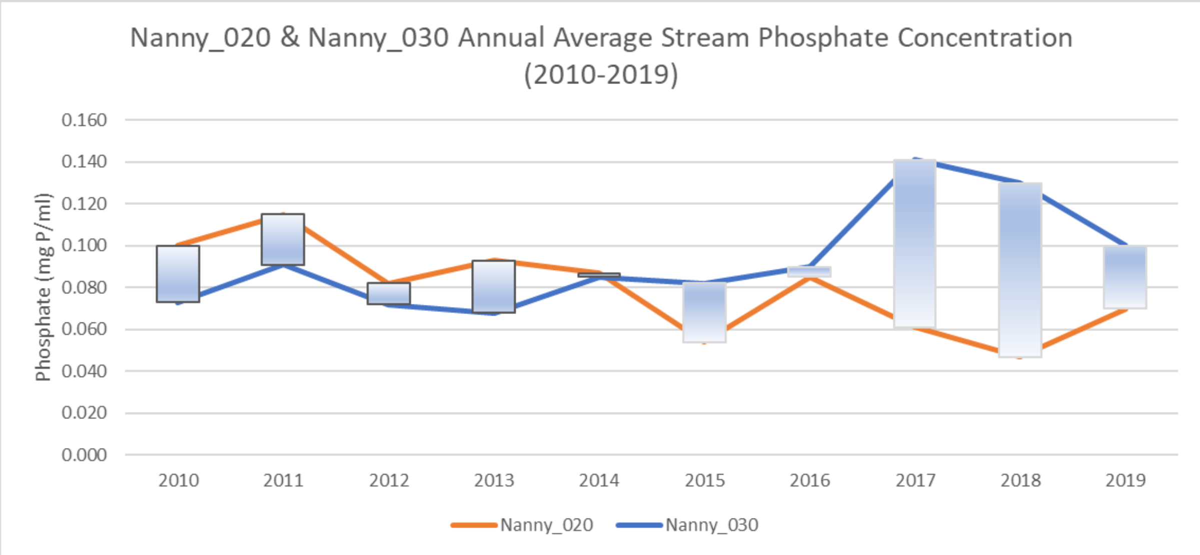

Figure 31 : Annual average phosphate concentrations in the Nanny_020 and Nanny_030 (2010-2019)

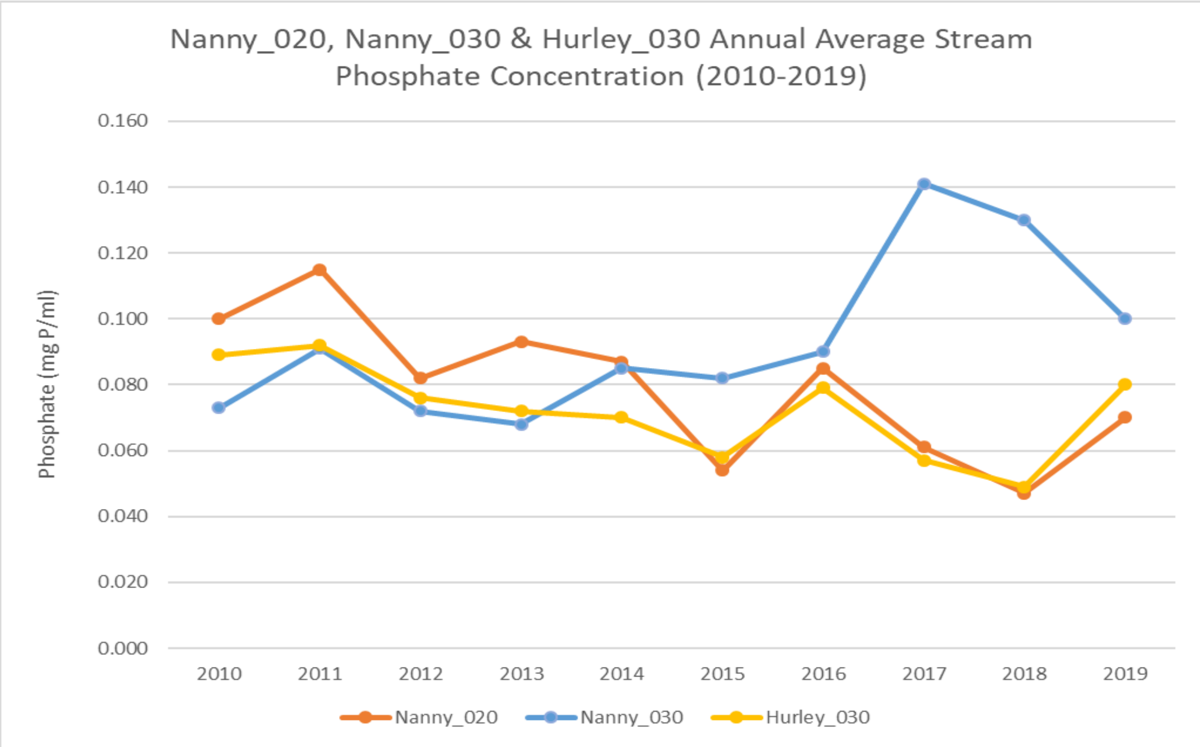

Figure 32 : Annual average phosphate concentrations in the Nanny_020, Nanny_030 and Hurley_030 (2010-2019)

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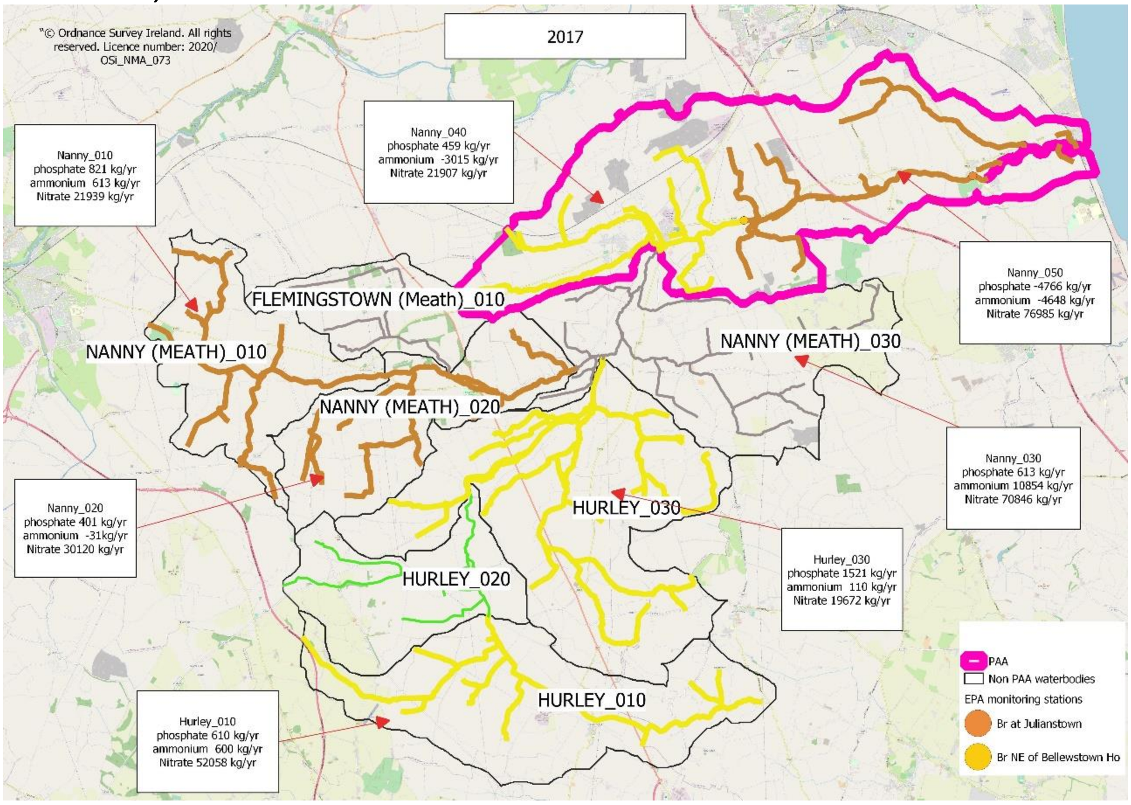

Figure 33 : Nutrient loads in the Nanny catchment in 2017.

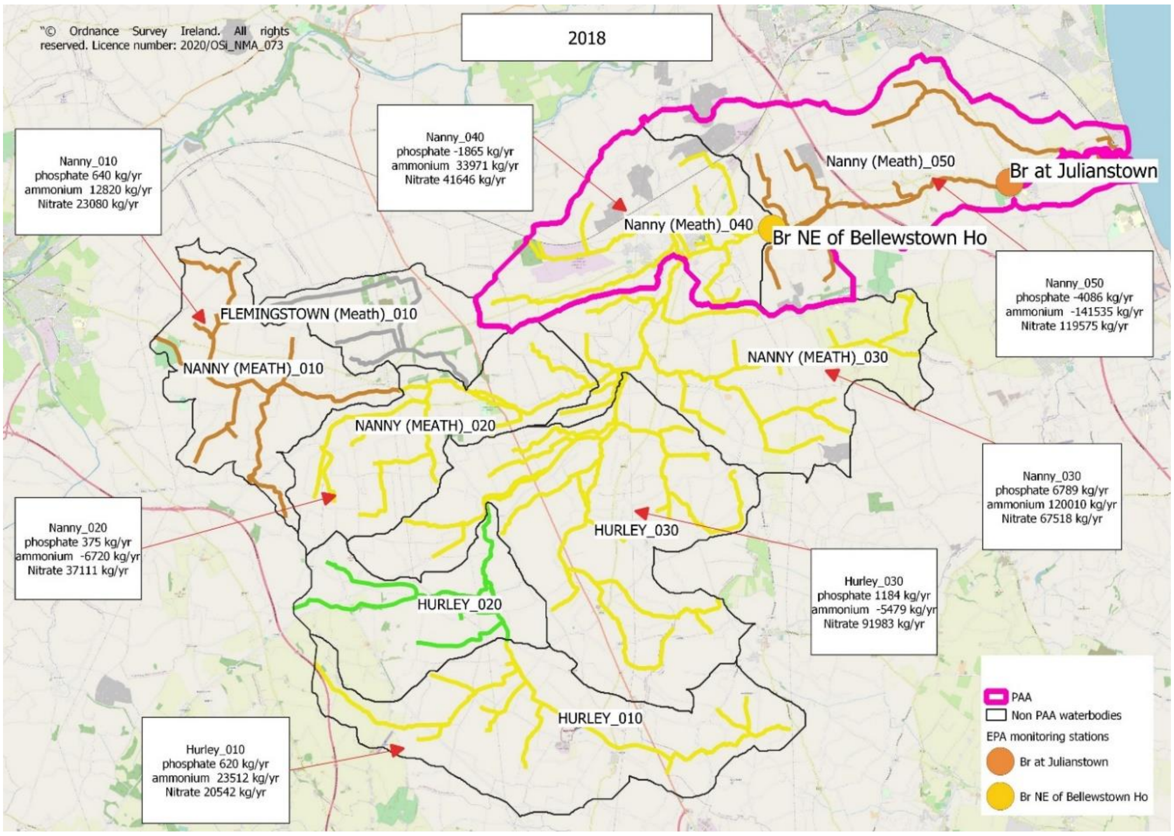

Figure 34 : Nutrient loads in the Nanny catchment in 2018.