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Graney Demonstration Catchment

Desk Study

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An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
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Information Sources Consulted

Several information sources were consulted during the preparation of this desk study including:

- WFD web application – Environmental Protection Agency (EPA) characterisation data and water quality data,
- Local Authority Waters Programme (LAWPRO) Graney desk study and Local Catchment Assessment (LCA) information,
- Forest Service data.
- National Parks and Wildlife information

Summary

The Graney Demonstration Catchment, based on EPA sub-catchment 25C_8 Graney[Shannon]_SC_020, is comprised of eight river waterbodies, Bleach_010, Graney (Shannon)_010, Graney (Shannon)_020, Drumandorra_010, Corra_010, Bleach_020, Corra_020 and Graney (Shannon)_030. The latter three are Blue Dot waterbodies, meaning that their Water Framework Directive (WFD) objective is to achieve High ecological status. Aside from Bleach_010, the headwaters of which are in south Galway, the demonstration catchment is situated in north east Clare. There are two lakes in the catchment, Lough Atorick in Bleach_010 and Lough Graney in Graney (Shannon)_020.

Most of the demonstration catchment lies in the Slieve Aughty Mountains SPA (Site Code 004168), of special conservation interest for Hen Harrier and Merlin. There are three SACs in the catchment, Loughatorick South Bog (000308) which includes part of the Corra_010 sub-basin, Glendree Bog (001912) which includes part of Graney (Shannon)_010 and Pollagoona Bog (002126), located wholly within the Bleach_010 sub-basin. These are all important examples of intact, active blanket bog. In a deforested section of Pollagoona Bog, restoration through water table re-establishment is endeavouring to create active bog habitats. The vicinity of Lough Atorick in the Bleach_010 sub-basin has a network of protected areas; Lough Atorick District Bogs Natural Heritage Area (NHA) is a cluster of seven, primarily upland, blanket bogs situated in the area around the lake (Appendix I).

Organo-mineral soils, mainly peaty gleys, overly low permeability tills and well drained, though shallow Brown Earths are found elsewhere.

Land use is driven by soil type. Private and public forestry on blanket peat and organo-mineral soils makes up about sixty percent of the land use (Appendix XII). Open moorland, mainly blanket peatland type and enclosed land especially around Lough Graney support agriculture.

The Drumandoora River from the west and the Bleach River (Bleach_010 and Bleach_020) from the east flow into Lough Graney on its northern shore. First and second order streams drain the sub-basin, Graney (Shannon)_020, which surrounds the lake. The outflow from Lough Graney marks the start of the Graney River which is joined from the west by the Caher River (Graney (Shannon)_010) just downstream of the lake. Further downstream, the Corra River (Corra_010 and Corra_020) discharges to the Graney (Shannon)_030.

WFD status tables and maps in this desk study report are based on 2013-2018 ecological status for the eight river waterbodies in the demonstration catchment, with five waterbodies meeting their Good status objective in the 2013-2018 reporting period, one Blue Dot waterbody (Corra_020) meeting its High status objective and two Blue Dot waterbodies (Bleach_020 and Graney (Shannon)_030) failing to meet their High status objective (biological monitoring results for these two waterbodies have not been High since 2012 and 2014 respectively). However, from results of the most recent biological monitoring survey conducted in the catchment in 2021, four of the eight river waterbodies are now not meeting their biological status objectives. Blue Dot waterbodies Bleach_020 and Graney (Shannon)_030 remained at Good biological status in the 2021 survey. Biological status for blue dot waterbody Corra_020 dropped to Good at the WFD monitoring point in 2021. Results for Graney (Shannon)_030 have also shown a deterioration with a drop from Good to Moderate biological status at the WFD monitoring point in 2021.

Monitoring undertaken by Clare County Council in the past has been enhanced by LAWPRO in WFD Cycle 2. Under the River Basin Management Plan 2018-2021, the Bleach River system (Bleach_010 and

Bleach_020) and Lough Graney were selected as a Prioritised Area for Action (PAA). Local catchment assessment work undertaken by LAWPRO is identifying issues and pressures in the PAA. The future work plan in these waterbodies will be to build on the work already done and to expand the areas of interest to encompass the entire subcatchment.

1 Introduction

1.1 Background to Catchment

The Waters of LIFE is an EU LIFE Integrated Project (IP) which aims to help reverse the deterioration of Ireland's most pristine waters. The Project will operate in five demonstration catchments nationally to test measures for the protection and restoration of High Status in Blue Dot rivers. The five demonstration catchments were selected from WFD subcatchments defined by the EPA. The selection process considered a number of criteria, including number and extent of significant pressures, status history and Q value amongst others. The project also includes one control catchment (the Sheen), which was selected on the basis that it consistently demonstrated High status in the past and is currently *Not at Risk* of failing to meet its WFD objectives. See Demonstration Catchment Selection Report for further information on the catchment selection process.

The Graney was selected as one of the five demonstration catchments primarily due to the presence of high forest cover on High status objective rivers (see Appendix XII). The demonstration catchment consists of the eight river waterbodies in WFD sub-catchment 25C_8_Graney[Shannon]_SC_020: Bleach_010, Graney (Shannon)_010, Graney (Shannon)_020, Drumandorra_010, Corra_010, Bleach_020, Corra_020 and Graney (Shannon)_030. There are two lakes situated in the catchment, Lough Atorick in Bleach_010, and Lough Graney in Graney (Shannon)_020. The demonstration catchment is located mainly in north east county Clare, apart from Bleach_010, the headwaters of which are in south Galway.

Bleach_020, Corra_020 and Graney (Shannon)_030 all have a High ecological status objective. All other rivers in the demonstration catchment are Good status objective.

The Bleach_010 and Bleach_020 river waterbodies and Lough Graney comprised the LAWPRO Cycle 2 Bleach & Lough Graney Prioritised Area for Action.

1.2 Summary Information

Figure 1 and **Figure** 2 show location of the Graney Demonstration Catchment, waterbodies within, the latest ecological status (2013-2018) and cycle 3 WFD risk. A schematic layout of the catchment is provided in **Figure 3**. Summary information on ecological status, risk, known pressures and associated significance for the waterbodies in the catchment is presented in **Table 1**. This is further summarised in the 'Receptor information and assessment' section.

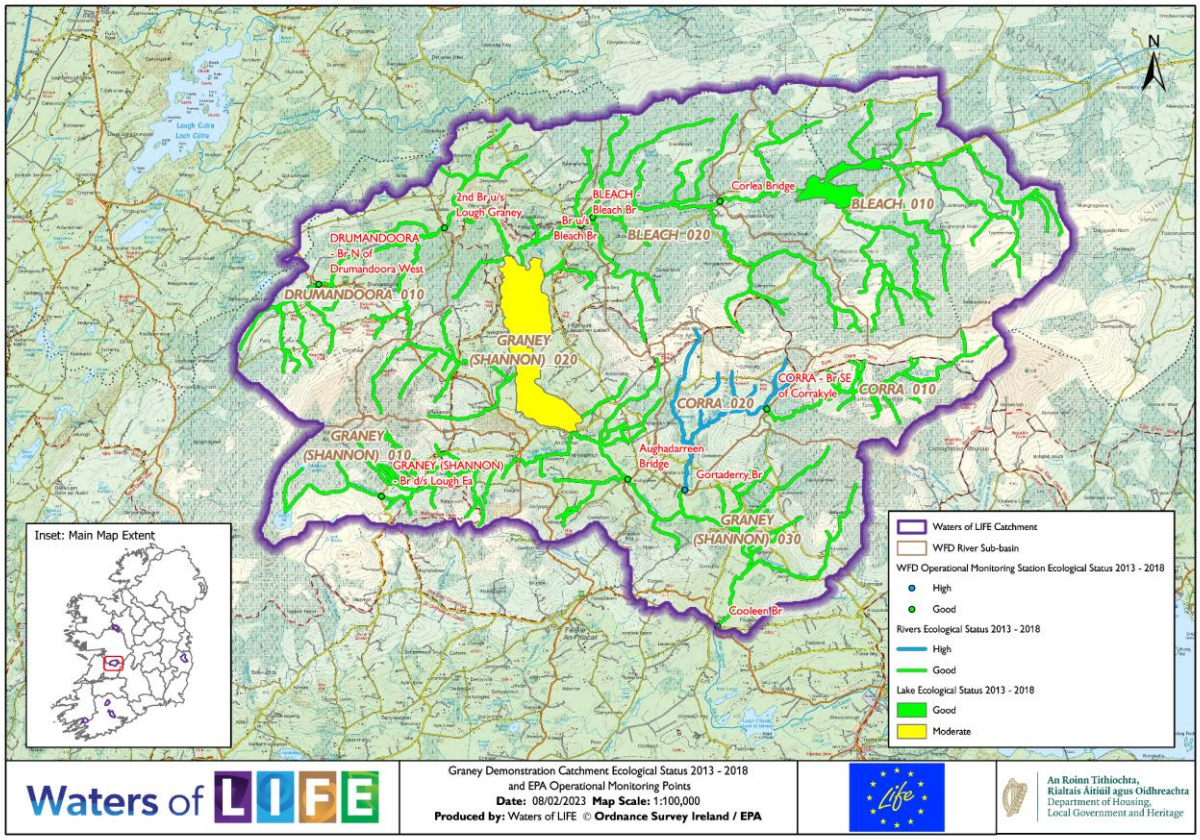


Figure 1 WFD status map, Graney Demonstration Catchment

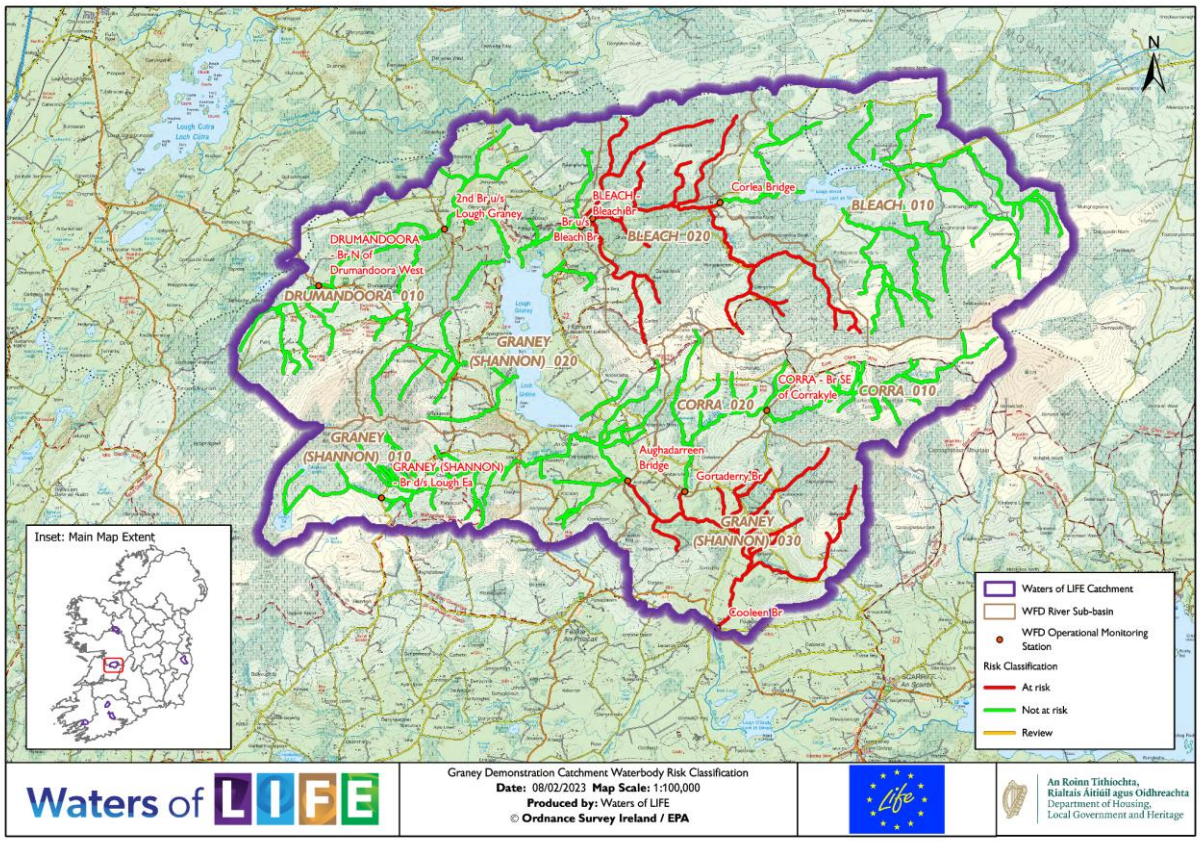
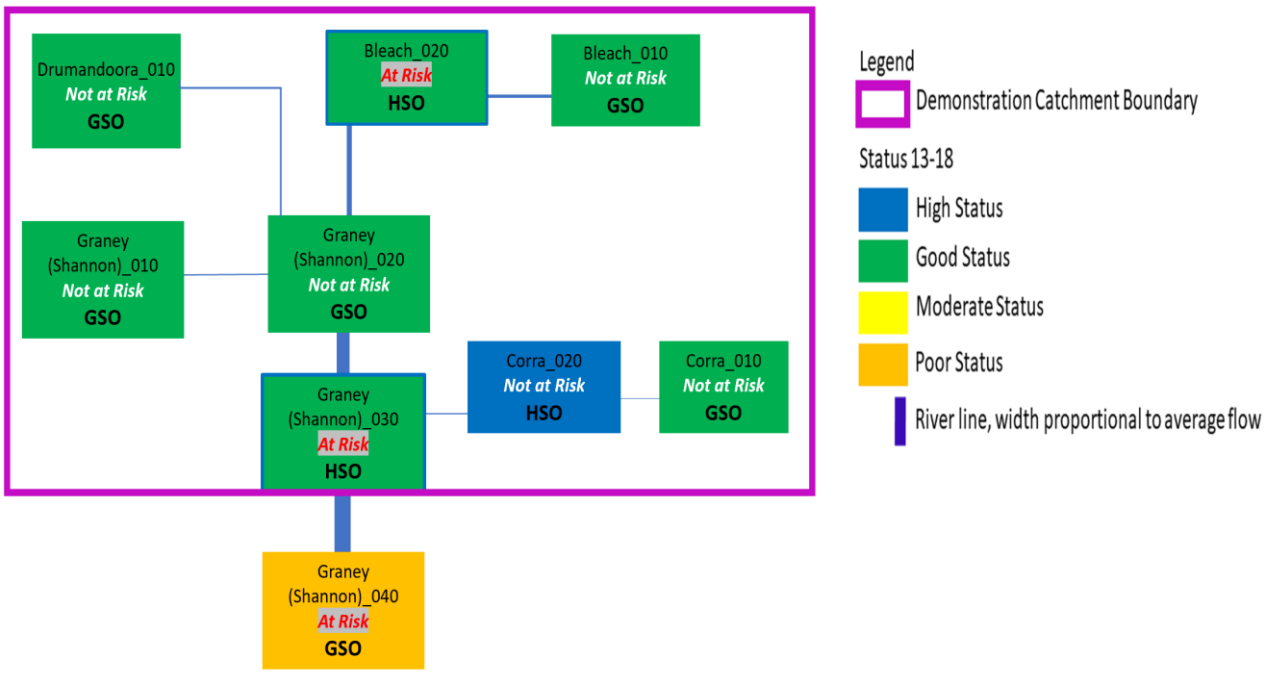


Figure 2 WFD risk map, cycle 3, Graney Demonstration Catchment



HSO: High status objective
GSO: Good status objective
Note : 2013-2018 Ecological Status is shown here. Biological status dropped to Good at the Corra_020 WFD monitoring point and Moderate at the Graney (Shannon)_020 monitoring point in the EPA 2021 survey.

Figure 3 Schematic layout of the waterbodies in the Graney Demonstration Catchment

Note that shading indicates the 2013-2018 ecological status for each waterbody. Italicised text indicates Cycle 3 Risk

Table 1: Summary of waterbody ecological status, WFD risk and pressure information for the Graney Demonstration Catchment

WB name	WB Code	WB Type	3rd Cycle WFD Risk	High Status Obj?	Ecological Status				Pressure Category	Pressure Sub-category	Significant Pressure Cycle 3?	Created in Cycle 2?
					2007-09	2010-12	2010-15	2013-18				
BLEACH_010	IE_SH_25B070100	River	*NAR*	No	U	G	P	G	Forestry	Forestry	No	Yes
BLEACH_020	IE_SH_25B070200	River	*AR*	Yes	H	H	M	G	Forestry	Forestry	Yes	Yes
CORRA_010	IE_SH_25C090100	River	*NAR*	No	U	P	G	G	No Pressure Impacts data available			
CORRA_020	IE_SH_25C090400	River	*NAR*	Yes	H	H	H	H	No Pressure Impacts data available			
DRUMANDOORA_010	IE_SH_25D060500	River	*NAR*	No	H	G	G	G	No Pressure Impacts data available			
GRANEY (SHANNON)_010	IE_SH_25G040025	River	*NAR*	No	G	G	G	G	No Pressure Impacts data available			
GRANEY (SHANNON)_020	IE_SH_25G040100	River	*NAR*	No	H	G	G	G	No Pressure Impacts data available			
GRANEY (SHANNON)_030	IE_SH_25G040200	River	*AR*	Yes	H	H	H	G	Forestry	Clearfelling	Yes	No

NAR = Not at risk, *AR = At risk*, *R = Review*. H = High, G = Good, M = Moderate, P = Poor, U = Unassigned

2 Receptor information & assessment

2.1 Context and Setting

Situated mainly in north east County Clare, the Graney Demonstration Catchment comprises four rivers (eight river waterbodies) in subcatchment 25C_8 Graney [Shannon]_SC_020), the Bleach, Corra, Drumandoora and Graney (Shannon). The river Bleach (Bleach_010 and Bleach_020) rises in the north-east of the subcatchment in County Galway and flows west into Graney (Shannon)_020. Lough Atorick sits in the Bleach_010 sub-basin. Two rivers flow from the west of the subcatchment; Drumandoora_010 rises in the north-west, flowing east to join the Graney (Shannon)_020 and eventually discharging to Lough Graney. Graney (Shannon)_010 rises in the south-west and flows east into Graney (Shannon)_020 joining the Graney River south of Lough Graney. Lough Graney is located on Graney (Shannon)_020 which flows from north to south across the centre of the subcatchment into Graney (Shannon)_030. The River Corra (Corra_010 and Corra_020) rises in the south-east of the sub-catchment and flows into Graney (Shannon)_030. Graney (Shannon)_030 flows south into Graney (Shannon)_040, part of subcatchment 25C_3 Graney [Shannon] SC_010 and outside the demonstration catchment boundary (**Figure 3**).

North-east Clare is remote with extensive high nature value areas. The Slieve Aughty Mountains Special Protection Area (SPA) extends across much of East Clare and South County Galway and encompasses most of the Graney Demonstration Catchment (Appendix I). The specific objective within this SPA is to maintain or restore the favourable conservation condition of two bird species, namely Hen Harrier and Merlin.

The vicinity of Lough Atorick in the Bleach_010 sub-basin has a network of protected areas. Lough Atorick District Bogs Natural Heritage Area (NHA) is a cluster of seven, primarily upland, blanket bogs situated in the area around Lough Atorick (Appendix I). The bogs are bounded by forestry plantations and agricultural lands. These bogs have developed in deep basins, within a blanket bog landscape. The bog sites consist of a series of raised domes of peat surrounded by fringes of regenerating cutover peat and regenerating peat banks. The site also contains reedbeds as well as quaking areas, hummock/hollow complexes and heath habitat. Blanket bog habitat is a globally scarce resource and it is for these habitats that Lough Atorick District Bogs NHA is a site of considerable conservation importance (NPWS, Site Synopsis). Likewise, Maghera Mountain Bog NHA in the west of the catchment has areas regenerating to active bog following generations of peat extraction.

Pollagoona Bog Special Areas of Conservation (SAC), Loughatorick South Bog SAC and Glendree SAC are important examples of intact, active blanket bog. In a deforested section of Pollagoona Bog, restoration through water table re-establishment is endeavouring to create active bog habitats.

Freshwater pearl mussel was previously recorded within the catchment but their current status is unknown.

Lough Graney and the Graney (Shannon)_020 sub-basin are important drinking water protected areas.

2.2 WFD Information

Tables 2, 3 and 4 present water quality information for the river waterbodies in the Graney Demonstration Catchment. The status and trends of the quality elements monitored are also detailed.

Table 2: Receptor information for Bleach_010 and Bleach_020 river waterbodies in the Graney Demonstration Catchment

Waterbody Name		**BLEACH_010**	**BLEACH_020**	
Waterbody Code		IE_SH_25B070100	IE_SH_25B070200	
Monitoring Station	**Station name**	Corlea Bridge	Br u/s Bleach Br	BLEACH - Bleach Br
	Station code	RS25B070100	RS25B070190	RS25B070200
	Station Type	Operational	Operational	Operational
Risk Category (Cycle 3)		***Not at Risk***	***At Risk***	
WFD objective		Good	High	
Biological Status (Inverts)	**2012**	Good	High	High
	2014	Poor	Moderate	Good
	2017	Good	Good	Good
	2018	No data	Good	Good
	2021	Good	Good	Good
	Trends in Q values	Declined from Q4-5 to Q4 between 2003 and 2012. Poor in 2014, good since.	Q4-5 between 2006 and 2012. Dropped to Q3-4 in 2014. Recovered to good in 2017.	Q5 from 1987 to 1993, Q4-5 from 1996 to 2012. Good since 2014.
Hydrochemistry		Pass	No data	Limited data only
Ortho-P (mg/l P)	**Baseline 2017**	0.005		0.005
	Indicative quality	High		High
Ammonium (mg/l N)	**Baseline 2017**	0.013		0.010
	Indicative quality	High		High
Total Oxidised Nitrogen (mg/l N)	**Baseline 2017**	0.108		0.100
	Indicative quality	Good		Good
Hydromorphology		No data	No data	No data

Waterbody Name		BLEACH_010	BLEACH_020	
Waterbody Code		IE_SH_25B070100	IE_SH_25B070200	
Monitoring Station	Station name	Corlea Bridge	Br u/s Bleach Br	BLEACH - Bleach Br
	Station code	RS25B070100	RS25B070190	RS25B070200
	Station Type	Operational	Operational	Operational
Ecological status	2010-2015	Poor	Moderate	
	2013-2018	Good	Good	
	Element/s driving status	Invertebrates	Invertebrates	Invertebrates
Protected areas		Slieve Aughty Mountains SPA, Lough Atorick District Bogs NHA, Pollagoona Bog SAC. Loughatorick South Bog SAC and Slieve Aughty Bog NHA partially overlapping these WB boundaries.		
Drinking water abstraction		Drinking water protected	Drinking water protected	
EPA biologist report	Substrate Features	Normal (2017)		Normal (2017 and 2018)
	Substrate Siltation	Clean (2017)		Slight (2017), Clean (2018)
	Filamentous algal cover		3% (2018)	0% (2018)
	Macrophyte cover		3% (2018)	15% (2018)
	Notes	Good ecological condition maintained at all three sites assessed on the Bleach in 2021.		
Significant issue for receptor (see section 2.3 to 2.5 for more details)		Sediment likely significant issue causing earlier deterioration here	Sediment. Phosphate also possible issue here	Sediment. Phosphate also possible issue here

Table 3: Receptor information for Graney (Shannon)_010, _020 and _030 river waterbodies in the Graney Demonstration Catchment

Waterbody Name		**GRANEY (SHANN0N)_010**		**GRANEY (SHANN0N)_020**	**GRANEY (SHANN0N)_030**
Waterbody Code		IE_SH_25G040025		IE_SH_25G040100	IE_SH_25G040200
Monitoring Stations	**Station name**	GRANEY (SHANNON) - Br d/s Lough Ea	Caher Br, S of L.Graney	Aughadarreen Bridge	Cooleen Br
	Station code	RS25G040010	RS25G040025	RS25G040100	RS25G040200
	Station Type	Operational	Surveillance and Operational	Operational	Operational
Risk Category		***Not at risk***		***Not at risk***	***At Risk***
WFD objective		Good		Good	High
Biological Status (Inverts)	**2012**	High	High	Good	High
	2014	High	High	Good	High
	2017	Good	High	Good	Good
	2018	Good	High	No data	No data
	2019	Good	No data	No data	Good
	2021	Good	High	Moderate	Good
	Trends in Q values	Q5 and Q4-5 from 1987 to 2014. Q4 from 2017 to date.	Longterm at high status. Q5: 2009 to 2017. Q4-5 since 2018.	Q4-5 and Q4 apart from Q3 in 1996 and the current Q3-4	Prior to 2003 fluctuating between Q5 and Q4. Q5 in 2003, Q4-5 from 2006-2014. Q4 from 2017 to date.
Biological Status (Fish)	**2007-2009**	Good		No data	No data
	2010-2012	Good			
	2010-2015	Good			
	2013-2018	Good			
Biological Status (Phytobenthos) (2013-2018)		High		No data	No data
Hydrochemistry		No data	Pass	Pass	No data
Ortho-P (mg/l P)	**Baseline 2017**	No data	0.013	0.006	No data
	Indicative quality		High	High	
	Baseline 2017		0.013	0.014	

Waterbody Name		GRANEY (SHANN0N)_010		GRANEY (SHANN0N)_020	GRANEY (SHANN0N)_030
Waterbody Code		IE_SH_25G040025		IE_SH_25G040100	IE_SH_25G040200
Monitoring Stations	**Station name**	GRANEY (SHANNON) - Br d/s Lough Ea	Caher Br, S of L.Graney	Aughadarreen Bridge	Cooleen Br
	Station code	RS25G040010	RS25G040025	RS25G040100	RS25G040200
	Station Type	Operational	Surveillance and Operational	Operational	Operational
Ammonium (mg/l N)	**Indicative quality**		High	High	
Total Oxidised Nitrogen (mg/l N)	**Baseline 2017**		0.134	0.130	
	Indicative quality		Good	Good	
Other water quality data	**BOD**			Occasional spikes	
Hydromorphology		No data	No data	No data	No data
Ecological status	**2010-2015**	Good		Good	High
	2013-2018	Good		Good	Good
	Element/s driving current status	Invertebrates (and Fish)		Invertebrates	Invertebrates
Protected areas		Slieve Aughty Mountains SPA, Maghera Mountain Bogs NHA and Glendree Bog SAC		Slieve Aughty Mountains SPA	Slieve Aughty Mountains SPA
Drinking water abstraction		Drinking water protected		Drinking water protected	Drinking water protected
EPA biologist notes		Mixed results. At Caher Bridge, south of L. Graney (Station 0025), High ecological conditions were maintained, as were the Good conditions at Stations 0010 and 0200. However, Station 0100 (Aughadarreen Bridge) has declined from Good in 2017 to Mod. in 2021 and the lowermost site (Station 0400) has declined from Mod. to Poor in same time period. Improvement from Poor to Mod at Station 0300 from 2017 to 2021.			
Significant issue for receptor (see section 2.3 to 2.5 for more details)		No known issues	Consistently High biological status here. Occasional elevated BOD levels.	Not yet known. Elevated TP observed upstream of L Graney but mon pt is d/s of lake outflow. Occasional BOD spikes here require further investigation. Sediment also a possible issue here.	Sediment is a likely significant issue here. Phosphate is also a potential issue.

Table 4: Receptor information for Corra_010, Corra_020 and Drumandoora_010 river waterbodies in the Graney Demonstration Catchment

Waterbody Name		**CORRA_010**	**CORRA_020**	**DRUMANDOORA_010**	
Waterbody Code		IE_SH_25C090100	IE_SH_25C090400	IE_SH_25D060500	
Monitoring Stations	**Station name**	CORRA - Br SE of Corrakyle	Gortaderry Br	Drumandorra - Br N of Drumandorra West	2nd Br u/s Lough Graney
	Station code	RS25C090100	RS25C090400	RS25D060200	RS25D060500
	Station Type	Operational	Operational	Operational	Operational
Risk Category		***Not at risk***	***Not at risk***	***Not at risk***	
WFD objective		Good	High	Good	
Biological monitoring					
Biological Status (Inverts)	**2012**	Poor	High	High	Good
	2014	Good	High	High	Good
	2017	Good	High	Good	Good
	2021	Good	Good	Good	Good
	Trends in Q values	Q5 and Q4-5 up to and including 2003. Q3 in 2012 and Q4 from 2014 to date.	Q5: 1987 to 2003, Q4-5: 2006 to 2017, currently Q4.	Q5 and Q4-5 apart from 1996, 2017 and 2021.	Q4-5 1999, 2006 and 2009 otherwise Q4.
Hydrochemistry		Limited data only	Limited data only	No data	No data
Ortho-P (mg/l P)	**Baseline 2017**	0.013	0.010		
	Indicative quality	High	High		
Ammonium (mg/l N)	**Baseline 2017**	0.014	0.007		
	Indicative quality	High	High		
Total Oxidised Nitrogen (mg/l N)	**Baseline 2017**	0.100	0.100		
	Indicative quality	Good	Good		
Hydromorphology		No data	High	No data	No data
Ecological status	**2010-2015**	Good	High	Good	
	2013-2018	Good	High	Good	
	Element/s driving current status	Invertebrates	Invertebrates	Invertebrates	Invertebrates
Protected areas		Slieve Aughty Mountains SPA and Loughatorick South Bog SAC	Slieve Aughty Mountains SPA	Slieve Aughty Mountains SPA and Maghera Mountain Bogs	

Waterbody Name		CORRA_010	CORRA_020	DRUMANDOORA_010	
Waterbody Code		IE_SH_25C090100	IE_SH_25C090400	IE_SH_25D060500	
Monitoring Stations	Station name	CORRA - Br SE of Corrakyle	Gortaderry Br	Drumandorra - Br N of Drumandorra West	2nd Br u/s Lough Graney
	Station code	RS25C090100	RS25C090400	RS25D060200	RS25D060500
	Station Type	Operational	Operational	Operational	Operational
Drinking water abstraction		Drinking water protected		Drinking water protected	
EPA biologist notes		Invertebrate fauna at both sites indicating Good ecological conditions represents no change at the upper site, but a disappointing decline at the lower site (Station 0400), which had been rated as being in High condition in all eleven previous assessments.		Good ecological condition maintained at both sites assessed in 2021.	
Significant issue for receptor (see section 2.3 to 2.5 for more details)		No known issues	Sediment is the most likely significant issue driving the 2021 deterioration here. Phosphate also a possible issue.	No known issues	

2.3 Biological Monitoring Data

Biological monitoring data for WFD operational and surveillance monitoring stations on the eight river waterbodies in the demonstration catchment are summarised in **Table 5**.

As can be seen from the table, most recent Q results (2021 survey) for the three High status objective waterbodies (Bleach_020, Graney (Shannon)_030 and Corra_020) were indicative of Good biological status (Q4) for all sites monitored. Results for Corra_020 had been consistently indicative of High status (Q 4-5 or Q5) for all previous surveys undertaken here from 1987 to 2017 inclusive.

All five Good ecological status objective waterbodies met their objective for the 2013-2018 reporting period but 2021 biological monitoring results showed a decline from Good to Moderate biological status at the Graney (Shannon)_020 WFD monitoring point in the EPA 2021 assessment.

Table 5: Biological monitoring data for WFD monitoring stations in the Graney Demonstration Catchment

Waterbody name	WFD monitoring station	1979	1984	1987	1989	1993	1994	1996	1999	2003	2006	2009	2012	2014	2017	2018	2019	2021
Bleach_010	Corlea Bridge				5			4-5	4-5	4-5			4	3	4			4
Bleach_020	Br us Bleach Br										4-5	4-5	4-5	3-4	4	4		4
	BLEACH-Bleach Br			5	5	5		4-5	4-5	4-5			4-5	4	4	4		4
Dromandoora_010	DRUMANDOORA-Br N of Drumandoora West				5		5	4	4-5	4-5			5	4-5	4			4
	2nd Br u/s Lough Graney								4-5	4	4-5	4-5	4	4	4			4
Graney (Shannon)_010	GRANEY (Shannon)-Br d/s L. Ea		4	4-5		5		5	5	4-5	4-5		4-5	4-5	4	4	4	4
	Caher Br, S of L.Graney		4-5	5		5		5	5	5	4-5	5	5	5	5	4-5	4-5	4-5
Graney (Shannon)_020	Aughadarreen Bridge	4	4	4		4		3	4	4-5	4	4-5	4	4	4			3-4
Graney (Shannon)_030	Cooleen Br	4	5	5			5	4	4	5	4-5	4-5	4-5	4-5	4		4	4
Corra_010	CORRA-Br SE of Corrakyle				5			5	5	4-5			3	4	4			4
Corra_020	Gortaderry Br			5	5	5		5	5	5	4-5	4-5	4-5	4-5	4-5			4

Source: EPA EDEN

2.4 Hydrochemistry

Only the waterbodies with hydrochemistry data are discussed in this section. Where relevant, results are assessed against environmental quality standards (EQSs) from S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Nitrate levels are assessed against WFD surrogate limits of 1.8mg/l N for Good status objective rivers and 0.9mg/l N for High status objective rivers (annual mean).

Bleach_010 (Good status objective)

From WFD chemistry monitoring data available for Corlea Bridge, nutrients do not appear to be a cause for concern in Bleach_010. Annual average orthophosphate results were well below the mean Good status EQS of 0.035mg/l from 2007 to 2021 inclusive (**Figure 4**). Individual sample results were also consistently below the mean EQS within the exception of one result in February 2021 which marginally exceeded 0.035mg/l but was significantly below the 95%ile limit of 0.075mg/l. 85% of individual sample results between February 2014 and April 2022 have been below the orthophosphate detection limit of 0.01mg/l.

Annual average and temporal nitrate nitrogen results at Corlea Bridge (**Figure 5**) were consistently very low, well below the surrogate limit of 1.8mg/l for Good status objective river waterbodies and also below the high status surrogate limit.

Annual average ammonium results at Corlea Bridge (**Figure 6**) were consistently below the mean Good status EQS of 0.065mg/l from 2007 to 2021. Temporally, individual sample results exceeded this mean limit on five occasions but the 95%ile limit was exceeded on one occasion only (0.37mg/l in October 2008).

Annual average biochemical oxygen demand (BOD) results (**Figure 7**) have been at or below the mean Good status EQS of 1.5mg/l with the exception of results for 2007 and 2010. Results for 44% of individual samples collected between February 2007 and April 2022 exceeded this mean limit (i.e. 22 out of 50 sampling events). However all but three of these results were for samples collected prior to 2013.

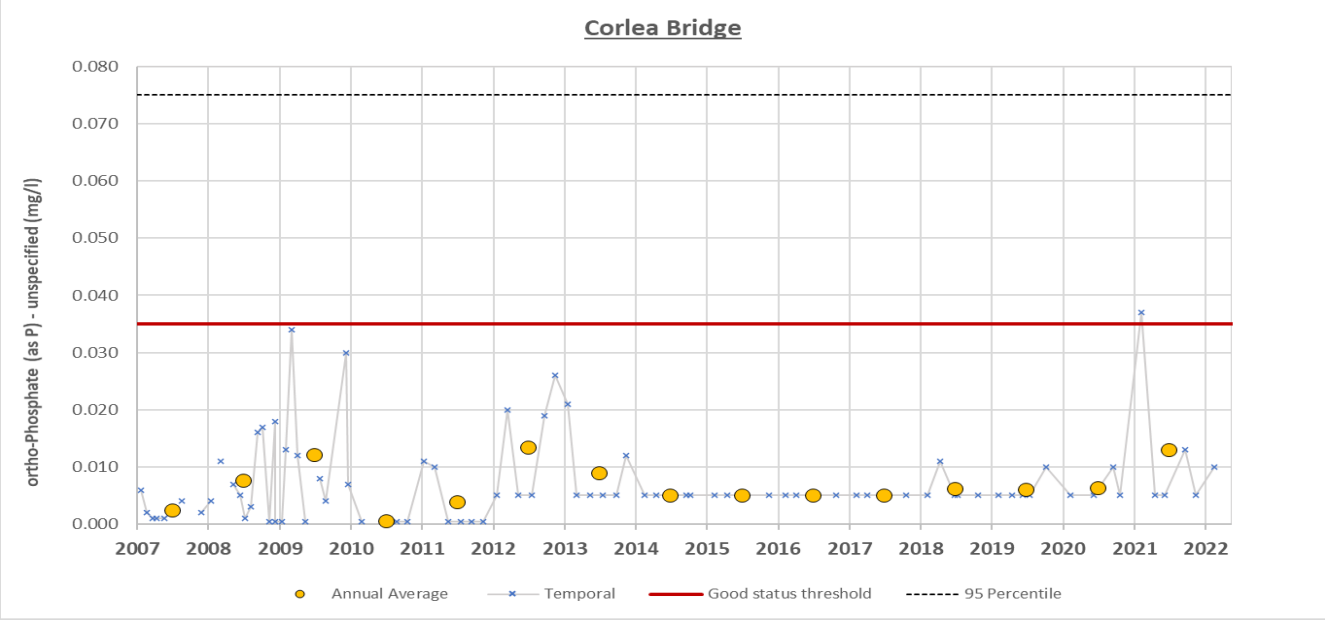


Figure 4 Orthophosphate concentrations at Corlea Bridge from Jan 2007 to Feb 2022

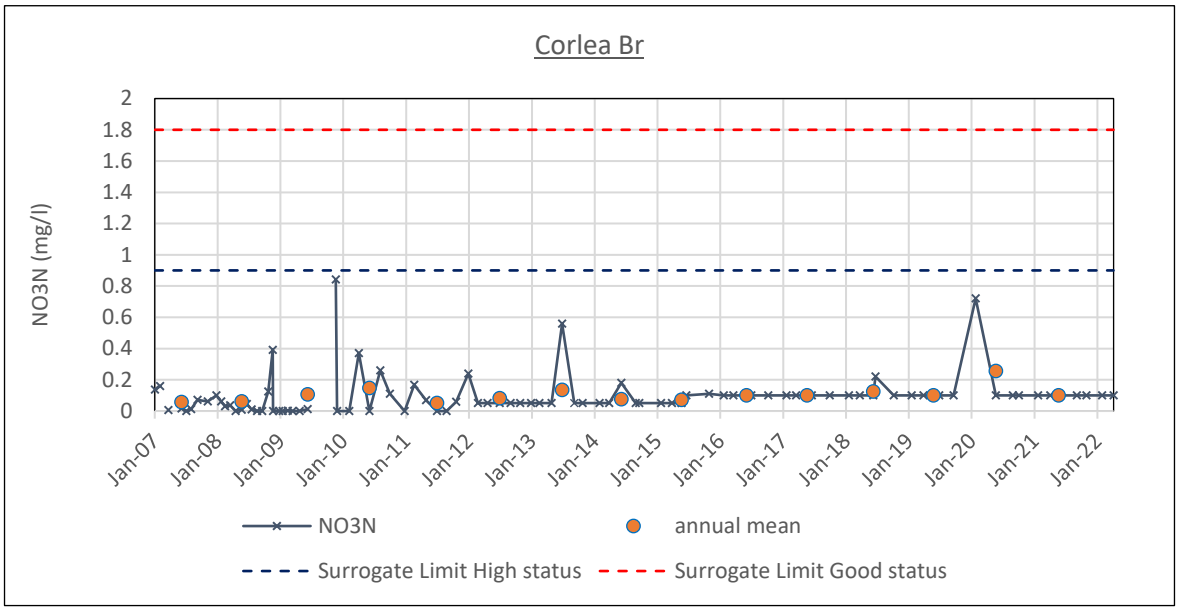


Figure 5 Nitrate nitrogen concentrations at Corlea Bridge from Jan 2007 to Feb 2022.

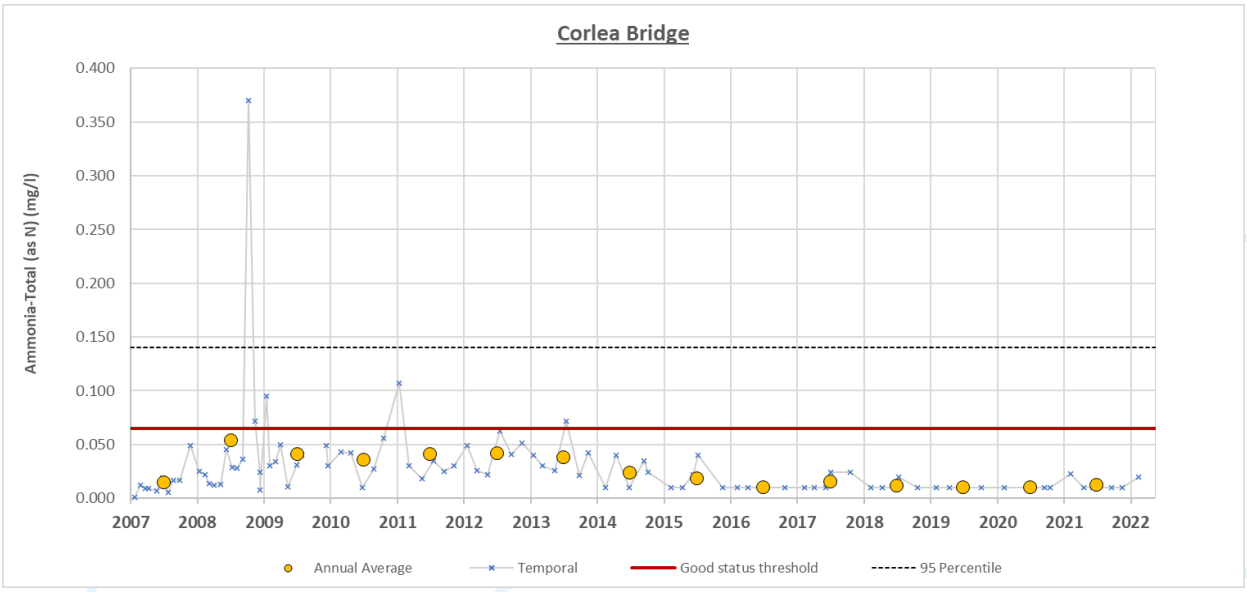


Figure 6 Total ammoniacal N concentrations at Corlea Bridge from Jan 2007 to Feb 2022

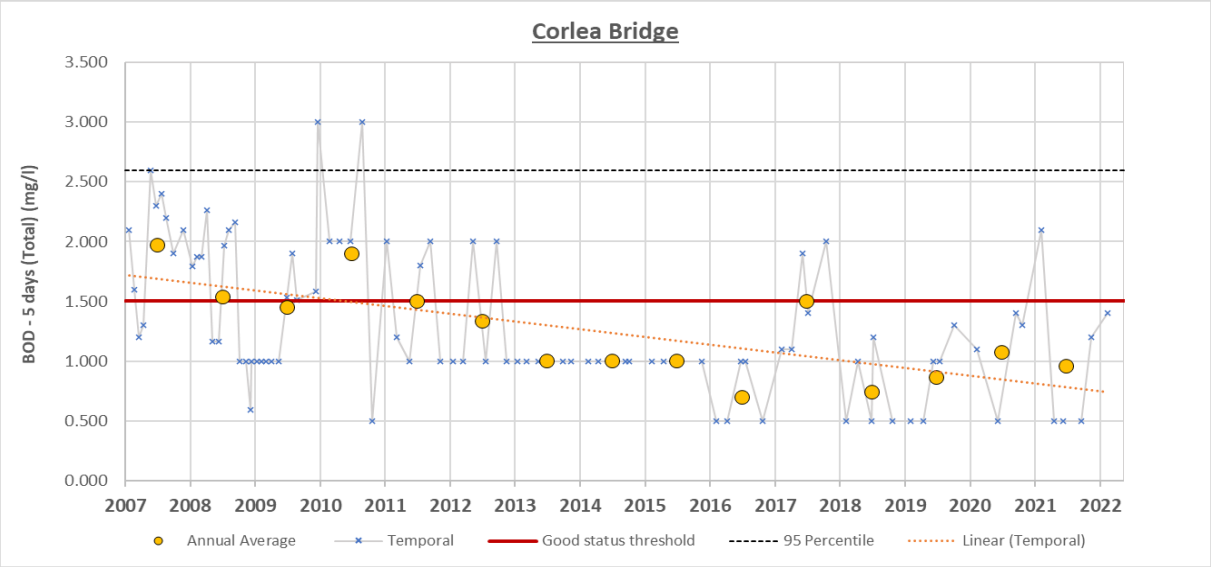


Figure 7 BOD levels at Corlea Bridge from Jan 2007 to Feb 2022

Bleach_020 (High status objective)

Limited hydrochemistry data are available for Bleach_020, for 2016 and 2017 only (August 2016 and May and August 2017). Results were indicative of High status nutrient conditions at the time.

Graney (Shannon)_010 (Good status objective)

Graney (Shannon)_010 is monitored for chemistry at the surveillance and operational monitoring station, Caher Br, S of L. Graney. Annual average orthophosphate results for this station have been below the mean Good status EQS each year from 2007 to 2021 inclusive (**Figure 8**). Temporally, individual results exceeded 0.035mg/l on only five occasions. No sample result exceeded the 95%ile limit of 0.075mg/l but one result was at this limit (March 2014).

Annual average results for nitrate nitrogen were consistently very low, well below the good status surrogate limit of 1.8mg/l (**Figure 9**Figure 9) and also below the High status surrogate limit of 0.9mg/l. Individual results were also below this limit.

Annual average ammonium results were below the mean Good status EQS every year from 2007 to 2021 inclusive (**Figure 10**). All individual sample results since June 2010 have been below the mean EQS. Results for six samples prior to June 2010 were above the mean EQS and one result in January 2010 exceeded the 95%ile limit of 0.14mg/l.

Annual mean BOD results were below the EQS except for 2017. Temporally, 12% of individual results were above the mean EQS. The Good status 95%ile limit of 2.6mg/l was breached on six occasions (**Figure 11**). For two of those sampling events, orthophosphate levels were also slightly elevated above the mean EQS of 0.035mg/l but levels of other nutrients were not elevated and dissolved oxygen levels were satisfactory.

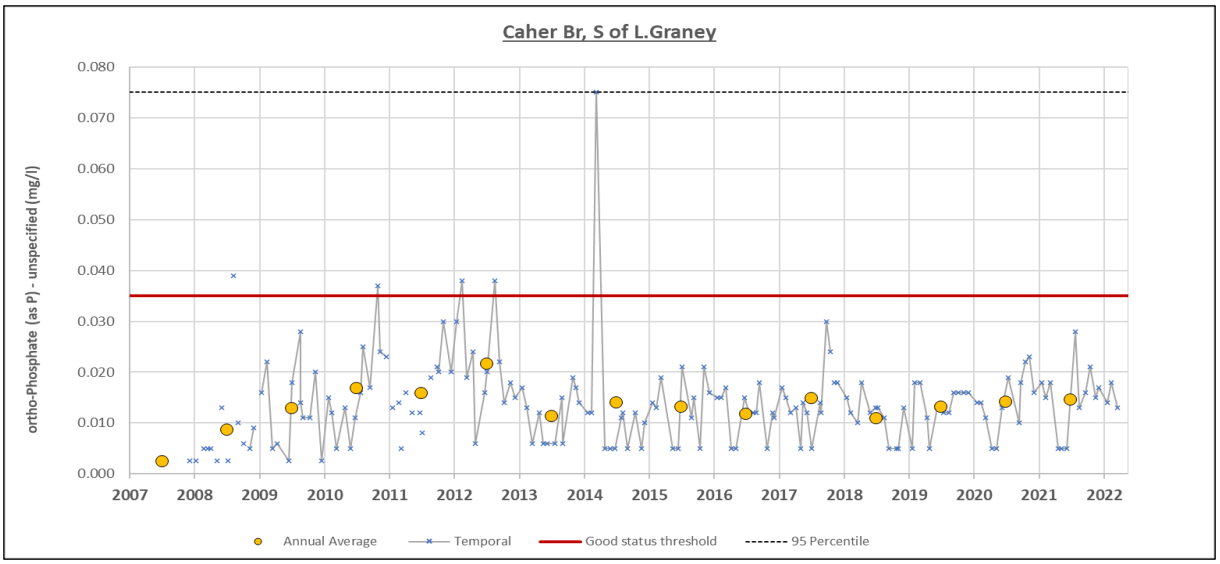


Figure 8 Orthophosphate concentrations at Caher Br, S of L. Graney from Jan 2007 to Feb 2022.

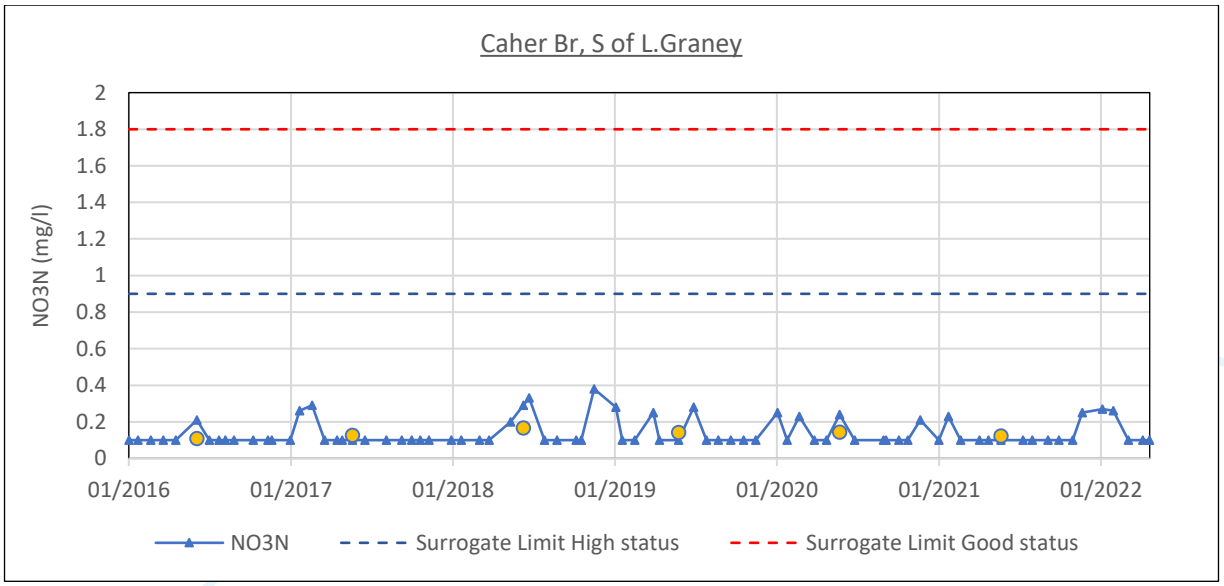


Figure 9 Total oxidised nitrogen concentrations at Caher Br, S of L. Graney from Jan 2007 to Feb 2022

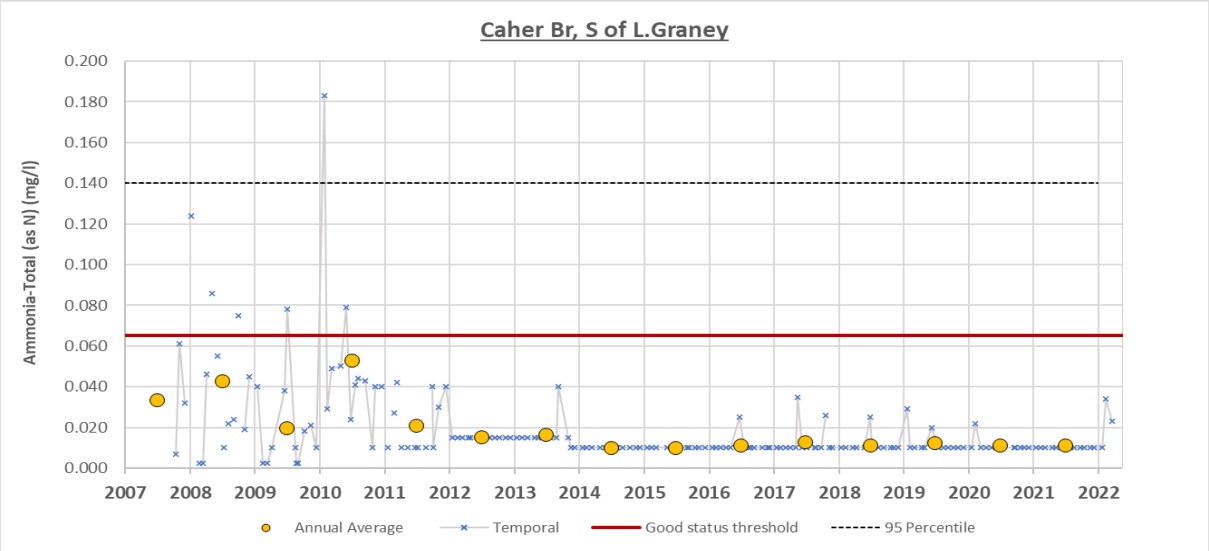


Figure 10 Total ammoniacal N concentrations at Caher Br, S of L. Graney from Jan 2007 to Feb 2022

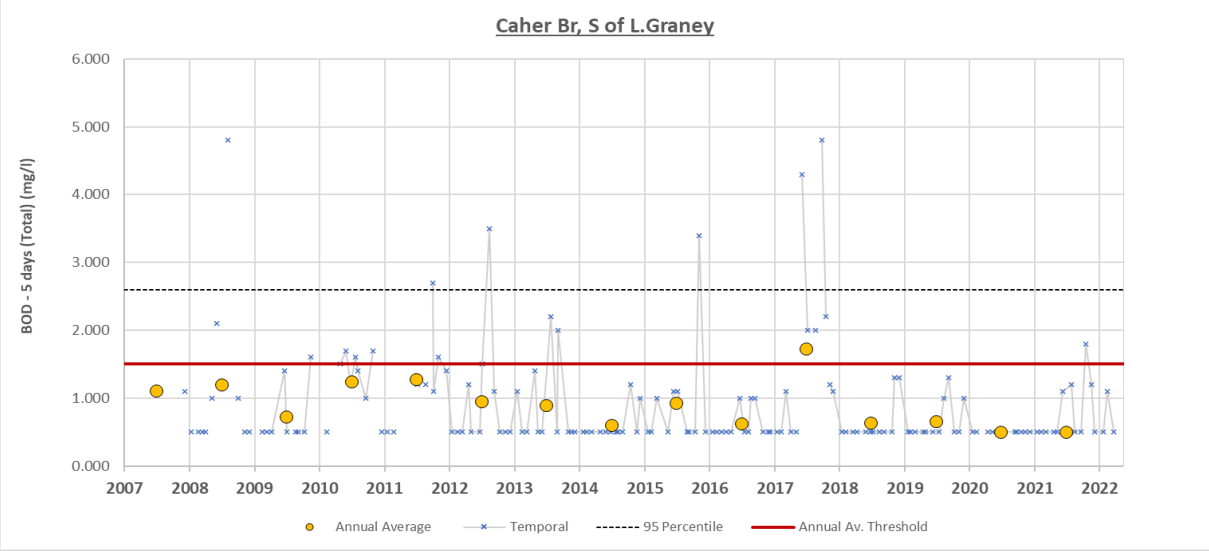


Figure 11 BOD results at Caher Br, S of L. Graney from Jan 2007 to Feb 2022

Graney (Shannon)_020 (Good status objective)

Annual average nutrient levels for Graney (Shannon)_020 have been well below their mean Good status EQS except for 2010 results for ammonium.

Temporally, individual orthophosphate results were above the mean EQS of 0.035mg/l just four times in the period January 2007 to February 2022 but all results were below the 95%ile limit of 0.075mg/l (**Figure 12)**.

Nitrate concentrations spiked and were higher than usual in the 2010 to 2012 period (**Figure 13)** but still remained below the Good status surrogate limit of 1.8mg/l.

Annual average ammonium results have been below the mean EQS of 0.065mg/l except for 2010 (mean result of 0.095mg/l) (**Figure 14**). Individual results exceeded the 95%ile limit (0.14mg/l) on one occasion (0.3mg/l in April 2010).

Annual average BOD results exceeded the mean EQS of 1.5mg/l in 2007, 2008 and 2012. Annual means from 2013 to 2021 inclusive were within this limit but there have been spikes in individual results observed on occasion, including a significant spike of 8mg/l in September 2012 (**Figure 15**). These BOD spikes did not coincide with elevated nutrients or low dissolved oxygen levels.

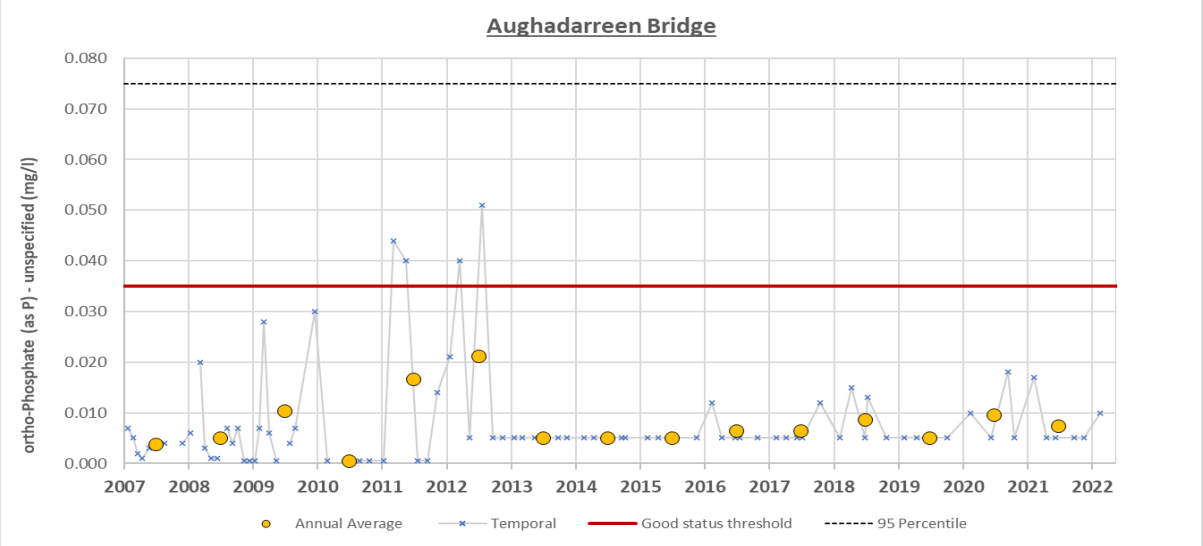


Figure 12 Orthophosphate concentrations at Aughadarreen Bridge from Jan 2007 to Feb 2022.

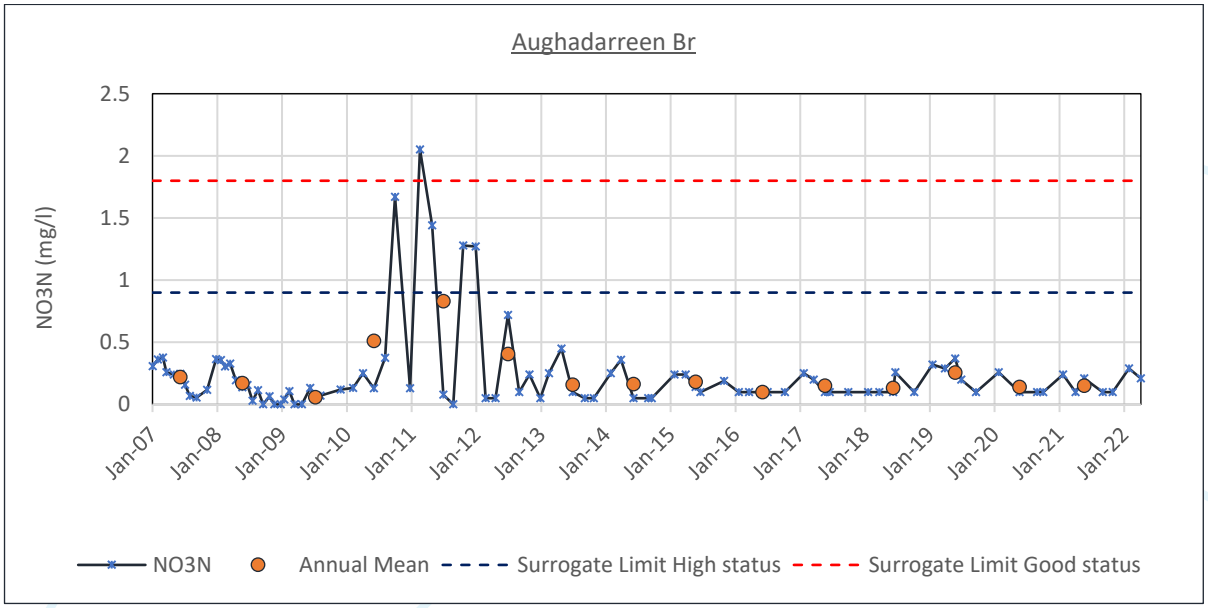


Figure 13 Nitrate concentrations at Aughadarreen Bridge from Jan 2007 to Feb 2022.

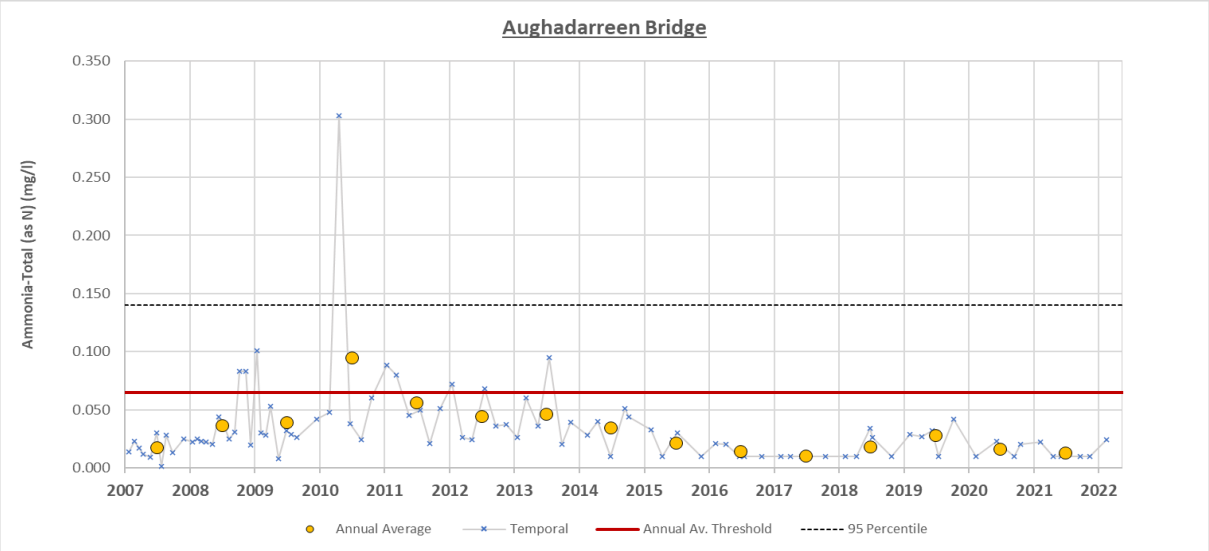


Figure 14 Total ammoniacal N concentrations at Aughadarreen Bridge from Jan 2007 to Feb 2022.

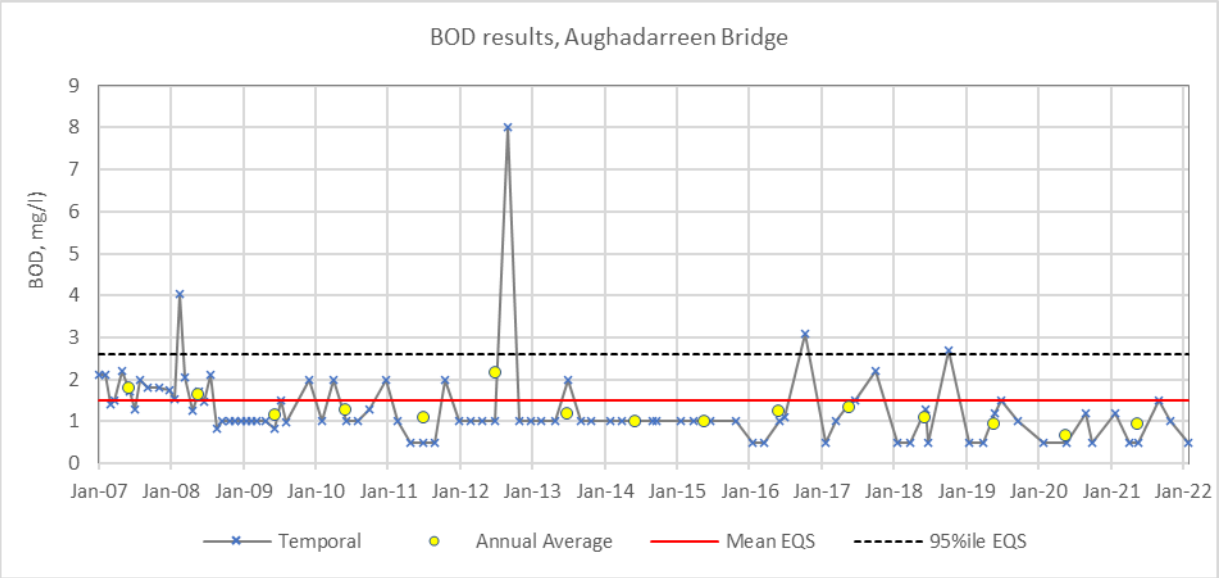


Figure 15 BOD levels at Aughadarreen Bridge from Jan 2007 to Feb 2022

2.5 Summary of the issues

Bleach_010

Bleach_010 is currently meeting its WFD Good status objective and is *Not at Risk*. Biological monitoring results dropped to Poor (Q3) at the Corlea Bridge monitoring point in 2014 but improved back to Good (Q4) in 2017, maintaining Good status when next assessed by the EPA in 2021. Data available from the WFD app suggests that nutrients are not an issue in Bleach_010.

Conservation Services (Ecological & Environmental Consultants) were commissioned by LAWPRO to carry out biological sampling and water quality assessment at eleven stream/river sites in the Bleach/Graney catchment (hereafter known as Conservation Services report). They reported Q4-5 and

no siltation visible on the main channel close to the Bleach_010 outlet in March 2020 (Site 1A, Appendix XIV). EPA biologists described the substrate siltation as clean at Corlea Bridge in 2017. However, this does not exclude suspended sediment as a periodic issue. Peat and other sediments are readily mobilised in these upland blanket peat landscapes. Sediment settings maps (Appendix XIII) indicate moderate levels of natural sediment accumulation throughout much of the Bleach_010 channel, including downstream of the lake outflow. This indicates that levels of suspended fine sediment would be relatively high after extreme rainfall events. Despite the reported absence of substrate siltation at Corlea Bridge in 2017, if suspended sediment was excessive in very high flows occurring for a period prior to the 2014 EPA biological assessment, this may have impacted the sensitive invertebrate taxa at that stage. Deterioration on Bleach_010 can potentially impact downstream High status objective waterbody Bleach_020, as appears to have happened in 2014 when Bleach_010 dropped from Good to Poor biological status and the WFD monitoring points downstream on Bleach_020 dropped from High at both stations to Moderate and Good.

Bleach_020

There are two WFD monitoring points on Bleach_020 (**Figure 2**), Bridge u/s of Bleach Bridge (RS25B070190) which is ~350m upstream of the waterbody outlet and Bleach Bridge at the waterbody outlet. Both stations are routinely monitored for biology only but limited chemistry sampling was undertaken in 2016 and 2017. Biological status at Bridge u/s Bleach Bridge dropped to Moderate in 2014 from High in 2012. It has since improved to Good status. Bleach Bridge was at High biological status from 1987 through 2012. It dropped to Good in 2014 and remains so to date (**Table 5**: Biological monitoring data for WFD monitoring stations in the Graney Demonstration CatchmentBleach_020 is a High ecological status objective waterbody so its WFD objective is not being met. Biologists noted moderate siltation and 25-50% Cladophora cover in 2014, indicating that the significant issue was a combination of sediment and nutrients. However, no Cladophora cover was observed in 2017 or 2018, indicative of the absence of nutrient impact. Slight substrate siltation was noted in 2017, reported as clean in 2018. Conservation Services assessed four sites on Bleach_020 in March 2020 and reported Q4-5 at all sites with moderate siltation at Sites 2, 3 and 4. Site 1 was heavily silted (see Appendix XIV for site location).

Limited nutrient monitoring data are available for Bleach Bridge and no data are available prior to 2014, when the water quality deterioration occurred. Three rounds of sampling undertaken between August 2016 and August 2017 were all below laboratory detection limits. However, this does not exclude nutrients as an issue as the occurrence of nutrient release, particularly phosphate, may be episodic and linked to sediment loss to the waterbody from upstream in the catchment.

Graney (Shannon)_020

This waterbody is monitored at Aughadarreen Bridge (RS25G040100), just under 2km downstream of the Lough Graney lake outflow. Biological status here dropped to Moderate in 2021. It had been meeting its Good status objective up to 2017. The waterbody had achieved High status periodically prior to 2012.

Nutrients do not appear to be an issue at the WFD monitoring point. However, it must be noted that elevated total phosphorus (TP) concentrations were measured in rivers and streams feeding into Lough Graney in the LAWPRO local catchment assessment undertaken in 2021 and 2022. Assessments were mainly focused on Lough Graney itself, with total phosphorus loading to the lake estimated for inputting rivers and streams. Site locations are shown in Appendix XIV and TP results and loading analysis are

provided in Appendix XVI. Monitoring was not undertaken downstream of the lake outflow as this was outside the Cycle 2 Prioritised Area for Action.

Elevated BOD levels have been observed on occasion at the Aughadarreen Bridge station. Elevated BOD is potentially indicative of organic pollution. However, BOD spikes did not coincide with elevated levels of ammonium, orthophosphate or nitrate and dissolved oxygen levels below the lower limit of 80% were not recorded, although results were frequently less than optimal; 64% of DO readings were below 95% and 21% of readings were less than 90%. This issue requires further investigation in the field. Sediment also cannot be ruled out as a possible significant issue driving the 2021 deterioration here. Sediment settings maps (Appendix XIII) indicate moderate levels of natural sediment accumulation throughout much of the channel downstream of Lough Graney.

Drumandoora_010

Drumandoora_010 is meeting its WFD Good status objective and is *Not at Risk*. There are two WFD monitoring points on the waterbody, Bridge N of Drumandoora West and 2nd Bridge u/s of Lough Graney. Both stations are monitored for biology only. While biological monitoring results are at Good status for both stations, results were at High status in the past (see Table 4). Biological status at the site at the waterbody outlet (2nd Br u/s Lough Graney) dropped from High to Good in 2009. The upstream site (Br N of Drumandoora West) dropped from High to Good in 2014. It is not known what issue/s may have caused this earlier deterioration from High status. Agriculture here is mainly extensive on a mix of soils. Phosphate susceptibility maps show the sub-basin to be moderate to low risk for phosphate loss to surface waters. Phosphate PIP maps show very few high risk (Rank 1 to 3) areas (see Appendix II).

Graney (Shannon)_010

Graney (Shannon)_010 is meeting its WFD Good ecological status objective (2013-2018 reporting period) and is *Not at Risk*. There are two WFD monitoring points on this waterbody. Bridge d/s Lough Ea (operational monitoring station) is situated close to the top of the waterbody. Results of the most recent biological monitoring survey undertaken in 2021 indicate that invertebrate status remains Good (Q4) here. Caher Br, S of L. Graney (surveillance and operational station) is just upstream of the waterbody outlet. Invertebrate status has been consistently High at this station, Q5 from 2009 to 2017 inclusive and Q4-5 in 2018, 2019 and 2021.

Corra_010

Corra_010 is meeting its Good status objective and is *Not at Risk*. There is one WFD monitoring station on this waterbody, CORRA Br-SE of Corrakyle. Biological monitoring results here were indicative of High status up to 2003 but dropped to Moderate when next assessed in 2012. Results improved back to Good status in 2014 and remained at Good status when assessed in 2017 and 2021. Limited hydrochemistry data are available, based on three samples taken in 2016/2017. Nutrient concentrations were low and well below the relevant EQS.

Corra_020

Corra_020 is High ecological status objective. It is meeting its objective for the 2013-2018 reporting period and *Not at Risk*. Biological monitoring results for the Gortaderry Br operational monitoring station were consistently at High biological status in all surveys undertaken between 1987 and 2017 inclusive but dropped to Good status in 2021. Limited hydrochemistry data are available based on three

samples taken in 2016/2017. Nutrients concentrations were low and well below their EQS but no recent data are available. Sediment is a possible issue driving the 2021 deterioration here. Soils are predominantly poorly draining (Appendix VI). Approximately one-third of the catchment is forested. Forestry activities are a potential sediment (and phosphate) source. Sediment settings maps (Appendix XIII) indicate moderate levels of natural sediment accumulation throughout much of the Corra_020 (and also Corra_010). As outlined earlier, this indicates that levels of suspended fine sediment would be relatively high after extreme rainfall events. Most of the remaining lands in the sub-basin are under agriculture (mainly extensive), with phosphate susceptibility maps showing these areas to be moderate to high risk for phosphate loss to surface waters. Phosphate is also a possible issue requiring further investigation.

Graney (Shannon)_030

Graney (Shannon)_030 is not meeting its High ecological status objective for the 2013-2018 reporting period and is *At Risk*. Biological status at the WFD monitoring point (Cooleen Br) dropped from High to Good in 2017, remaining at Good in the 2019 and 2021 EPA surveys. Forestry makes up about 30% of the land use in the sub-basin, with agriculture making up the remainder. Sediment is a likely significant issue here; from the Pressure/Impact information available in the WFD App, slightly turbid water was noted in the EPA 2017 survey, indicative of sediment impact and DO was not optimal at 95%. Sediment accumulation maps indicate moderate levels of natural sediment accumulation throughout most of the Graney (Shannon)_030 main channel and the lower NE-SW tributary (Appendix XIII). Nutrient status is unknown in this waterbody and nutrient data from the inputting waterbodies are scarce. Nutrients cannot be ruled out as an additional potential issue here, with phosphate susceptibility maps showing high risk areas particularly on agricultural lands close to the river channel and phosphate PIP maps showing high risk areas (Rank 1 and 2) upstream of the WFD monitoring point (Appendix II).

3 Significant pressure information

3.1 Initial EPA Characterisation

The information in the following table was extracted from the WFD app on 04/05/2022. This is the current WFD Cycle 3 initial characterisation data. The waterbodies with 'No pressure impact data available' are deemed to be *Not at Risk.*

Table 6: EPA initial characterisation information

Waterbody	Pressure Details				
Name	**Id**	**Category**	**Sub-Category**	**Significant ?**	**Pressure & impact details**
Bleach_010	WBP0003225	Forestry	Forestry	No	
Atorick	WBP0004058	Forestry	Forestry	Yes	Nutrient pollution
					Altered habitat due to morphological changes
Bleach_020	WBP0003226	Forestry	Forestry	Yes	Other significant impacts - Sediment
Graney (Shannon)_020	No pressure impact data available				
Graney	WBP0003230	Forestry	Forestry	Yes	Nutrient pollution
	WBP0003232	Agriculture	Pasture	Yes	Nutrient pollution
	WBP0003233	Invasive Species	Invasive Species	Yes	Other significant impacts (Zebra Mussel)
Drumandorra_010	No pressure impact data available				
Graney (Shannon)_010	No pressure impact data available				
Graney (Shannon)_030	WBP0007452	Forestry	Clearfelling	Yes	Other significant impacts - Sediment
Corra_010	No pressure impact data available				
Corra_020	No pressure impact data available				

3.2 Further information

Bleach_010

Private and public forestry on blanket peat makes up ~75% of the land use in the Bleach_010 sub-basin and open moorland makes up the remainder, on which extensive agriculture is practiced. EPA initial characterisation identified forestry as a significant pressure in Cycle 2 but no significant pressure is listed against Bleach_010 for Cycle 3 (**Table 6**) as it is now meeting its Good status objective and is *Not at Risk*. However, forestry has the potential to be significant in the future depending on forest management plans within the sub-basin. The 2014 deterioration in Bleach_010 and in downstream High status objective waterbody Bleach_020 is likely to have been due to forest related activities in Bleach_010.

Bleach_020

Land use in Bleach_020 is mainly under forestry. EPA initial characterisation listed forestry as the only significant pressure on Bleach_020 for WFD Cycle 3 (**Table 6**). Aerial photography shows ongoing forest management activities. Moderate to high sedimentation levels were reported by Conservation Services in March 2020 on tributaries where forestry is the dominant land use, possibly coinciding with forestry activities at the time. Land is under agricultural use and farmyards are located close to the river channel at the sub-basin outlet. Phosphate PIP maps rank these areas as mainly 4 to 6 with smaller areas of higher risk (Rank 3) (see Appendix II). These factors may be significant considering the proximity to WFD monitoring stations in this Blue Dot waterbody.

Drumandoora_010

A protect status should be applied to this waterbody. Status here has never been less than Good, its WFD objective. Agriculture is mainly extensive. Soils are a mix of poor and well draining with peat along the lower reaches. Forestry is a significant land use and ensuring correct mitigation measures are in place for all management activities will be important to minimise risk of sediment loss to the waterbody and the downstream catchment to protect against status deterioration.

Graney (Shannon)_020

Agriculture accounts for ~70% of the land use in this sub-basin with forestry making up the remainder. The drop to Moderate status here in 2021 requires further investigation. Nutrient concentrations are not an issue at the waterbody outlet despite phosphate susceptibility maps indicating high risk areas for phosphate loss. TP was elevated in some feeder streams discharging to Lough Graney, indicative of a possible orthophosphate issue in the sub-basin but no data are available downstream of the lake outflow. The monitoring station (Aughadarreen Bridge) is in close proximity to a forested area. Thinning applications were made in 2018 for c25 hectares upstream of this site (from Forest Licence Viewer (https://forestry-maps.apps.rhos.agriculture.gov.ie, accessed 10th January 2022). Information on the dates that thinning was undertaken is not available at this time. Both forestry and agriculture are potential pressures requiring field investigation in Graney (Shannon)_020.

Graney (Shannon)_010

Graney (Shannon)_010 is meeting its WFD Good status objective and is *Not at Risk,* therefore no initial characterisation pressures have been assigned against it (**Table 6**). The lower station (Caher Br, S of L.Graney) has consistently been at High status from 1984 to 2021 inclusive. The sub-basin is mainly under agriculture. Phosphate PIP maps (Appendix II) show these agricultural areas to be mainly Rank 4 (moderate risk for near surface phosphate loss). Lands in the upper reaches are under forestry. For the future, ensuring correct mitigation measures are in place for all management activities will be important to minimise any nutrient or sediment loss to the waterbody.

Corra_010

Corra_010 is meeting its Good status objective. Forestry is the main land use (60%) in the sub-basin. Agriculture (mainly extensive) makes up the remaining land use. A small area of high risk to phosphate loss has high hydraulic connectivity to the waterbody. To protect the waterbody's Good status, protect measures to minimise nutrient and sediment loss to the waterbody should be implemented.

Corra_020

Biological status in Corra_020 dropped from High (Q4-5) in 2017 to Good in 2021. This is the first drop to Good status since monitoring began in this waterbody. The reason for the deterioration is not known but forestry is a likely significant pressure here. From the Forest Licence Viewer, https://forestry-maps.apps.rhos.agriculture.gov.ie/# accessed 12th and 17th January 2023, applications to thin approximately 40 hectares were approved in February and March 2019 on forestry stands towards the lower reaches of Corra_020, including a 25 hectare area adjacent to the river channel and approximately 600m upstream of the Gortaderry Bridge monitoring point. Upstream in Corra_010, which is mainly under forestry, approximately 130 hectares (in eight stands) were approved for thinning between September 2018 and April 2019 and approximately 21 hectares were approved for clearfell and thinning

between September and December 2018. While dates that forestry management activities were undertaken are not known for either waterbody, it is likely that at least some of these works were carried out prior to the 2021 deterioration in Corra_020.

Agriculture is extensive in the Corra_020 sub-basin but phosphate susceptibility maps indicate that agricultural land use is on mainly high risk areas for phosphate loss to surface waters.

Both forestry and agriculture should be investigated as potential significant pressures.

Graney (Shannon)_030

Graney (Shannon)_030 is not meeting its High ecological status objective for the 2013-2018 reporting period and is *At Risk*. Sediment is a likely significant issue here and Pressure/Impact information available in the WFD App indicates that forestry is a likely significant pressure, with clearfelling, thinning and replanting carried out on forestry stands in the sub-basin between 2015 and 2020 and felling undertaken upstream of the monitoring station between 2017 and 2019. Forest management activity has the potential to cause sediment loss to the river, impacting invertebrate habitat due to sedimentation or suspended sediment, displacing sensitive taxa. Agriculture also cannot be ruled out as a pressure at this stage and will be considered in the future workplan.

4 Pathway information & analysis

The conceptualised understanding of the catchment is described here and in **Table 7. Figure 16** illustrates the conceptual model.

The majority of the demonstration catchment is overlain by blanket peat. Appendix VI and VII illustrate the main soil types and soil drainage characteristics in the catchment. Gortaclareen and Puckane soil series have high organic matter content and are typical surface water gleys. The Ballylanders series are free draining typical Brown Earths in the west of the catchment. Most of the wet soils are underlain by peat and sandstone and shale tills, the tills are of low permeability. The well-drained areas are characterised by bedrock at or close to the surface. The entire demonstration catchment is located over a poor aquifer (bedrock which is generally unproductive except for local zones) (see Appendix VIII) due to the generally low transmissivity and storativity of the bedrock aquifer. There are significant areas of extreme groundwater vulnerability to the east and west of L. Graney (Appendix X). The rest of the catchment is characterised by low vulnerability (thick subsoils) with smaller areas of high and moderate vulnerability. There is low to very low sub-surface susceptibility for both nitrate and phosphate (Appendix IV and V). Areas of bedrock at the surface have high near surface susceptibility for nitrate with the wet soils having a high to moderate near surface susceptibility to phosphate. The catchment is dominated by wet soils and peat with poorly productive aquifers so the dominant pathway is overland flow of phosphates in the mostly poorly drained areas with some areas of surface nitrate sensitivity over bedrock.

Recharge occurs particularly in the upland areas, and where rock outcrops or subsoils are thin. Much of the potential recharge runs off in the upland areas. Where the water table is close to the surface in upland or lowland areas, potential recharge may be rejected. Locally, groundwater flows to the surface water bodies and is determined by local topography; there is no regional flow system.

Due to the shallow groundwater flow in this aquifer, groundwater and surface waters are closely linked. There are several ecosystems in the catchment dependent on groundwater. Groundwater and surface water interactions require special attention where the terrestrial ecosystems within this catchment are dependent on a sustainable balance between the two.

Table 7: Description of the conceptualised compartments

	Compartment 1 **(C1)**	Compartment 2 **(C2)**
Bedrock unit	Devonian Old Red Sandstone (~66%), Silurian Metasediments and Volcanics (~35%), Ordovician Volcanics (<1%), Dinantian Lower Impure Bedded Limestone (<1%)	Silurian Metasediments and Volcanics (~85%), Devonian Old Red Sandstone (~10%), Ordovician Volcanics (~5%)
Aquifer	Generally Unproductive except for Local Zones (Pl)	
Aquifer properties	GWB is comprised of generally low transmissivity and storativity rocks. i.e., Silurian and Devonian. Flows in the aquifer are typically concentrated in a thin zone at the top of the rock. Recharge occurs particularly in the upland areas, and where rock outcrops, or subsoils are thin. Locally, groundwater flows to the surface water bodies and is determined by local topography.	
Topography	Undulating to hill in Bleach sub-basin, Lough Graney and Graney mainchannel, hill to mountain elsewhere	Undulating to hill/hill to mountain
Soil	Peat, Poorly drained - Humic Surface-water Gleys (Gortaclareen Series) and Humic Groundwater Gleys (Puckane Series).	Well drained - Typical Brown Earths (Ballylanders Series)
Subsoil	BktPt (~65%), TDSs (~20%), Rck (~5%) TLPSsS (~10%), Alluvium (~1%)	Rck (~75%) TLPSsS (~25%)
Groundwater vulnerability	High to X-Extreme in west and south and east of Lough Graney, moderate to low in North-East	High to X-Extreme, shallow soils/sub-soils and rock outcrops
PO_4^+ susceptibility	High (risk ranked as 2-4)	Very high (risk rank 1) localised, risk rank 2-3 along the mainchannel
PO_4^+ Flowpaths	Overland flow and near surface	Overland flow and near surface
NO_3 susceptibility	Low	High to very high (risk ranked 1-4). Very high risk around Lough Graney and to the west of the catchment
NO_3 flowpaths	Near surface	Near surface

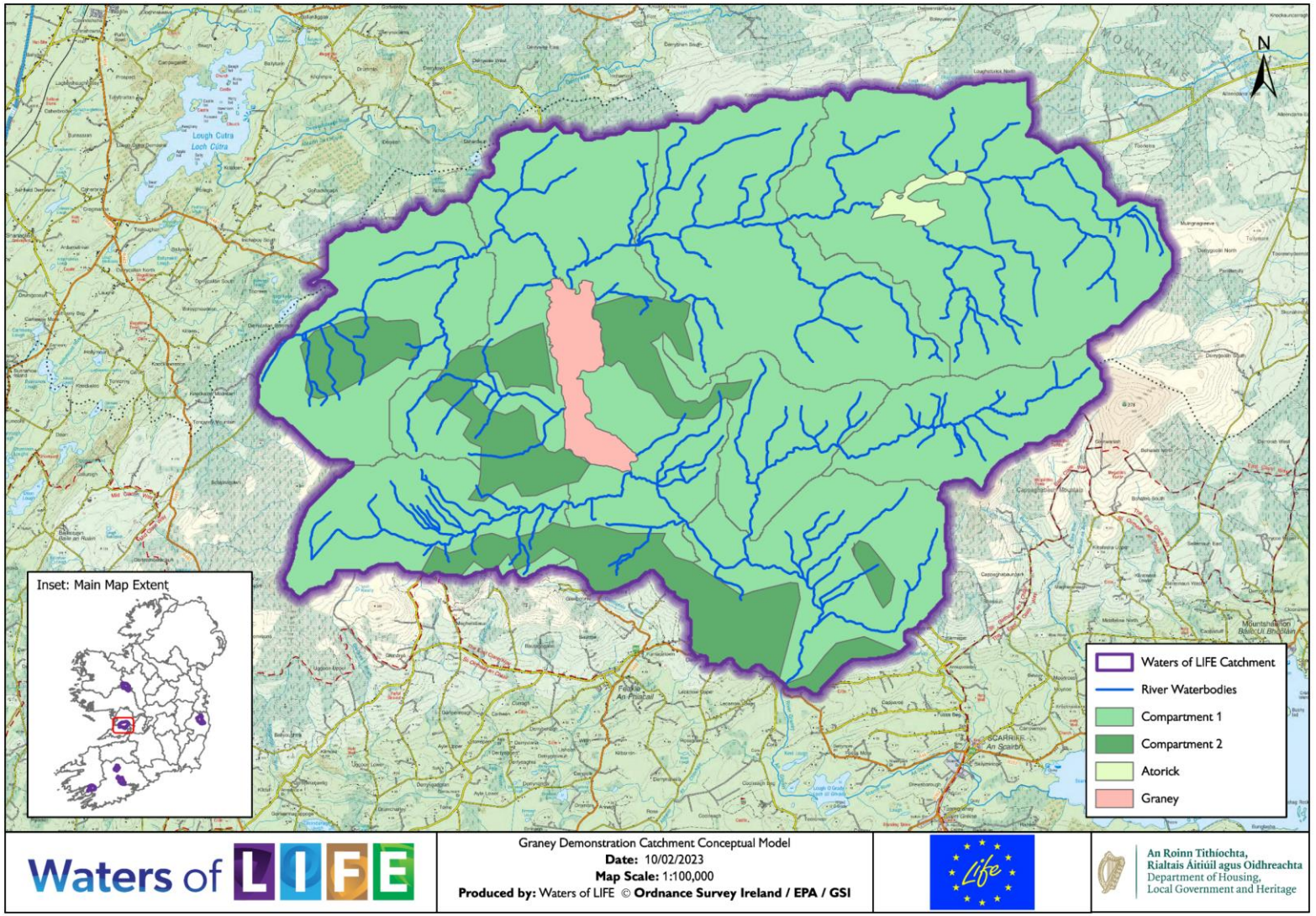


Figure 16 Conceptual model illustrating the compartments

5 Interim Story of Demonstration Catchment

The Graney Demonstration Catchment comprises eight river waterbodies. Three of these are Blue Dot waterbodies.

Bleach_010

- Good status objective waterbody.
- Good ecological status (2013-2018 cycle) and *Not at Risk*.
- Macroinvertebrates driving status here.
- Hydrochemistry monitoring indicates Good to High conditions.
- WFD objective: Protect.
- Significant issue driving the 2014 deterioration likely to be sediment.
- Potential pressure/s: Forestry.

Bleach_020

- High status objective waterbody.
- *At Risk* and at Good ecological status (2013-2018 cycle).
- Macroinvertebrates driving status. No routine chemistry monitoring.
- Limited hydrochemistry monitoring indicates Good to High conditions.
- LCA monitoring undertaken by LAWPRO indicates elevated TP levels in the river upstream of Lough Graney.
- WFD objective: Restore
- Likely significant issues: Sediment and possibly phosphorus.
- Likely significant pressure/s: Forestry and possibly agriculture.

Drumandoora_010

- Good status objective waterbody.
- *Not at Risk* and at Good ecological status (2013 – 2018).
- Macroinvertebrates driving status.
- WFD objective: Protect.
- Significant issues for protect function: Sediment.
- Potential future pressure/s: Forestry and Agriculture.

Graney (Shannon)_020

- Good status objective waterbody.
- *Not at Risk* and at Good ecological status (2013 – 2018)
- Moderate biological status in 2021
- Macroinvertebrates driving status
- WFD objective: Restore, based on 2021 biological monitoring results.
- Likely significant issues for restore function: Unknown at present. Elevated TP observed upstream of Lough Graney but monitoring point is d/s of lake outflow. Occasional BOD spikes require further investigation. Sediment is also a possible issue here.
- Likely significant pressures: Forestry and Agriculture

Graney (Shannon)_010

- Good status objective waterbody.
- *Not at Risk* and at Good ecological status (2013 – 2018)
- Good biological status at d/s site and High status maintained at u/s site in 2021
- Macroinvertebrates driving status.
- Good fish status (2013-2018).
- High and Good indicative quality for nutrients. Occasional elevated BOD levels at Caher Br monitoring point.
- WFD objective: Protect.
- Likely issues for protect function: Sediment.
- Potential future pressures: Forestry and Agriculture.

Corra_010

- Good status objective waterbody.
- *Not at Risk* and at Good ecological status (2013 – 2018).
- Good biological status in 2021.
- Macroinvertebrates driving status.
- Limited hydrochemistry data show low nutrient concentrations.
- WFD objective: Protect.
- Likely significant issues for protect function: Sediment.
- Potential future pressure: Forestry.

Corra_020

- High status objective waterbody.
- *Not at Risk* and at High ecological status for 2013 to 2018.
- Dropped to Good biological status in 2021.
- Macroinvertebrates driving status.
- Limited hydrochemistry data indicate low nutrient concentrations.
- WFD objective: Restore, based on 2021 biological monitoring results.
- Likely significant issues for restoration: Sediment and possibly phosphate.
- Likely significant pressure/s: Forestry and agriculture.

Graney (Shannon)_030

- High status objective waterbody.
- *At Risk* and at Good ecological status (2013 – 2018).
- Good biological status in 2017, 2019 and 2021.
- Macroinvertebrates driving status.
- No hydrochemistry data. Unable to determine nutrient conditions.
- WFD objective: Restore.
- Likely significant issues for restoration: Sediment and possibly nutrients (phosphate).
- Likely significant pressure/s: Forestry and agriculture.

6 Work plan

Proposed sites for initial local catchment assessment are shown in Figure 17 to **Figure 24.**

These sites are not exhaustive and ongoing fieldwork will direct locations for additional sites where required. Except where otherwise proposed for individual waterbodies (see below), LCA sites should include the following:

i. Field parameters should be recorded (conductivity, dissolved oxygen, pH and temperature)
ii. Small Stream Impact Score (SSIS) or Rapid Assessment (RA) should be undertaken, depending on habitat suitability.
iii. Sediment is a potential significant issue across the catchment so sediment assessments should be undertaken at each site. Where sediment issues are confirmed, stream walks should be carried out upstream of impacted reaches to identify sediment sources.
iv. Only three of the eight river waterbodies in the demonstration catchment are routinely monitored for nutrients under WFD (Bleach_010, Graney (Shannon)_010 and Graney (Shannon)_020). All sites should be assessed for nutrients (orthophosphate and ammonium) in low, mean and high river flows. If monitoring results are not indicative of a nutrient issue but field observations are inconclusive, higher resolution sampling may be required, particularly in High status objective waterbodies.

Elements of particular relevance to each waterbody are outlined below:

Bleach_010

This waterbody is upstream of Bleach_020 which has a High status objective. Therefore, maintaining or improving status in Bleach_010 is crucial to drive the improvements required in the Bleach_020 downstream. Sediment is the issue most likely to have been responsible for the earlier deterioration in this waterbody (and in downstream Bleach_020). Forestry is the likely significant pressure. Sediment can potentially be released during afforestation, forest road construction, thinning and felling. Forestry stakeholders will have a pivotal role here in ensuring that sediment is prevented from leaving the sites during forest management operations by putting mitigation action in place. LCA work should build on that of LAWPRO's catchment scientists, which is ongoing, focusing on identifying sources of sediment input to the river. Initial LCA sites are shown in Figure 17. Stream walks will be useful to identify unmapped drains connecting forestry stands to the river, particularly where future forestry management is planned during the life of the project.

Bleach_020

Restoration in this waterbody is required to achieve its High status objective. Forestry is a significant pressure but limited total phosphorus (TP) monitoring data obtained during the LAWPRO LCA are indicative of a possible nutrient source here. The LAWPRO monitoring programme in WFD Cycle 2 focused on TP only as the purpose was to estimate TP loading to Lough Graney. Elevated TP can result from movement of sediment related to forestry activities. Additional monitoring to include orthophosphate and ammonium will be required to determine whether agriculture is also a possible pressure here (diffuse or point source/s). LCA sites shown in Figure 18 should be assessed for parameters listed under I to iv above. If field assessments indicate that nutrients are a potential issue but nutrient monitoring results are inconclusive, higher resolution sampling may be required at the WFD

monitoring point. Sediment sources also need to be identified. This will require stream walks to identify problematic areas as a baseline for further work.

Drumandoora_010

Drumandoora_010 consistently achieves its Good status objective and is currently *Not at Risk* so has a protect status. There are two WFD monitoring points on this waterbody which achieved High biological status in the past. Biological monitoring results for the upstream station, Br N of Drumandoora West were indicative of High status in 2014, dropping to Good in the 2017 survey. The downstream station, 2nd Br u/s Lough Graney, was last High in 2009. It is likely that too much time has elapsed for LCA to determine what caused this earlier deterioration from High status but bridge hops as outlined in Figure 21 will be useful to establish the current baseline and to identify areas where sediment is a potential issue. Forestry is a significant land use in the sub-basin and ensuring correct mitigation measures are in place for all management activities will be important to minimise future risk of sediment loss to the waterbody and prevent any status deterioration. Stream walks to identify unmapped drains particularly connecting forestry stands to the river channel would also be useful, particularly where forestry management activities are likely to take place during the life of the project.

Graney (Shannon)_020

Moderate biological status in 2021 requires that this waterbody be restored to Good status. Local catchment assessment should be undertaken on sites shown in **Figure 23**, for parameters outlined in I to iv above. If sediment is confirmed to be an issue at the WFD monitoring point, forestry is the likely significant pressure. Initial LCA sites are shown in Figure 23. Forested areas adjacent to and upstream of the monitoring station should also be walked to identify sediment sources. Periodic elevated BOD at Aughadarreen Bridge also requires field investigation. Elevated BOD results did not coincide with elevated nutrients and dissolved oxygen levels below the limit of 80% have not been recorded here. However DO is frequently below optimal, with 21% of results below 90%. If summer macrophyte cover is high at this site, it may be useful to assess diurnal DO variation here.

Graney (Shannon)_010

Graney (Shannon)_010 is *Not at Risk* and meeting its Good ecological status objective (2013-2018). There are two WFD monitoring points on the waterbody. The upstream monitoring point, Br d/s L.Ea, dropped from High (Q4-5) to Good between 2014 and 2017. Biological status is High (Q4-5) at the waterbody outlet monitoring point, Caher Br S of L Graney (Q5 here up to and including 2017). Local catchment assessment would be useful to help to understand what may have caused the upstream deterioration. LCA should include assessments at both WFD monitoring locations for parameters outlined in i to iv above (see Figure 22). Stream walks to identify potential sediment sources should also be undertaken here. Sediment released in this waterbody has the potential to impact downstream. Upstream of Br d/s L.ea the river channel is bordered by forestry on the left bank for approximately 2.6km. Where access permits, it would be useful to undertake a stream walk to identify unmapped drains connecting forestry stands to the river channel, particularly if forestry management activities are planned for the area during the life of the project. Occasional elevated BOD results have been observed at the Caher Br monitoring point in the past. This requires field investigation.

Corra_010

This Good status objective waterbody has a protect status as it is currently *Not at Risk*. However, downstream waterbody Corra_020 did not meet its High status objective in the most recent biological monitoring survey undertaken (2021). It was at High biological status (Q4-5) when last assessed in 2017. It is possible that issues arose in Corra_010 which did not prevent it meeting its Good status objective but which impacted on High status objective Corra_020. This needs to be investigated in the field. Forestry is the main land use in Corra_010 and from the forest licence viewer, a significant number of applications for clearfell and thinning were approved for the sub-basin between 2018 and 2021. LCA here should focus on sediment as a potential issue impacting downstream. Undertake sediment assessment at the locations shown on Figure 19. Where access permits, undertake stream walks with Coillte/Forest Service staff to identify sediment pathways from forested areas, particularly where management activities are likely to be undertaken during the life of the project.

Corra_020

Though *Not at Risk* and at High ecological status (2013 – 2018), this Blue Dot waterbody will require restoration due to the drop to Good biological status in 2021. Initial assessments should focus on the WFD monitoring point, walking upstream to identify impacted reaches. LCA sites are shown in Figure 20. Parameters listed under I to iv above should be assessed. If sediment is found to be a significant issue at the monitoring point, work upstream to identify sediment sources. This will involve stream walks to map drainage pathways from forested areas. This will establish a baseline for future work as sediment should be assessed on an ongoing basis.

While agriculture is extensive in the sub-basin, there are areas under agriculture with poorly draining soil. Phosphate susceptibility maps indicate these may be moderate to high risk for phosphate (and sediment) loss to waters. Initial nutrient sampling should focus on low, mean and high river flows but higher resolution sampling may be needed if LCA indicates that nutrients are a potential issue.

Graney (Shannon)_030

This Blue Dot waterbody requires restoration. It is at Good ecological status (2013-2018) and *At Risk*. Initial LCA sites are shown in Figure 24**.** Sites should be assessed as outlined in I to iv above. Sediment is a likely significant issue at the WFD monitoring station so LCA should involve sediment assessment across the sub-basin. As for other waterbodies in the catchment, sediment sources should be identified to aid in planning for mitigation measures. If nutrient monitoring results are inconclusive but LCA indicates that nutrients may be an issue, higher resolution sampling may be needed at the WFD monitoring point in case of periodic nutrient spikes.

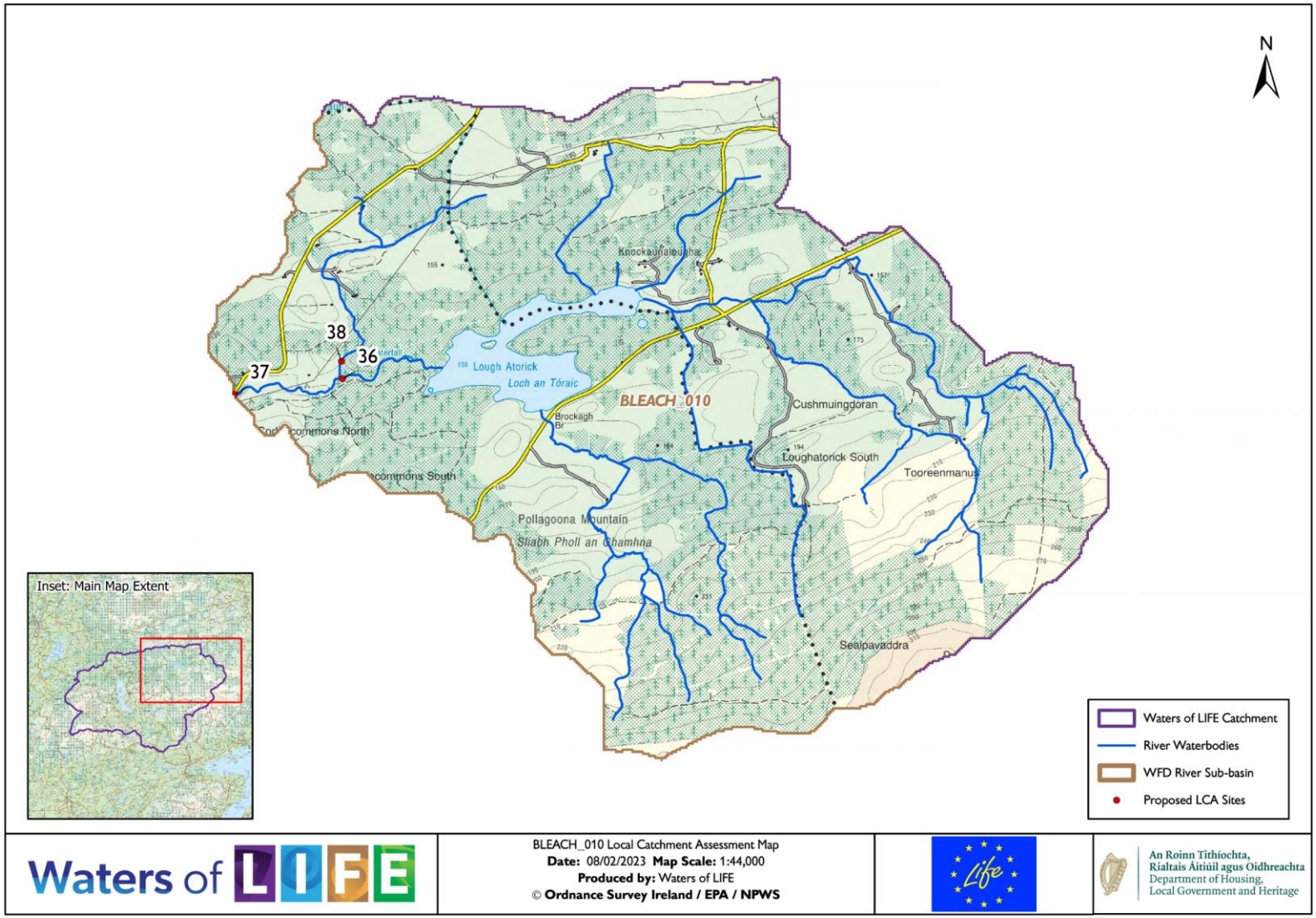


Figure 17 LCA sites in Bleach_010

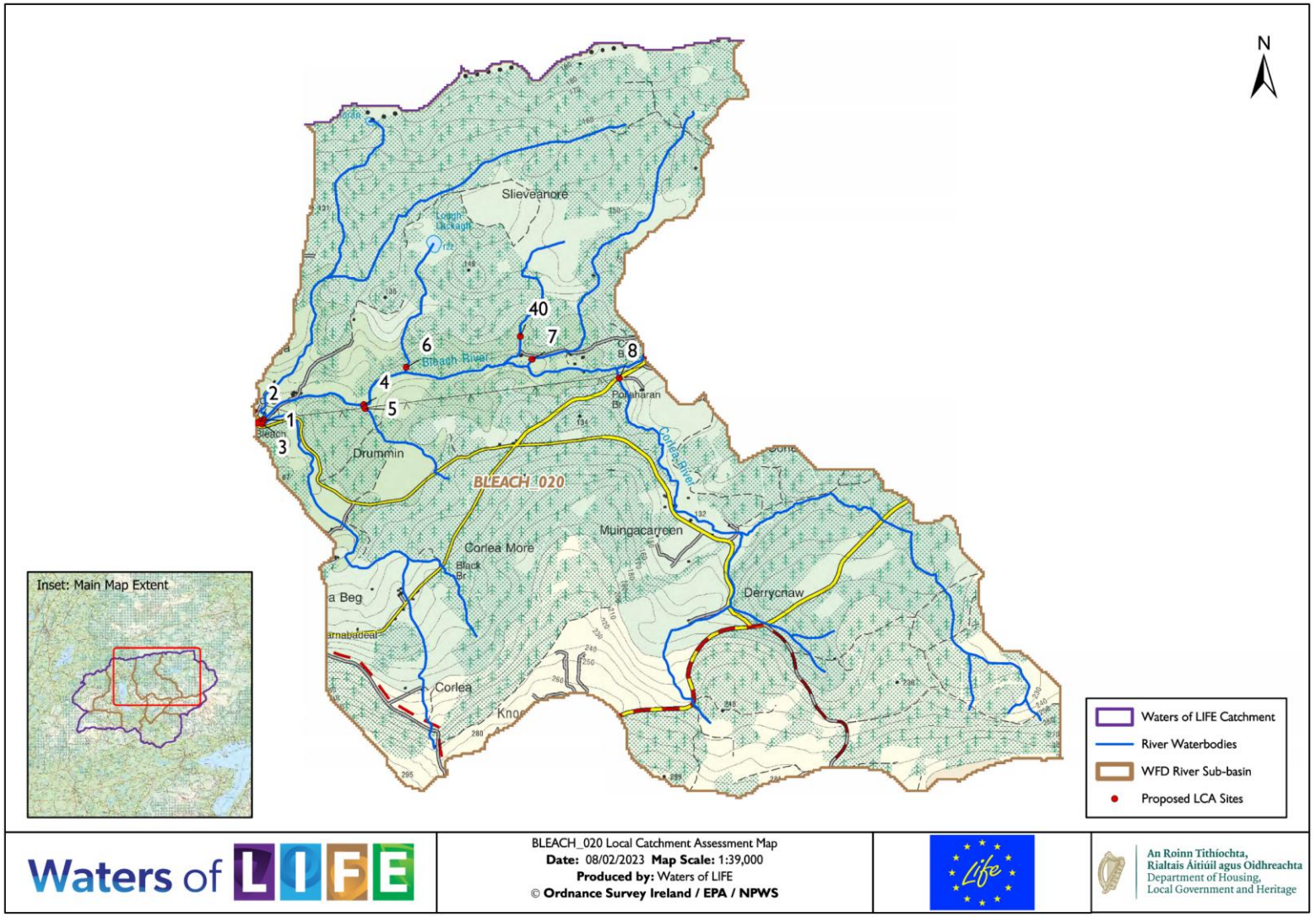


Figure 18 LCA sites in Bleach_020

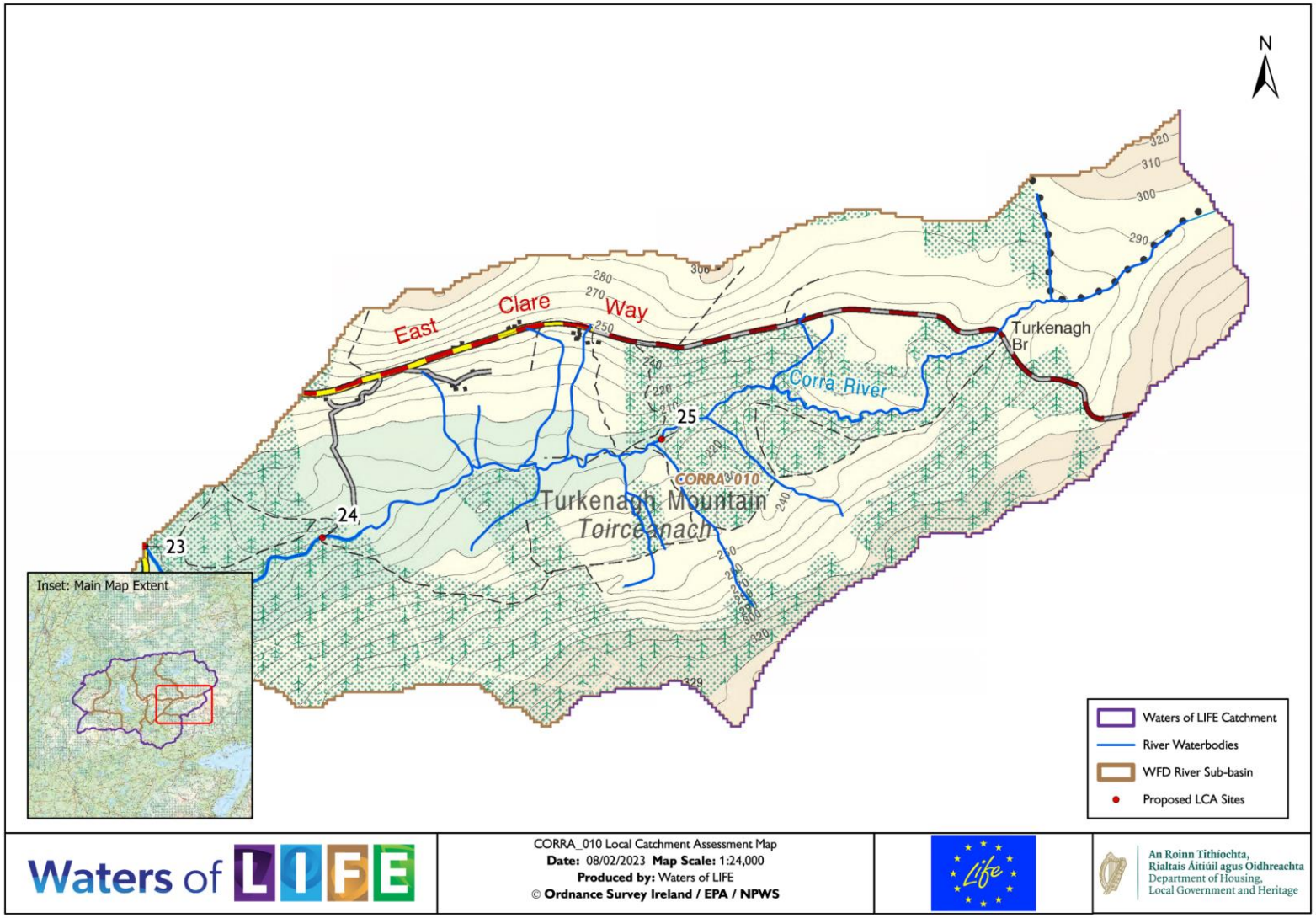


Figure 19 LCA sites in Corra_010

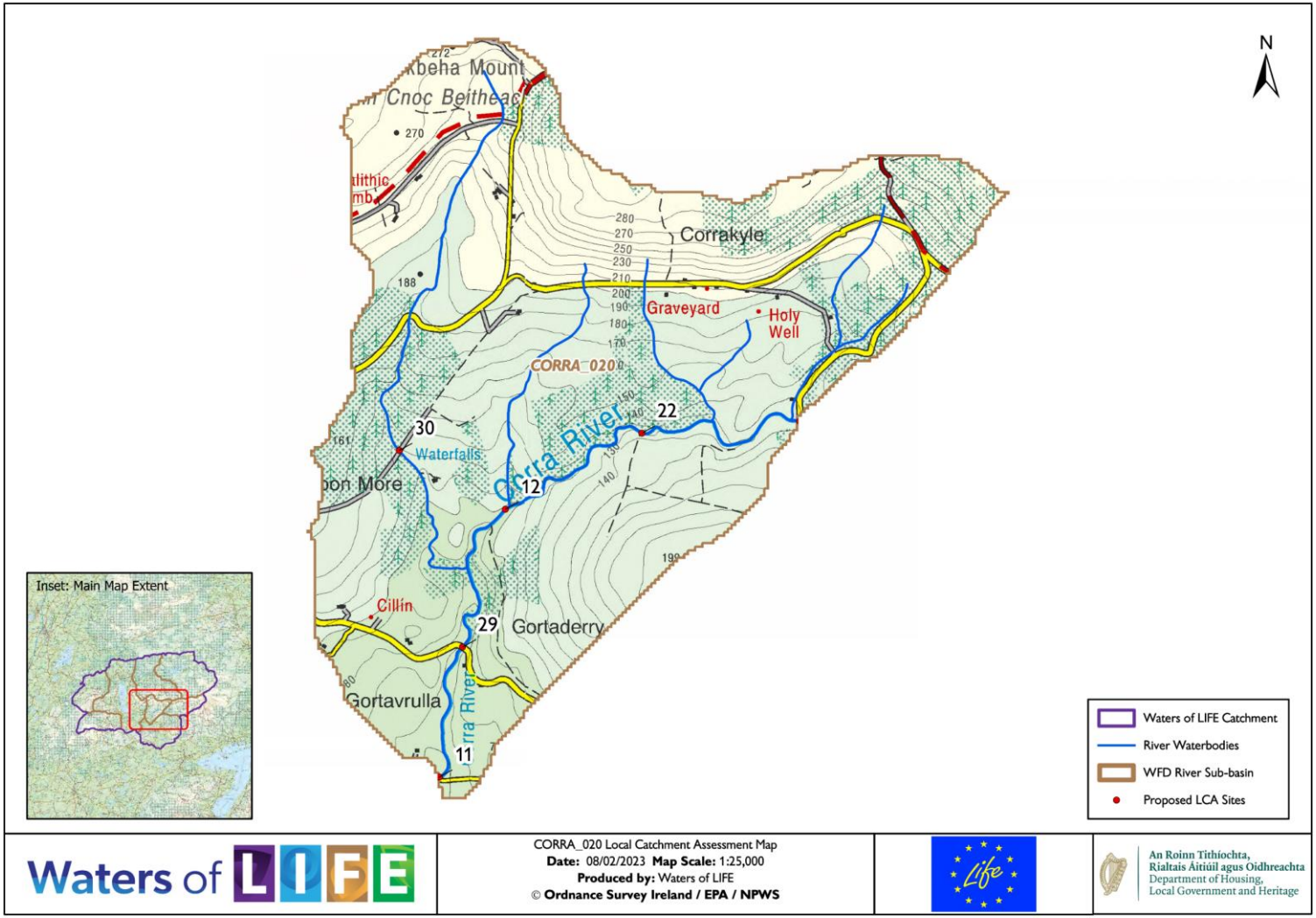


Figure 20 LCA sites in Corra_020

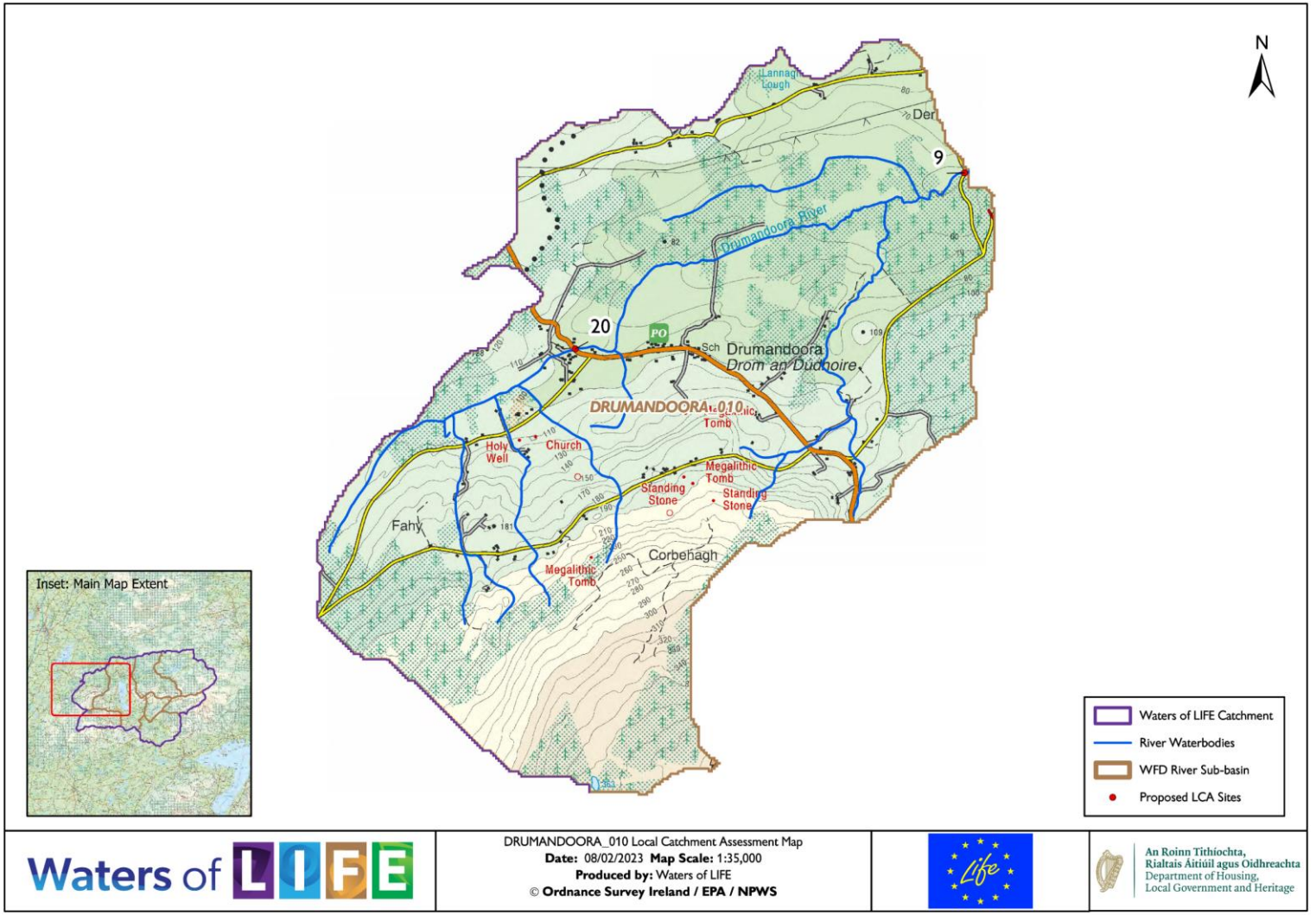


Figure 21 LCA sites in Drumandoora_010

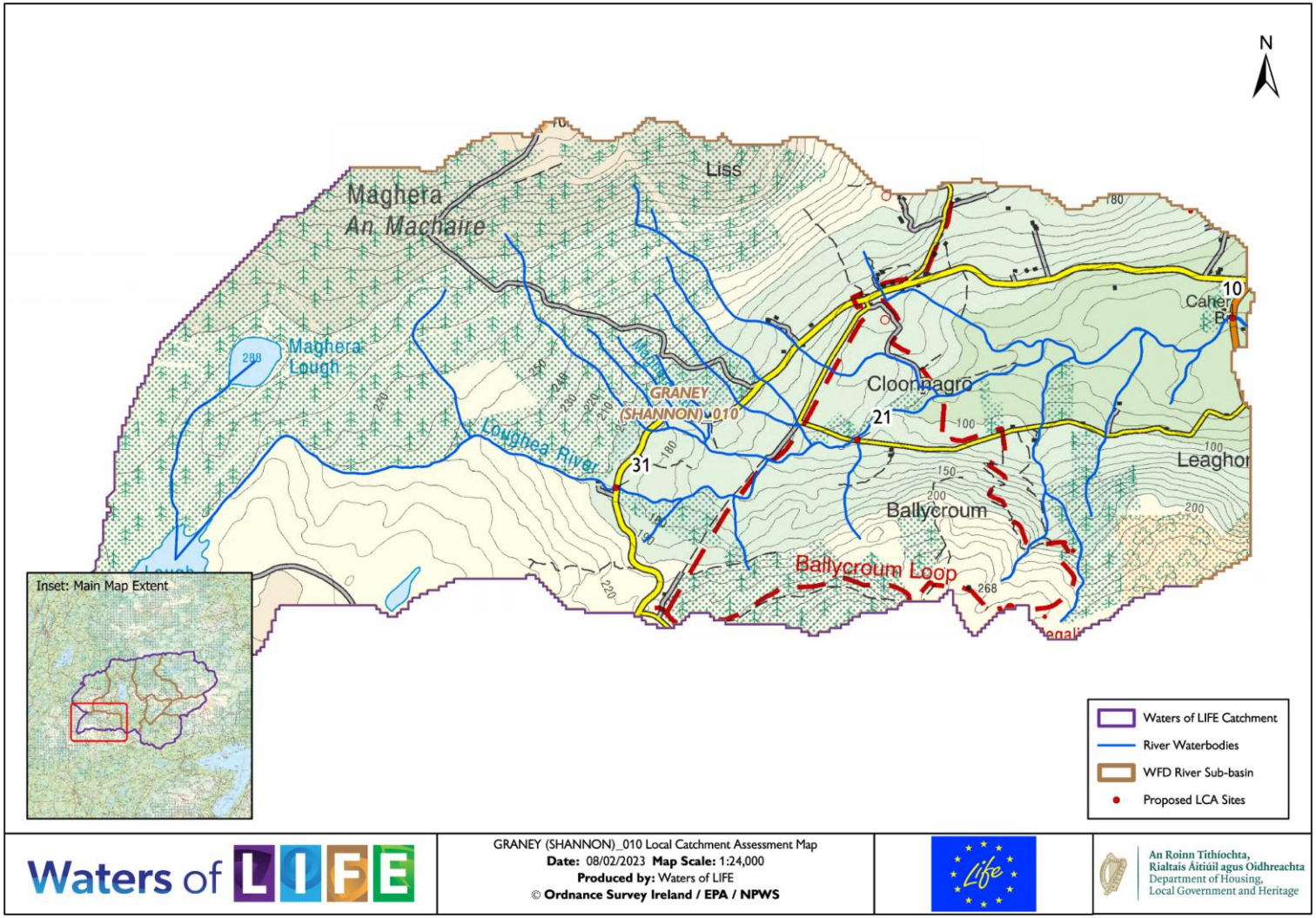


Figure 22 LCA sites in Graney(Shannon)_010

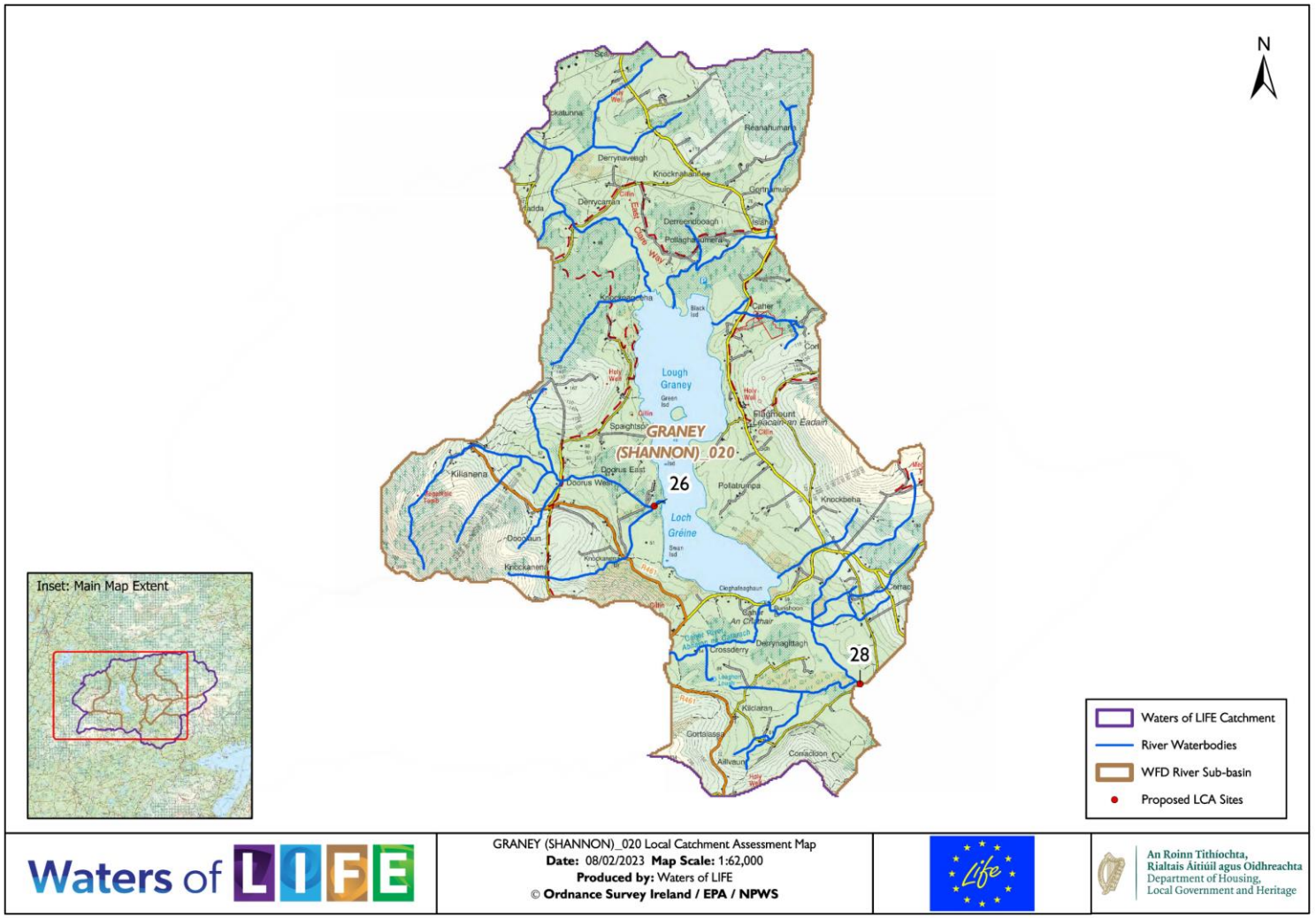


Figure 23 LCA sites in Graney(Shannon)_020

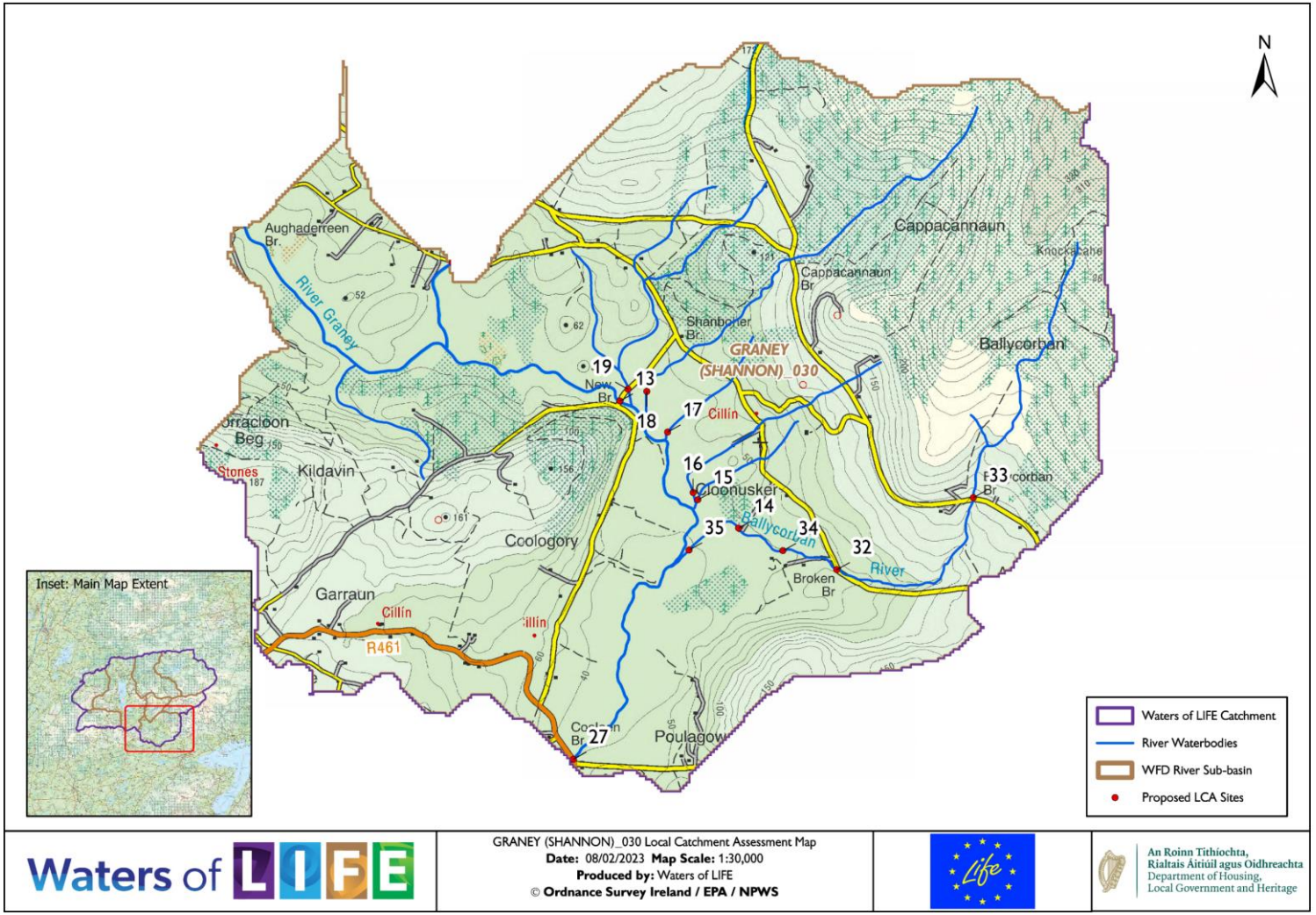


Figure 24 LCA sites in Graney(Shannon)_030

7 Review of mitigation options

Mitigation actions which focus on sediment loss are likely to be the most effective for achieving WFD targets in the Graney Demonstration Catchment. Some suggested mitigation actions are outlined below. These measures are proposed for restoring High ecological status in the High Status Objective waterbodies in the demonstration catchment (Bleach_020, Corra_020 and Graney (Shannon)_030 but they are also applicable to the five Good status objective waterbodies in the catchment to protect and restore.

7.1 Forestry

Detailed drainage surveys (ground-truthed by walk over surveys) should be required for all afforestation, forest road construction, thinning and felling applications. This is to ensure that there are no direct drainage pathways to watercourses for new afforestation applications and that high risk pathways connecting existing forestry stands to waters are identified in advance of any works being undertaken. The walkover surveys should inform appropriate surface water management regimes on site in accordance with Best Forest Practice. Site specific measures should be put place for existing forestry stands to break these high risk drainage pathways for sediment (and nutrient) loss to watercourses in advance of works being undertaken.

Re-establishment after clear fell in legacy forestry sites must apply Best Forest Practice e.g. set-backs and surface water management to minimise risk of future impacts.

On site supervision during felling is important to minimise risk and ensure compliance with water quality protection measures specified in licence conditions for HSOWBs.

Aerial fertilisation carries a risk of uncontrolled fertiliser dispersal and loss to waters and should be considered inappropriate for all HSOWBs. Forest Service to advise forestry owners in such areas and discourage applications for aerial fertilisation.

7.2 Agriculture

Education and awareness raising for farmers of agricultural pressures from farm yards, from effluent management and from overland flow pathways for phosphate.

Source control, mobilisation control and pathway interception measures to reduce sediment loss to watercourses.

Where relevant, phosphate PIP maps should be used to help raise awareness by landowners and farmers of areas on their own lands where there may be a risk.

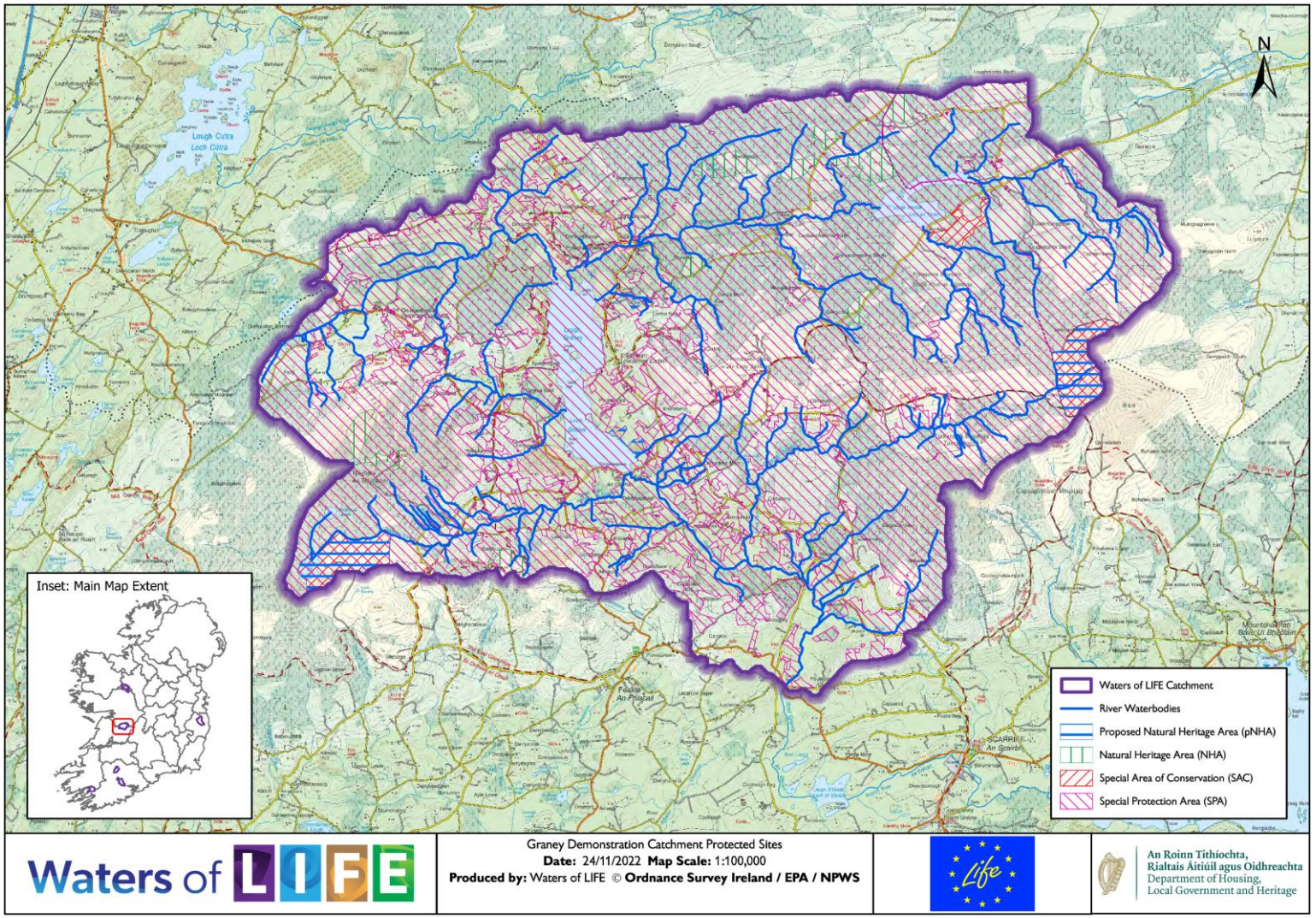
Awareness to landowners and farmers of impacts of land reclamation. Advise on better practice and measures to prevent sediment losses to water and riparian removal etc.

Advise on land drainage following best practice guidance from agricultural advisory bodies

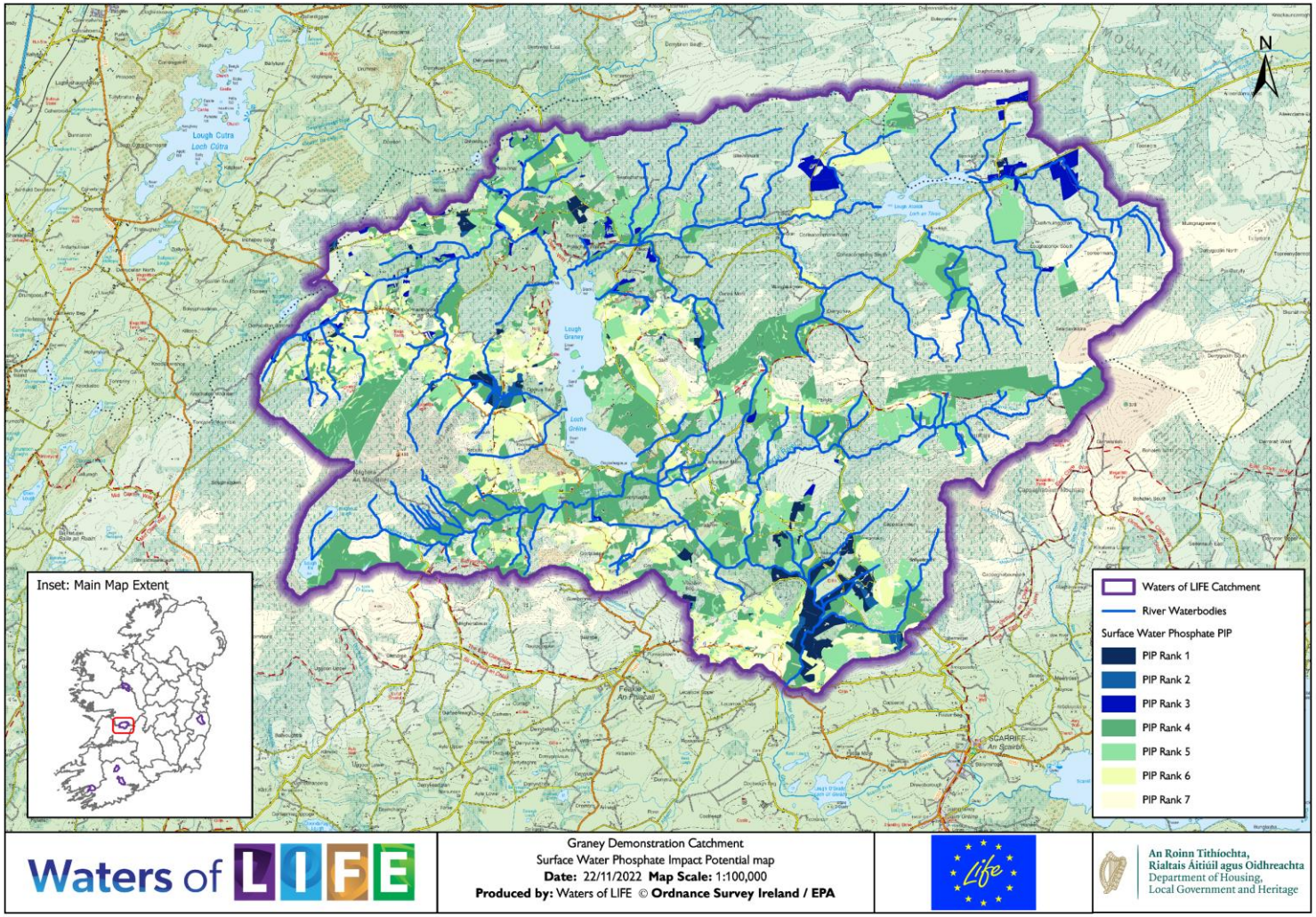
7.3 DWWTS

Domestic wastewater treatment systems have not been identified as a significant pressure in any of the *At Risk* waterbodies in the demonstration catchment. General protect measure recommended, to encourage grant uptake in HSOWBs and raise awareness of risk.

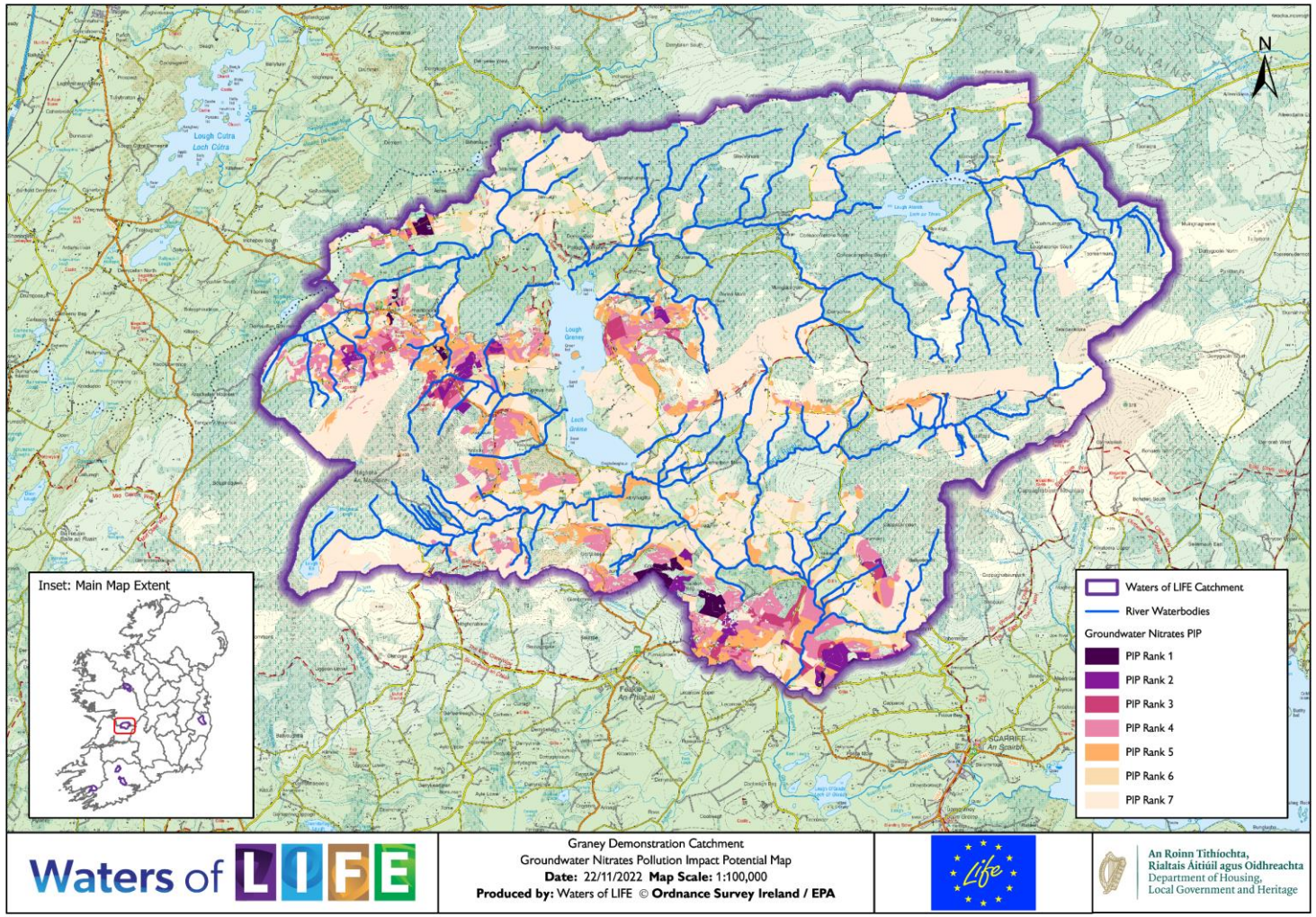
Appendix I: Protected areas in the Graney Demonstration Catchment.



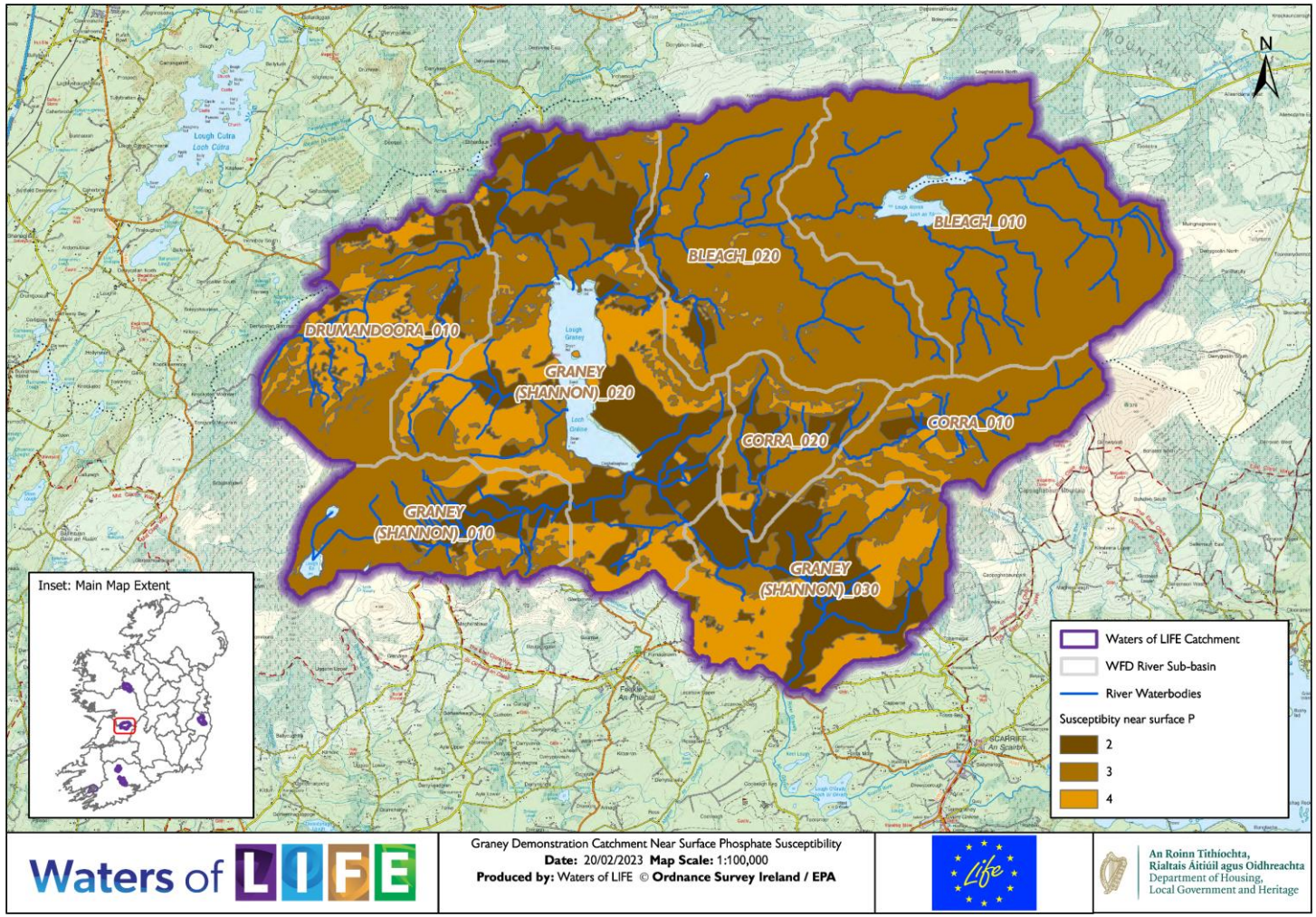
Appendix II: Phosphate PIP map, Graney Demonstration Catchment



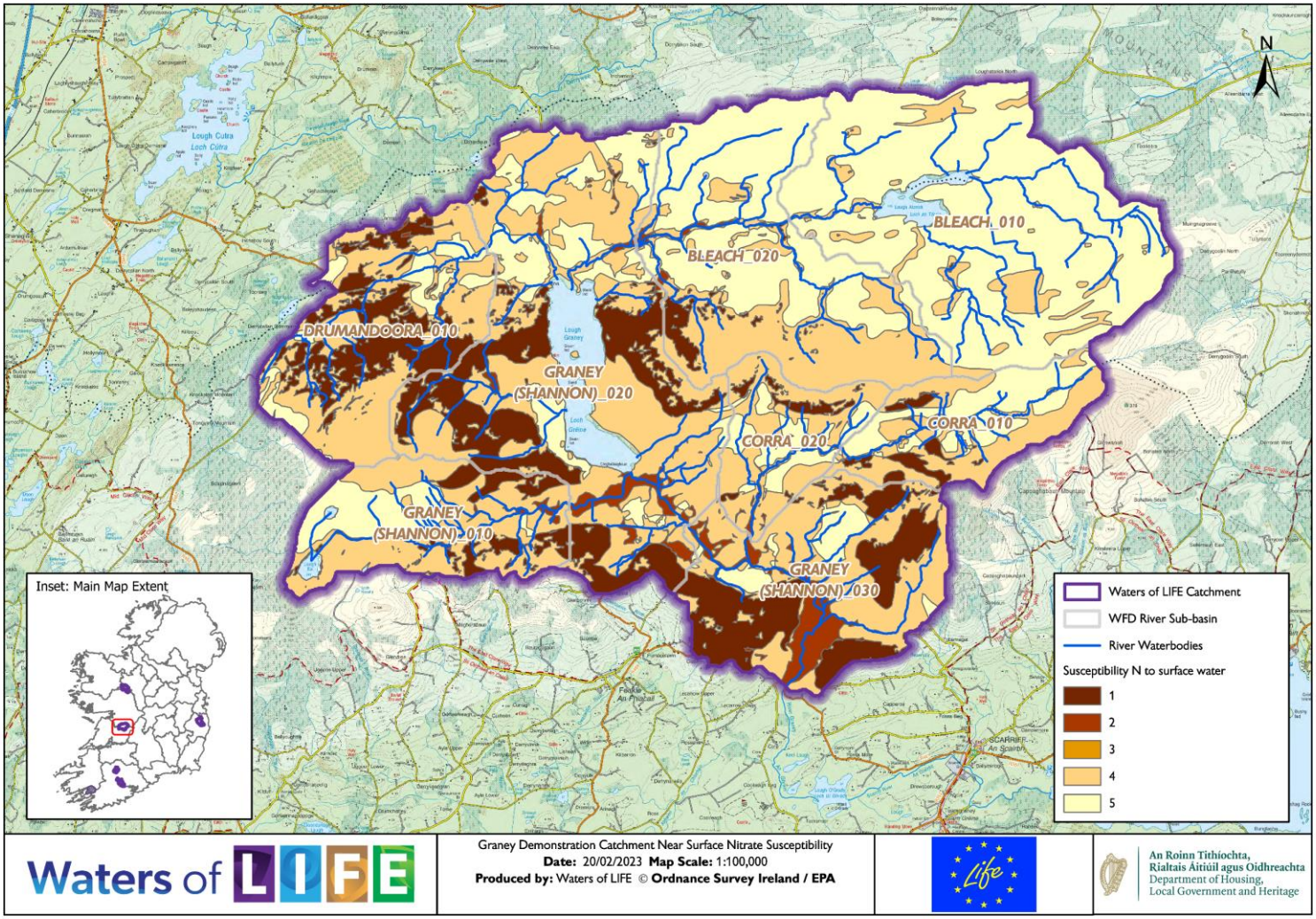
Appendix III: Nitrate PIP map, Graney Demonstration Catchment



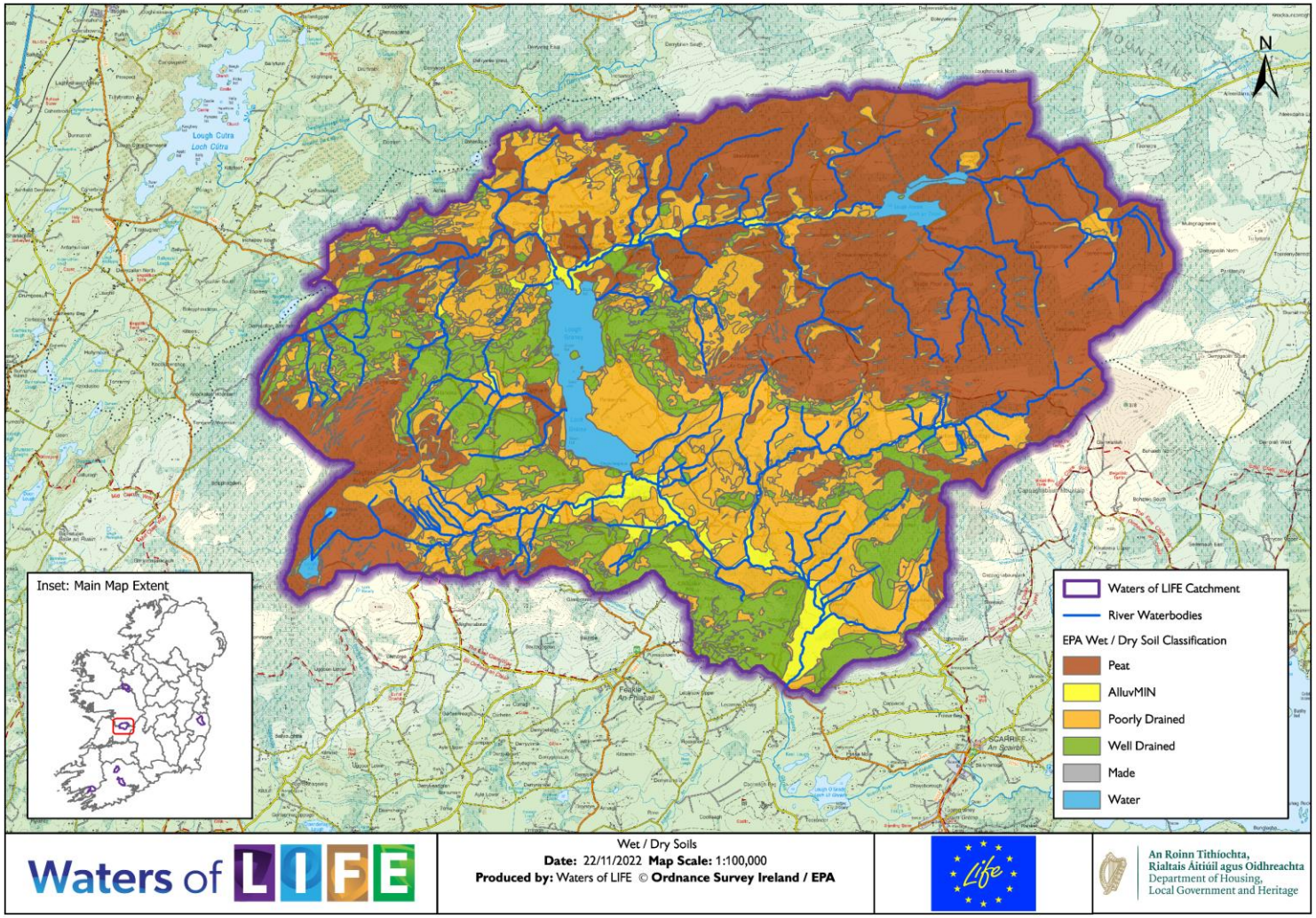
Appendix IV: Phosphate susceptibility map, Graney Demonstration Catchment



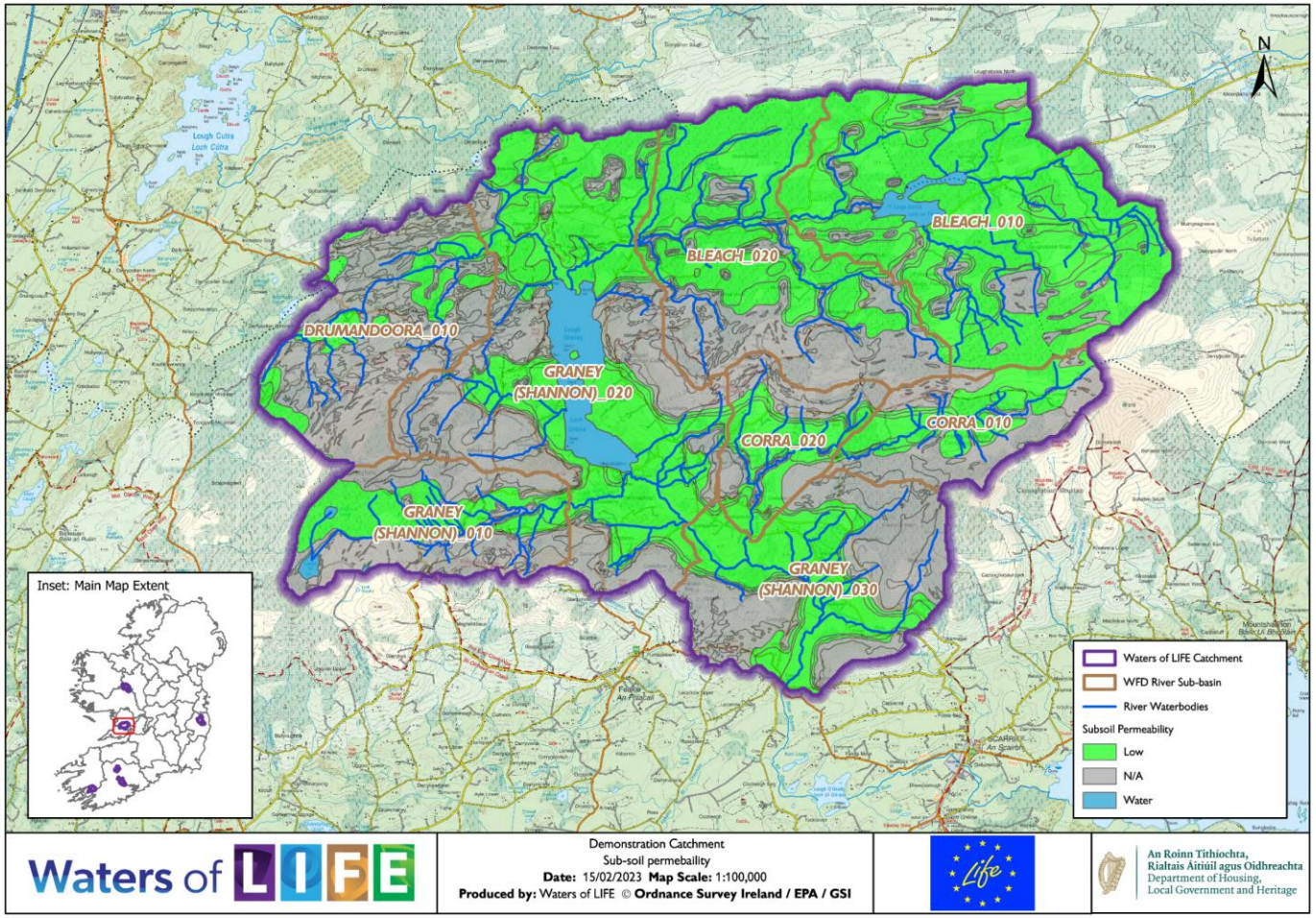
Appendix V: Nitrate susceptibility map, Graney Demonstration Catchment



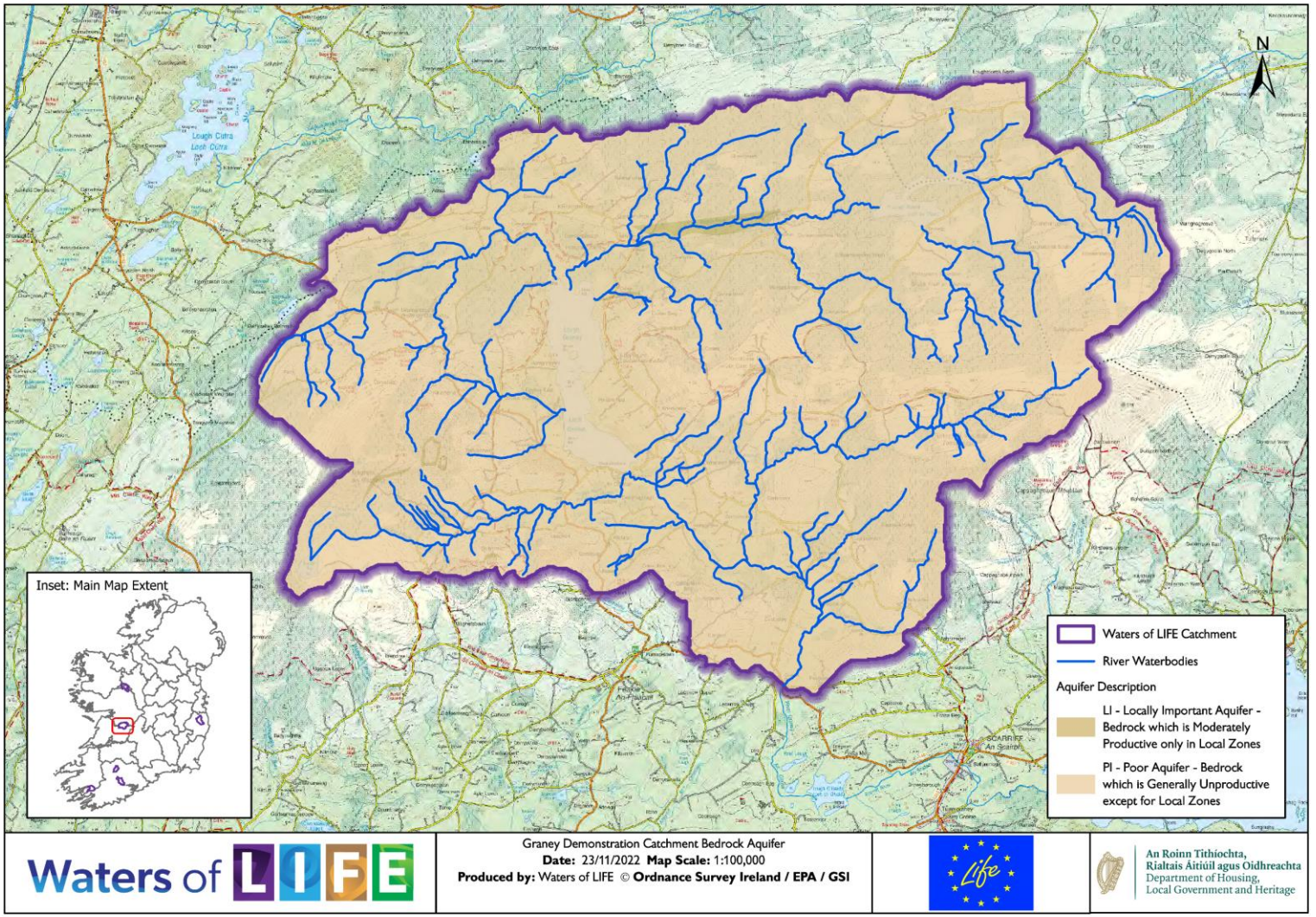
Appendix VI: Wet Dry Soils map, Graney Demonstration Catchment



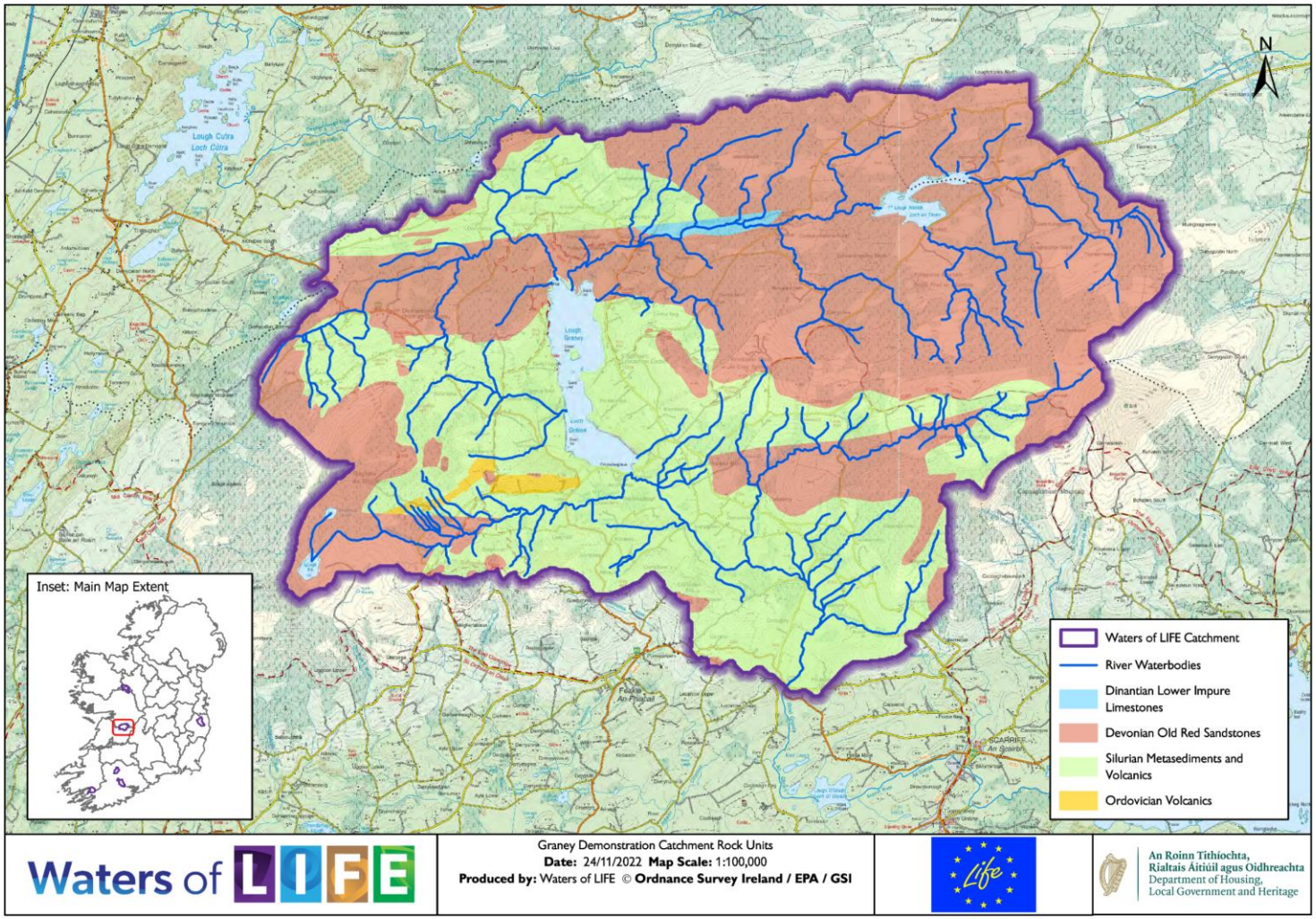
Appendix VII: Subsoil permeability map, Graney Demonstration Catchment



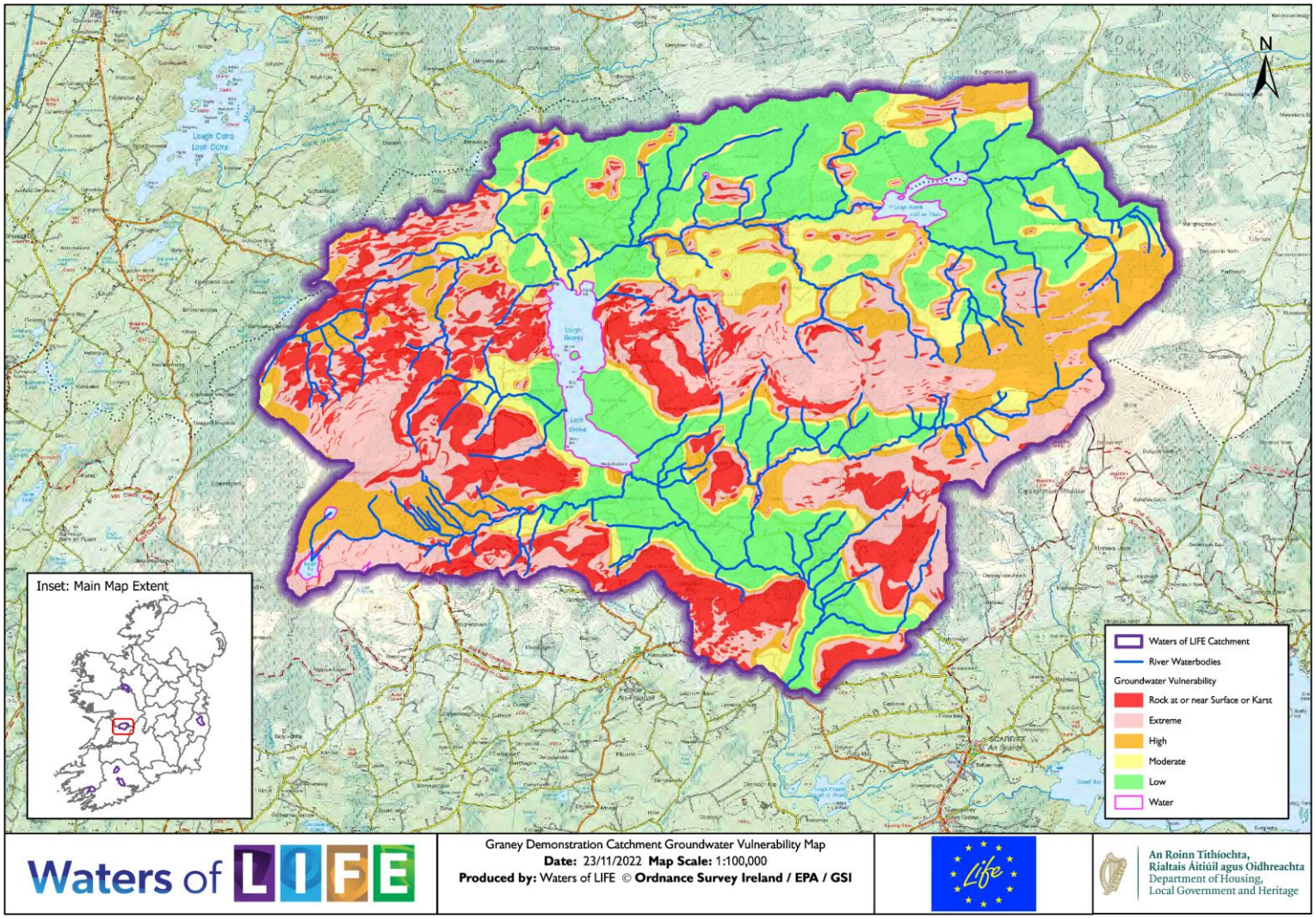
Appendix VIII: Bedrock aquifer map, Graney Demonstration Catchment



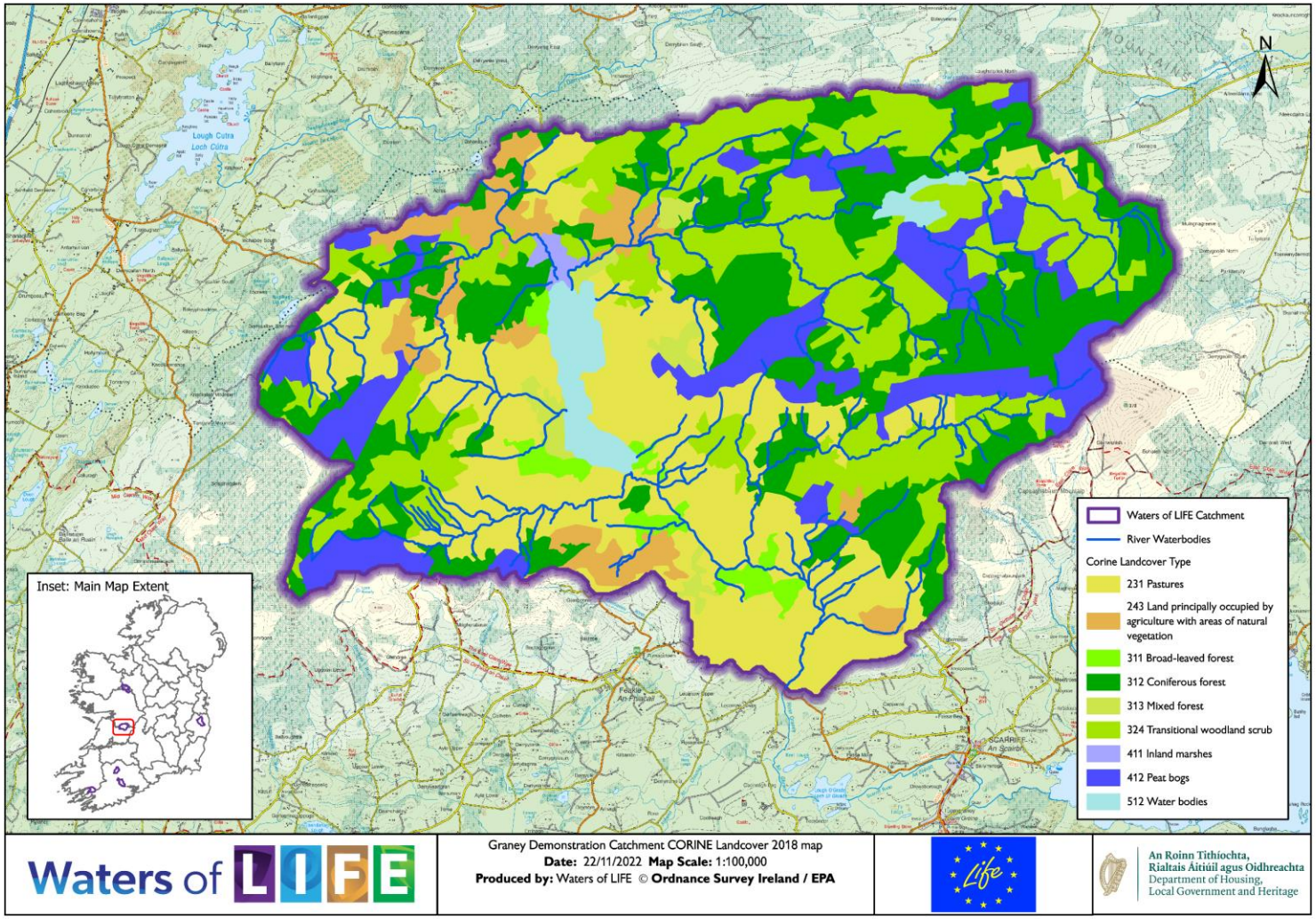
Appendix IX: Rock units, Graney Demonstration Catchment



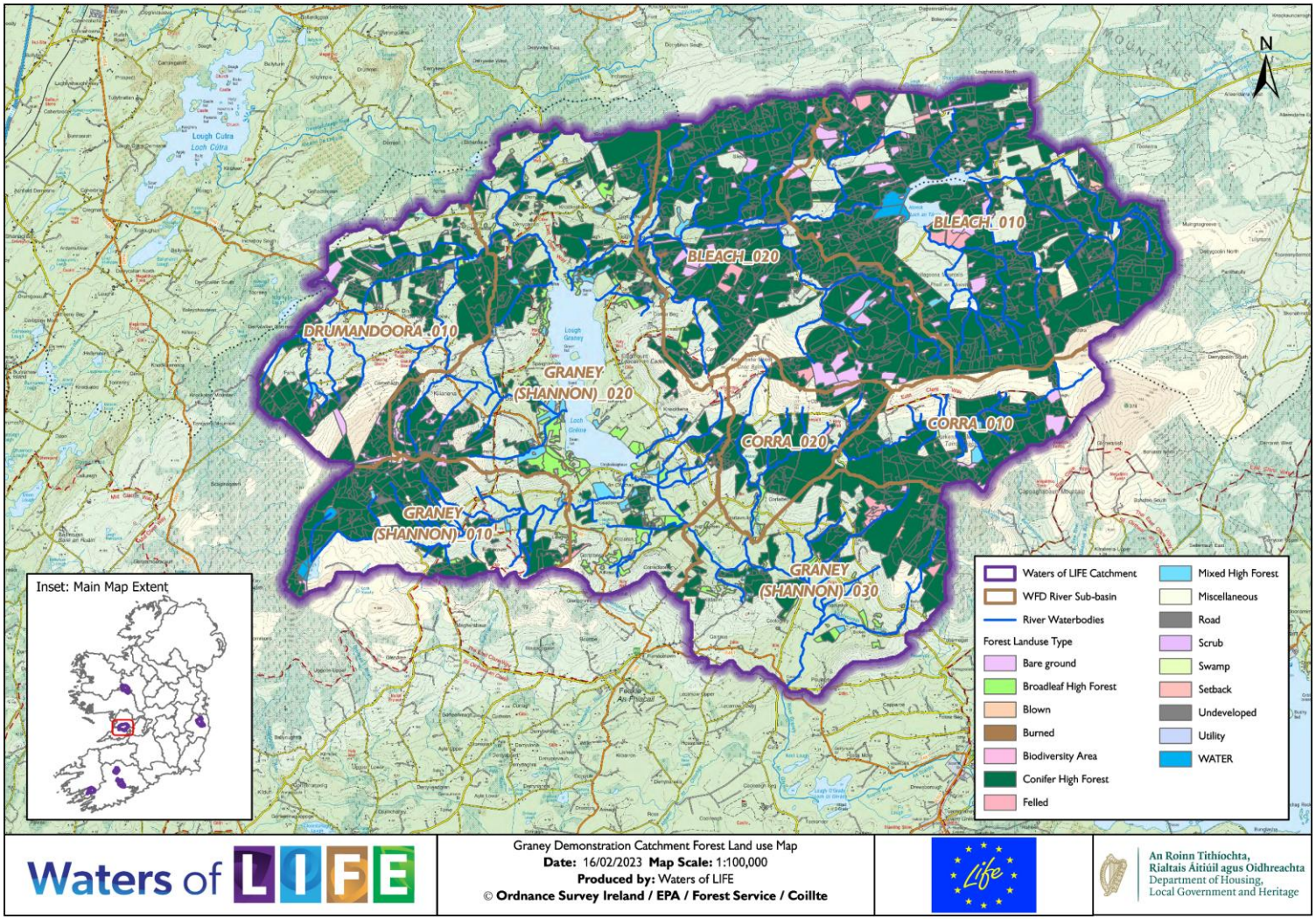
Appendix X: Groundwater vulnerability, Graney Demonstration Catchment



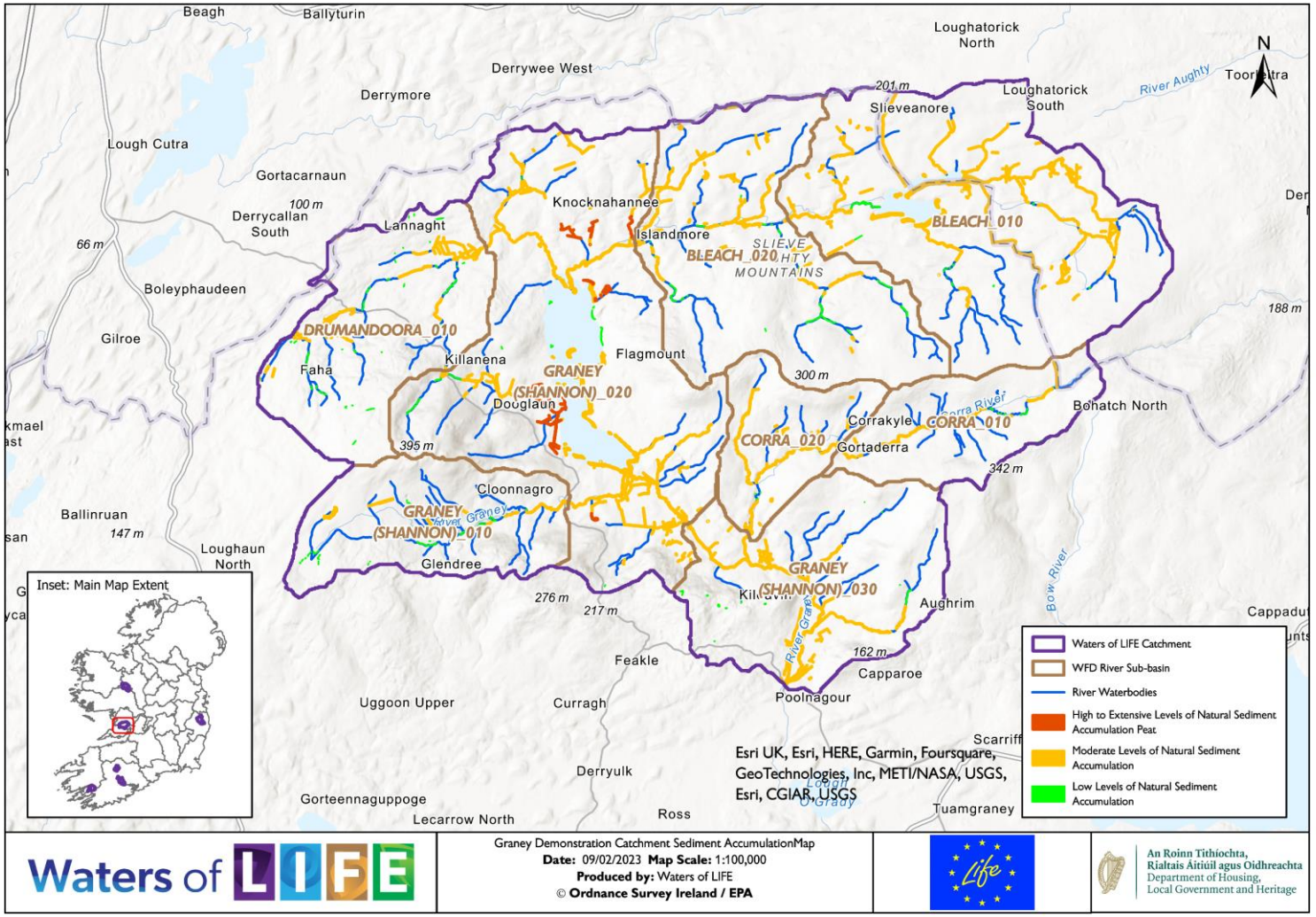
Appendix XI: Corine land use map, Graney Demonstration Catchment



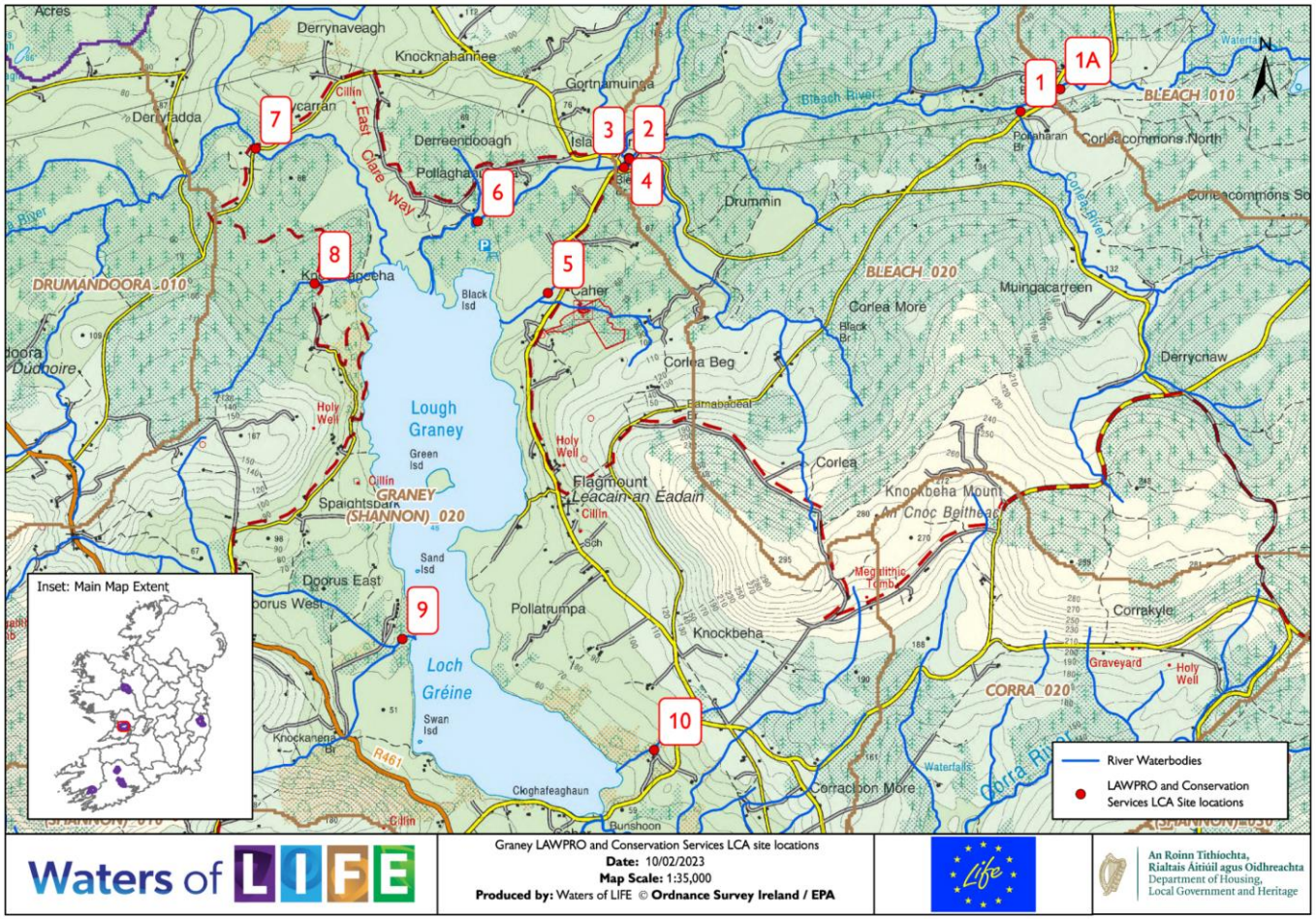
Appendix XII: Forest land use map, Graney Demonstration Catchment



Appendix XIII: Sediment Settings map, Graney Demonstration Catchment



Appendix XIV: LAWPRO and Conservation Services LCA site locations for biological and hydrochemistry assessments



Courtesy of Conservation Services

Appendix XV: Biological quality assessment results for river/stream sites in the Bleach/Lough Graney catchment

Site	Q Rating March 2022
1A	Q4-5
1	Q4-5
2	Q4-5
3	Q4-5
4	Q4-5
5	Q4-5
6	Q4-5
7	Q3-4
8	Q4
9	Q4-5
10	Q4-5

Appendix XVI: Results of 2021 LAWPRO assessment of total phosphorus loading to Lough Graney.

Site	Catchment Area	Flow		Total Phosphorus				
	km^2	Percentile %	Rate m^3/day	Concentration mg/l	Load kg/day	Load kg/km^2/day	Required Load Reduction kg/year	Required Load Reduction kg/km^2/year
5	1.8	Q40	3249	**0.043**	0.14	0.08	-27	-16
	1.8	Q5	13962	**0.046**	0.64	0.37	-133	-76
	1.8	Q20	6540	**0.035**	0.23	0.13	-36	-20
6	65.6	Q40	130982	**0.199**	26.07	0.40	-8558	-130
	65.6	Q5	606010	**0.030**	18.18	0.28	-2212	-34
	65.6	Q20	245549	0.022	5.40	0.08	-179	-3
7	23.4	Q40	34992	**0.031**	1.08	0.05	-140	-6
	23.4	Q5	130982	0.021	2.75	0.12	-48	-2
	23.4	Q20	63850	0.019	1.21	0.05	23	1
8	1.0	Q40	1860	**0.058**	0.11	0.11	-26	-26
	1.0	Q5	7981	0.020	0.16	0.16	0	0
	1.0	Q20	3736	0.019	0.07	0.07	1	1
9	7.8	Q40	16762	**0.029**	0.49	0.06	-55	-7
	7.8	Q5	52963	0.016	0.85	0.11	77	10
	7.8	Q20	28166	0.017	0.48	0.06	31	4
10	0.9	Q40	1581	**0.031**	0.05	0.06	-6	-7
	0.9	Q5	6765	0.021	0.14	0.17	-2	-3
	0.9	Q20	3171	0.014	0.04	0.05	7	8

Site locations are as shown in Appendix XIV.