

Lickeen System

Priority Area for Action Desk Study (AFA0104)



Southern shore of Lickeen Lake. Photograph taken on 28th May 2020.

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Data attribution

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

- Catchment boundaries, waterbodies and areas for action: EPA (2018)
 - Bedrock Unit: GSI (2008)
 - Aquifer Category: GSI (2015)
 - Groundwater body: EPA Catchments Unit (2018)
 - Soils & Subsoils Maps: Teagasc-EPA (2015)
 - IFS Soils: EPA (2006)
 - Susceptibility and Pollution Impact Potential Maps: EPA (2018)
 - WFD waterbody status: EPA (2018)
 - Pollution Impact Potential Maps: EPA (2016)
 - National Research Survey Programme, Fish Stock Survey of Lickeen Lough: IFI September (2016)
 - Abstractions-National POMS/Standards Study Revised Risk Assessment Methodology for Surface Water Abstractions from Lakes, CDM January 2009
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Summary

The Lickeen Priority Area for Action (PAA) comprises Lickeen Lake and the Ballymacravan_010 waterbody. The PAA is situated approximately 4 kms south west of the village of Kilfenora and less than one km to the north west of Ennistymon in County Clare.

Lickeen Lake (Type 8) is the drinking water supply for approximately 14,000 people in Ennistymon and environs and so is a WFD Registered Protected Area for Drinking Water, as is the Ballymacravan River.

Ballymacravan_010 flows into and out of Lickeen Lake, in a westerly direction to the Inagh River Estuary SAC. There is a second river channel within the Ballymacravan_010 waterbody, to the north of the main channel. This northern stream discharges separately to the Inagh Estuary and is not monitored for WFD purposes. It is not included in the scope of this desk study as it is not hydrologically connected to the main Ballymacravan_010 river channel.

Pasture is the predominant land use in the sub-basin with small areas of peat bogs, transitional woodland scrub and pockets of forestry (private and Coillte), particularly to the south of the lake.

Soils around the lake are a mix of poorly draining and peat. Soils in the Ballymacravan_010 downstream of the lake are mainly well draining.

Topography is relatively hilly with elevated areas throughout. The sub basin is underlain by a poorly productive (LI) aquifer (Milltown Groundwater Body).

Ballymacravan_010

- Ballymacravan_010 is currently at Poor status and *At Risk* of failing to meet its WFD Good status objective.
 - There are two WFD operational monitoring stations on the waterbody.
 - Nutrients are not monitored at either station, but the conclusion of this desk study is that nutrients are unlikely to be a significant issue here.
 - The Poor WFD status of Ballymacravan_010 is driven by 2015 biological monitoring results for the upstream monitoring station '*BALLYMACRAVAN-Br just d/s Lickeen Lough*' (RS28B020100). This site has not achieved better than Q3-4 (Moderate status) since monitoring commenced. The suitability of this site for WFD monitoring is questionable as it could not be assessed between 2000 and 2009 and again in 2012 because it was dry. The significant pressure here is (possibly) the lake abstraction which may be causing the river to dry up at this location in low flow conditions or exacerbating the risk of it doing so. The site is also very close to the lake outlet (30m downstream) and the lake outflow may be impacting river biology here.
 - The second WFD station downstream at Calluragh Bridge (RS28B020400) was consistently at Good status (Q4) from 2006 to 2015 inclusive. Status was Poor with a toxic impact in 2003 and Moderate with extensive siltation when assessed in 2018. The Ballymacravan water treatment plant is located approximately 500m upstream of the Calluragh bridge site. Occasional incidents of ferric sludge discharge have been reported from the facility, indicating that it may be a potential significant pressure on the Calluragh Bridge monitoring station given that sediment can be released with the treatment plant sludge. There is also a small housing development (five houses) on its own wastewater treatment system, located immediately north of the water treatment plant. However, this is unlikely to be a significant pressure if sediment is the significant issue at the WFD monitoring point.
-

Lickeen Lake

- Lickeen Lake is at Bad ecological status, with status driven by Fish.
- The lake is the drinking water supply for Ennistymon and surrounds, serving a population of 14,000.
- The lake is *At Risk* of failing to meet its WFD Good status objective.
- The significant issue impacting on water quality is total phosphorus
- The significant pressures are agriculture and forestry.

Recommended Actions:

- Local catchment assessment (LCA) on Ballymacravan_010 will focus on the main river channel between the Calluragh Bridge Station and the lake outlet and will include an assessment of the WTP potential point source pressure.
 - The local catchment assessment on Lickeen Lake will focus on all inputting tributaries, including the feeder streams and the headwaters of Ballymacravan_010, assessing nutrient (TP) load to the lake.
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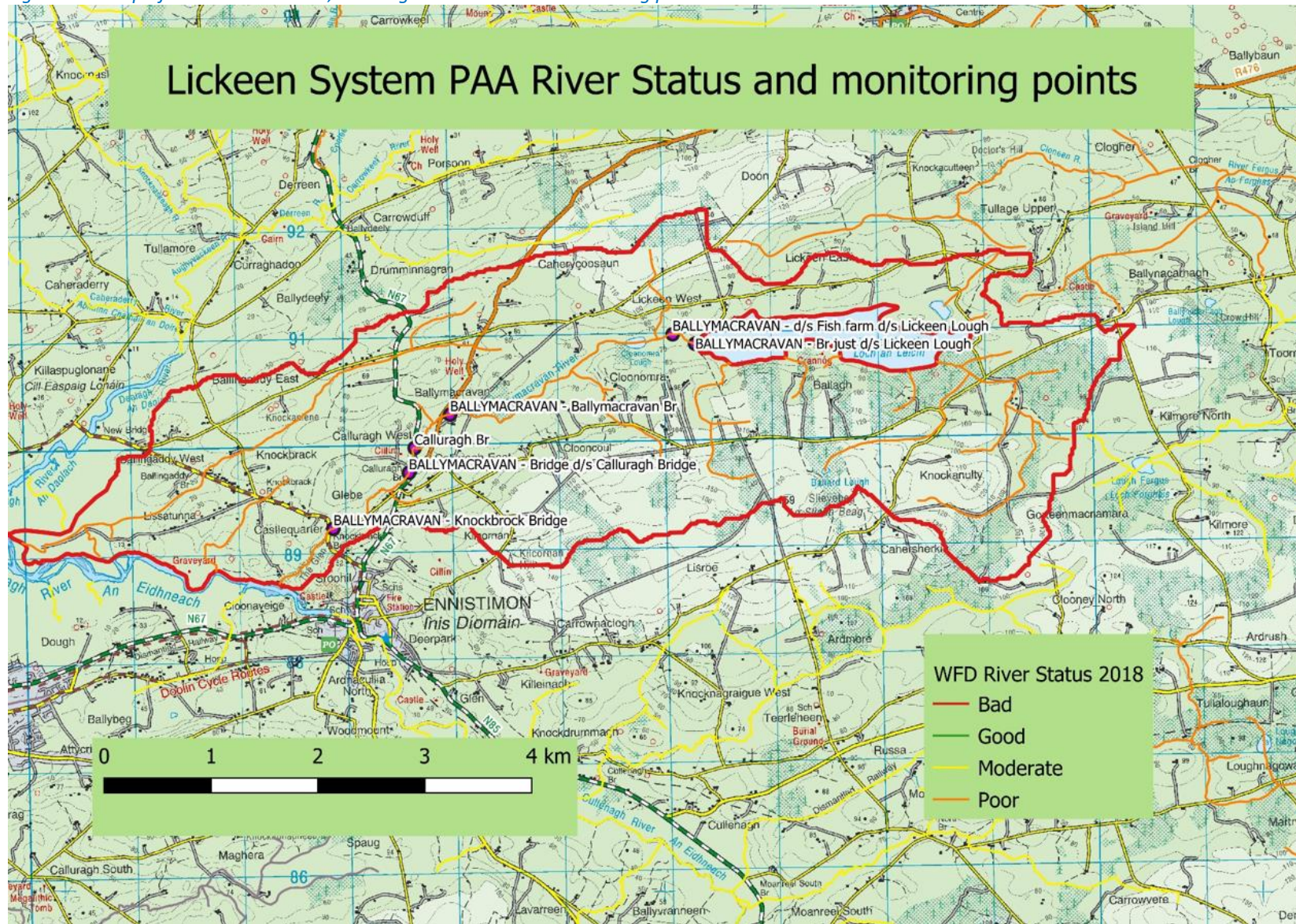
1 Background

1.1 Background information on the Lickeen System PAA

Priority Area for Action	Catchment Number	Catchment Name	Sub catchment	Region	Local Authority
Lickeen System	28	Mal Bay	(28_6 Inagh[Ennistymon]_SC-020)	South West	Clare County Council

Priority Area for Action	No. of <i>At Risk</i> WBs	No. of <i>Review</i> WBs	No. of <i>dRBMP</i> Prioritised WBs	No of WBs for Status Improvement:		
				2021	2027	Beyond 2027
Lickeen System	2	0				
Reasons for selection	<ul style="list-style-type: none"> • Reasons for Selection: • Bad status lake • Lickeen lake is an important trout fishery and former char lake. • Active community group. • Manageable area - small number of landowners. • Two deteriorated water bodies. • One water body (Lickeen lake) is failing to meet its protected area objectives for drinking water. 					

Figure 1-1: Map of Lickeen catchment, showing River Status and monitoring point locations:



1.2 Waterbody Information

Table 1.1: Summary information from WFD App

WB Code	WB Name	WB Type	Risk	Status Obj.	2007-2009	2010-2012	2010-2015	2013-2018	Pressure Category	Pressure sub-category	Sig?	Action
IE_SH_28B020400	Ballymacravan_010	River	At Risk	Good	Good	Mod	Poor	Poor	Hydromorphology	Dams, barriers, locks, weirs	Yes	IA1 (EPA)
IE_SH_28_85	Lickeen	Lake	At Risk	Good	Poor	Bad	Bad	Bad	Forestry	Forestry	Yes	IA1 (IFI)
									Agriculture	Pasture	Yes	IA9

Source: WFD App

Table 1.2: Monitoring point locations

Waterbody	Monitoring Point Code	Name	Type	Monitoring results
Ballymacravan_010	RS28B020100	BALLYMACRAVAN - Br just d/s Lickeen Lough	Operational	No. Q only
	RS28B020400	Calluragh Br	Operational	No. Q only
Lickeen	LS280014900800010	Site 1	Surveillance and Operational (22m depth approx.)	Yes
	LS280014900800020	Site 2	Surveillance and Operational (8m)	Yes
	LS280014900800030	Lickeen Surrogate Shore Site 1a	Surveillance and Operational	Yes
	LS280014900800030	Lickeen Surrogate Shore Site 2a	Surveillance and Operational	Yes
	LS280014900800040	PB_0010: _LIT_0010	Surveillance and Operational	No
	LS280014900800050	M_6	Surveillance and Operational	No
	LS280014900800060	M_5	Surveillance and Operational	No
	LS280014900800070	M_4	Surveillance and Operational	No
	LS280014900800080	M_3	Surveillance and Operational	No
	LS280014900800090	M_2	Surveillance and Operational	No
	LS280014900800100	M_1	Surveillance and Operational	No
	LS280014900800120	PRF_010	Investigative	No
	LS280014900800130	historical profile site	Investigative	No
	LS280014900800140	historical profile site	Investigative	No
LS280014900800150	Fish/Biota Dummy site	Surveillance	No	

2 Receptor Information

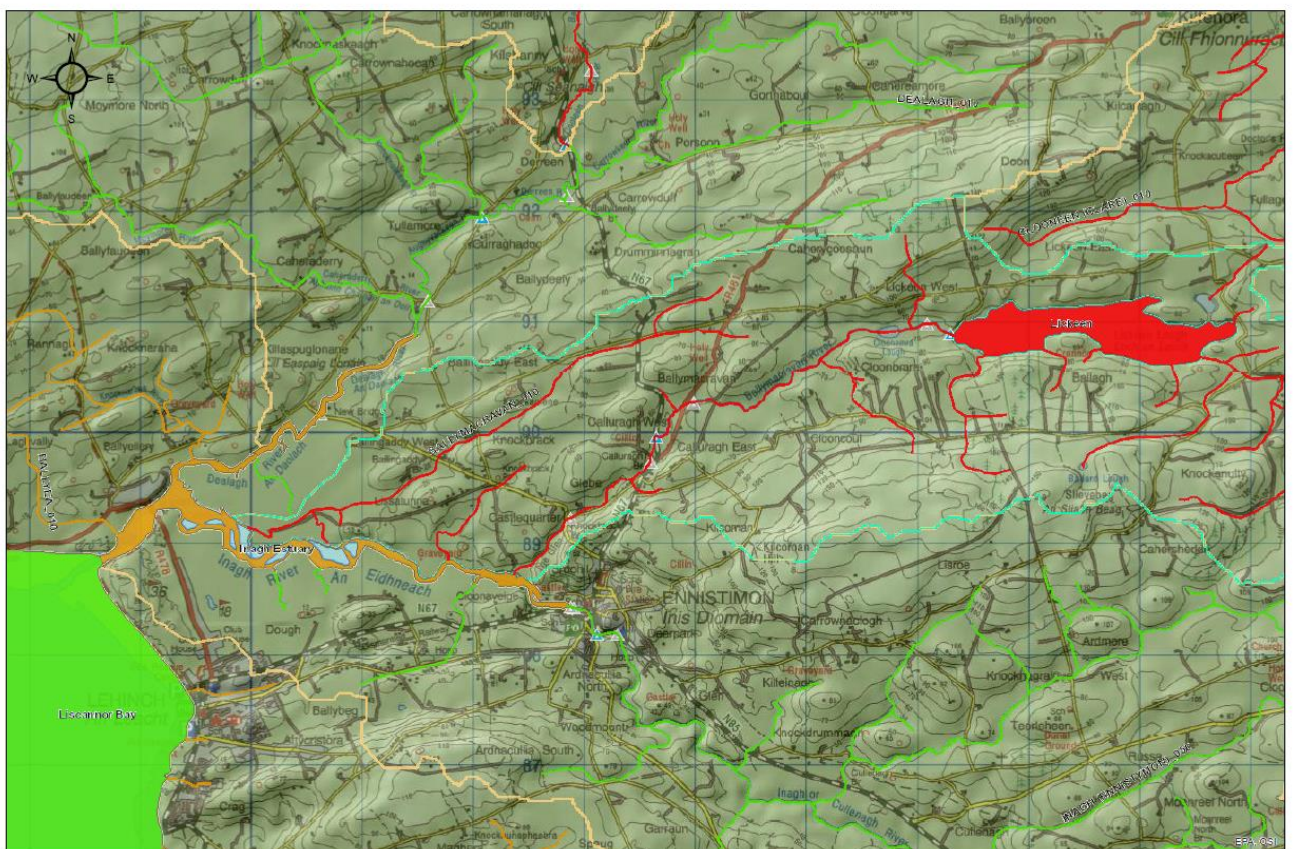
2.1 Receptor overview

Lickeen system PAA comprises Lickeen Lake and the Ballymacravan_010 waterbody. Lickeen Lake (Bad WFD status and *At Risk*) is a Type 8 lake (84 hectares). It is the public drinking water supply for Ennistymon and surrounds (Ennistymon PWS 0300PUB1004) serving a population of 14,000 and supplying 6,000-7,500m³/day approximately.

Ballymacravan_010 flows in to and out of Lickeen Lake. Ballymacravan_010 is at Poor status and *At Risk*.

PAA WFD Risk and Status maps are provided in Figures 2-1 and 2-2 respectively.

Figure 2-1: Lickeen System PAA waterbody risk map



Source: WFD Application

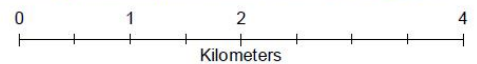


Table 2-1: Receptor information for Lickeen System

Waterbody Name		Figs/ Tables	Ballmacravan_010		Lickeen
Monitoring Point No. Name			RS28B020100 BALLYMACRAVAN – Br j d/s Lickeen Lough	RS28B020400 Calluragh Br	Various (see table 1.2)
Risk Category		y	At Risk		At Risk
Biological Status	2009 2012 2015 2018 trends in Q values	y	Not monitored (dry) Moderate Poor Not monitored (dry)	Good Good Good Moderate	
	Fish status (where relevant)		NA		
Ortho-P (mg/l P)	Baseline (2017) indicative quality Trends - significant? Dist to threshold	y	NA	NA	MRP is monitored but no limits apply.
NH4-N (mg/l N)	Baseline indicative quality Trends - significant? Dist to threshold	y	NA	NA	0.014 (2017)
					High
					Upwards No
					Far
TON (mg/l N)	Baseline indicative quality Trends - significant? Dist to threshold		NA	NA	
TP (mg/l)	Baseline indicative quality Trends - significant? Dist to threshold		NA	NA	0.029 (2017)
					Moderate
					Upwards No
					Far
Chlorophyll (mg/l)	Baseline indicative quality	Y	NA	NA	11.3 (2017)
	Trends - significant?				Moderate
	Dist to threshold				Upwards No
					Far
Other Supporting Chemistry Conditions	Oxygenation Condition		NA	NA	Pass 2013-2018. High in previous reporting periods
	Specific Pollutant Condition		NA	Na	Pass
Chemical Surface Water Status		N	NA	NA	Good

Waterbody Name		Figs/ Tables	Ballymacravan_010		Lickeen
Monitoring Point No. Name				RS28B020100 BALLYMACRAVAN – Br j d/s Lickeen Lough	RS28B020400 Calluragh Br
Hydromorph- ology	RHAT score/Other		NA	NA	Hydromorphological condition = Good in 2013-2018. High in previous assessments
	Evidence of Arterial drainage		No	No	No
Ecological Status	2010-2012		Moderate		Bad
	2010-2015		Poor		Bad
	2013-2018		Poor		Bad
	Elements driving status		Invertebrates		Fish
Protected Areas			Discharges to the Inagh River Estuary SAC		Discharges to the Inagh River Estuary SAC via Ballymacravan_010
WFD Objective			Good		Good
EPA biologist notes (if any)			2015 comments: Slight to moderate siltation. Cattle having a mild impact downstream. 2018 result marked 3-4*, indicative of heavy substrate siltation		NA
Significant issue/impact for receptor			Unknown but proximity to lake outflow is a concern	Sediment issue is likely from 2018 survey results.	Nutrients. Abstraction pressure also possible here.

2.2 Assessment of Results

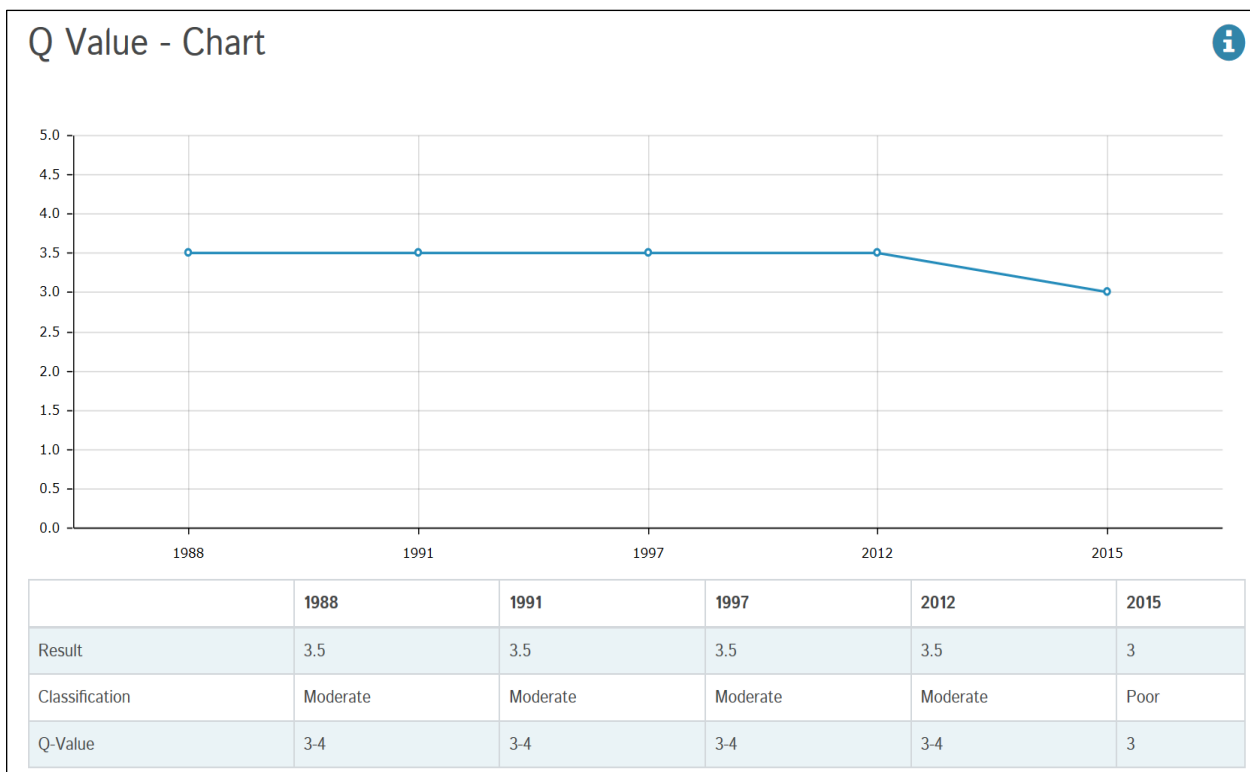
Monitoring results for each waterbody are outlined below. Locations of WFD operational monitoring stations are shown in Figure 1-1.

Ballymacravan_010

There are two WFD monitoring stations on Ballymacravan_010: *BALLYMACRAVAN - Br just d/s Lickeen Lough (RS28B020100)* and *Calluragh Br (RS28B020400)*, both monitored for biology only.

Q values for Ballymacravan-Br just d/s Lickeen Lough are graphed below in Figure 2.3.

Figure 2-3: Biological monitoring results at *BALLYMACRAVAN-Br just d/s Lickeen Lough (RS28B020100)*

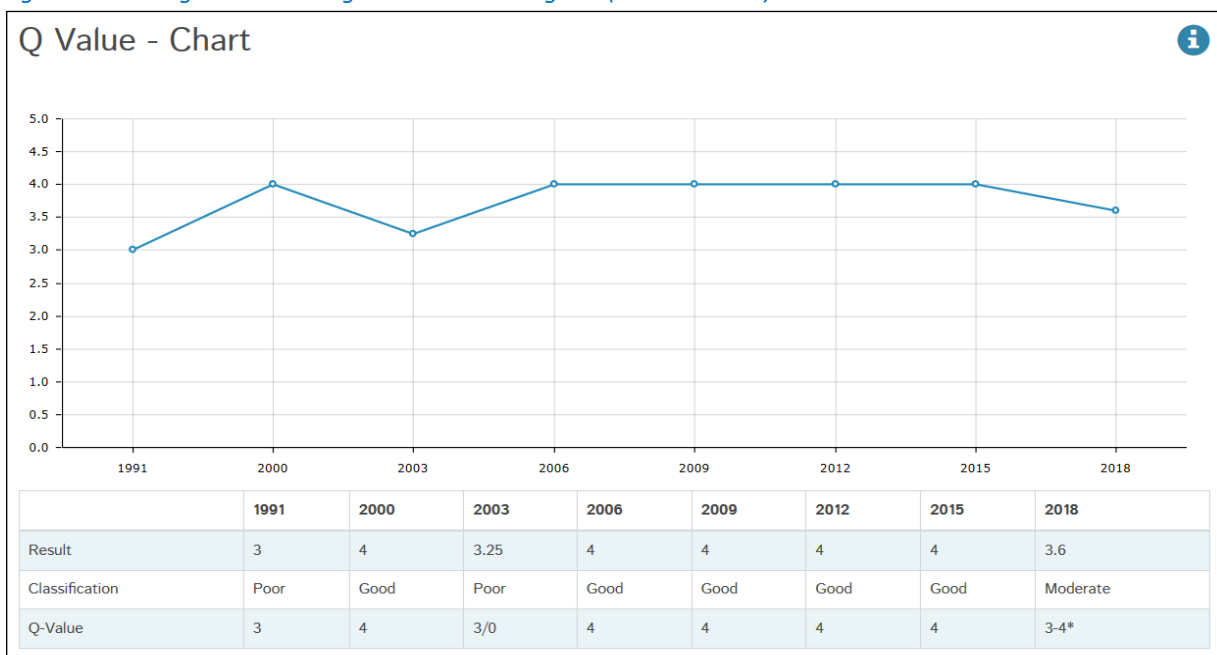


Source: WFD App

The 2013-2018 Poor WFD status of Ballymacravan_010 is driven by 2015 biological monitoring results at RS28B020100, which is very close to the lake outflow (30m downstream of the outflow). The WFD app refers to a lake impoundment here which is restricting outflow in low water, but the Local Authority Area Engineer has advised that there is no physical barrier or impoundment on the lake. However, the lake is used for the Ennistymon drinking water supply and the abstraction may be potentially impacting on downstream river level, causing the river to periodically dry up at this WFD site in low flow conditions (see section on lake abstraction pressure below). The site wasn't assessed between 2000 and 2009 inclusive because the river was dry at this location during that period. It was also dry in 2018. The close proximity of this monitoring station to the lake outlet could also potentially impact on river biology here. Even when water level is adequate for assessment, this monitoring station has not been at Good status since monitoring commenced here. The suitability of '*BALLYMACRAVAN-Br just d/s Lickeen Lough*' (RS28B020100) for WFD monitoring is questionable for both of these reasons.

Q values for the Calluragh Bridge monitoring station are graphed below in Figure 2.4.

Figure 2-4: Biological monitoring results at Calluragh Br (RS28B020400)



Source: WFD App

As can be seen from Figure 2-4, biological status at 'Calluragh Br' (RS28B020400) was Poor with a possible toxic impact when assessed in 2003. It was consistently Good from 2006 to 2015 inclusive, dropping to Moderate (Q3-4*) in the 2018 survey. The biologists' notes for the 2018 survey state that *the river was highly coloured and turbid with extensive siltation noted on the riverbed that indicated a significant departure from the ideal 'reference condition' for such a river.* The Calluragh Bridge monitoring station is approximately 500m downstream of the outfall from the Ballymacravan water treatment plant. The local authority has advised that there is an occasional discharge of ferric sludge and sediment from the plant. This discharge in low flow conditions, could potentially impact the invertebrate community at the Calluragh bridge site. This needs to be investigated in the local catchment assessment. There is also a small residential development (5 houses) on its own system to the immediate north of the water treatment plant but if problematic, this would be more likely to cause nutrient and organic rather than sediment issues.

Lickeen Lake (IE_SH_28_85)

- **Monitoring results**

WFD monitoring commenced on Lickeen lake in 2007. WFD sampling is undertaken at two lake sites (and two surrogate shore sites) for surveillance and operational monitoring parameters. Site 1 is approximately 22m depth and Site 2 is approximately 8m depth).

Seven lake sites are assessed for biological parameters (M1-M6 and PB_0010:LIT_0010).

Lake chemical status is Good. Nutrient conditions are High for nitrate and ammonia but Moderate for total phosphorus.

Individual total phosphorus results from 2007 to most recent available results are graphed below in Figure 2-5. Mean results from 2016 to 2019 are graphed in Figure 2-6.

Figure 2-5: Total phosphorus levels for Lickeen Lake (Sites 1 and 2) 2007-2019

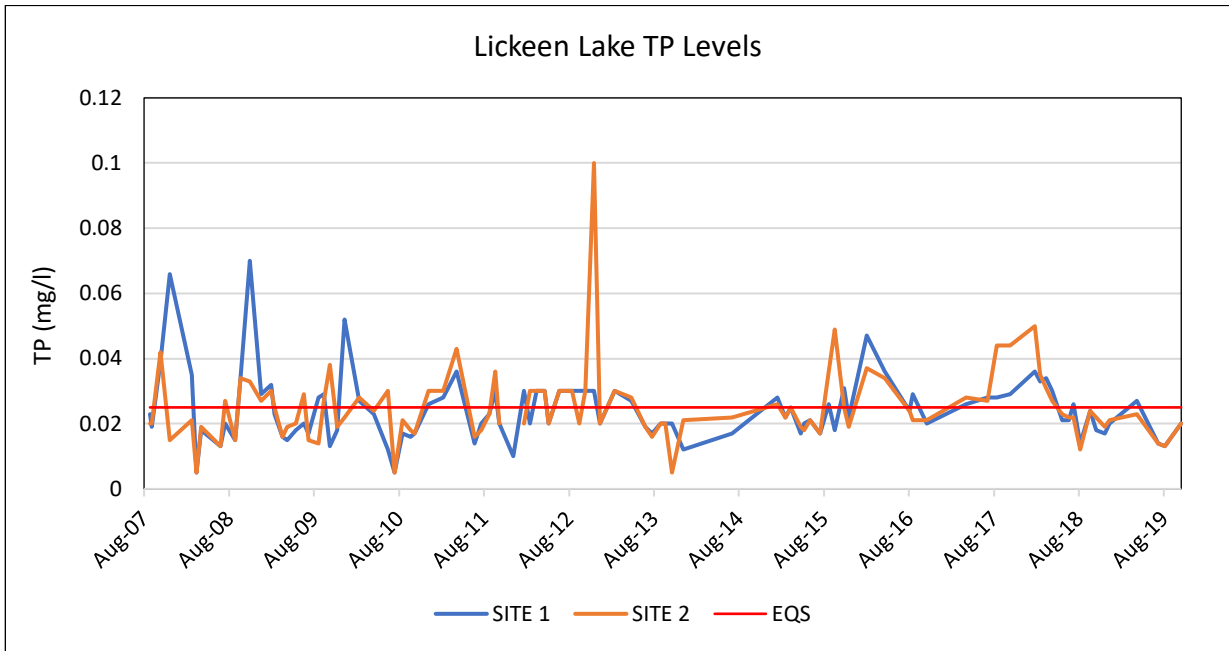
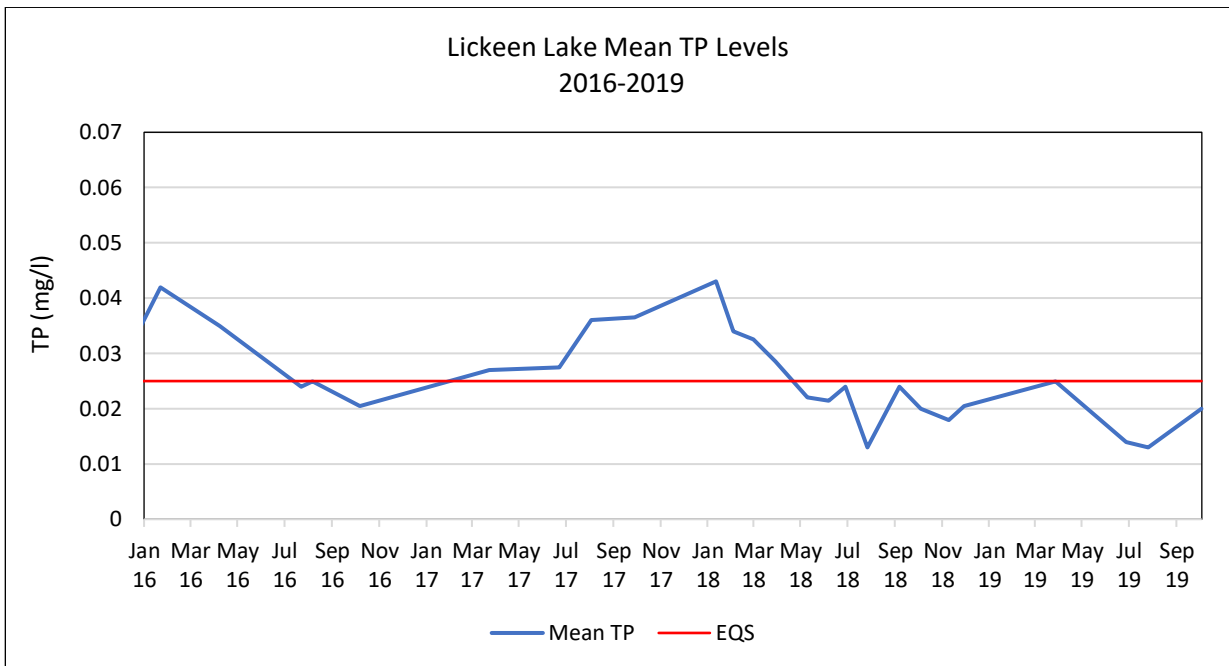


Figure 2-6: Mean total phosphorus levels, 2016-2019



As can be seen from the graphs, individual total phosphorus results have periodically exceeded the mean good status EQS of 0.025mg/l. Annual average results also periodically exceeded this standard (2007, 2012, 2016, 2017, 2018, see table 2-2 below).

Lake chlorophyll levels (individual results) are graphed in Figure 2-7 below. Mean results from 2016 to 2019 are graphed in Figure 2-8.

Figure 2-7: Lake Chlorophyll Levels (Site 1 and 2) 2007-2019

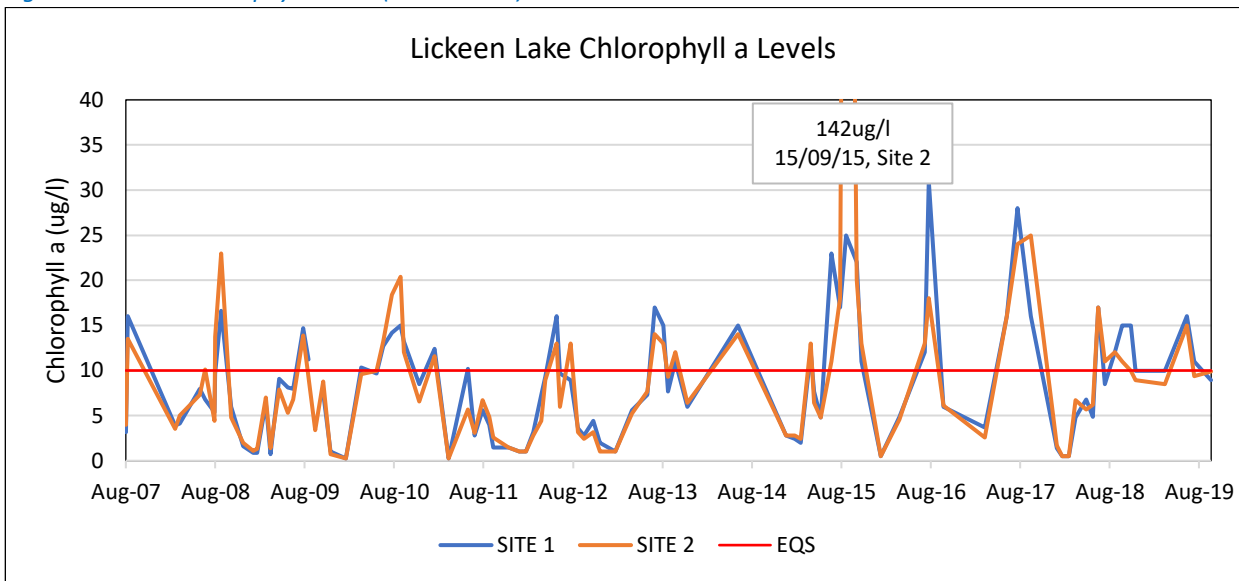
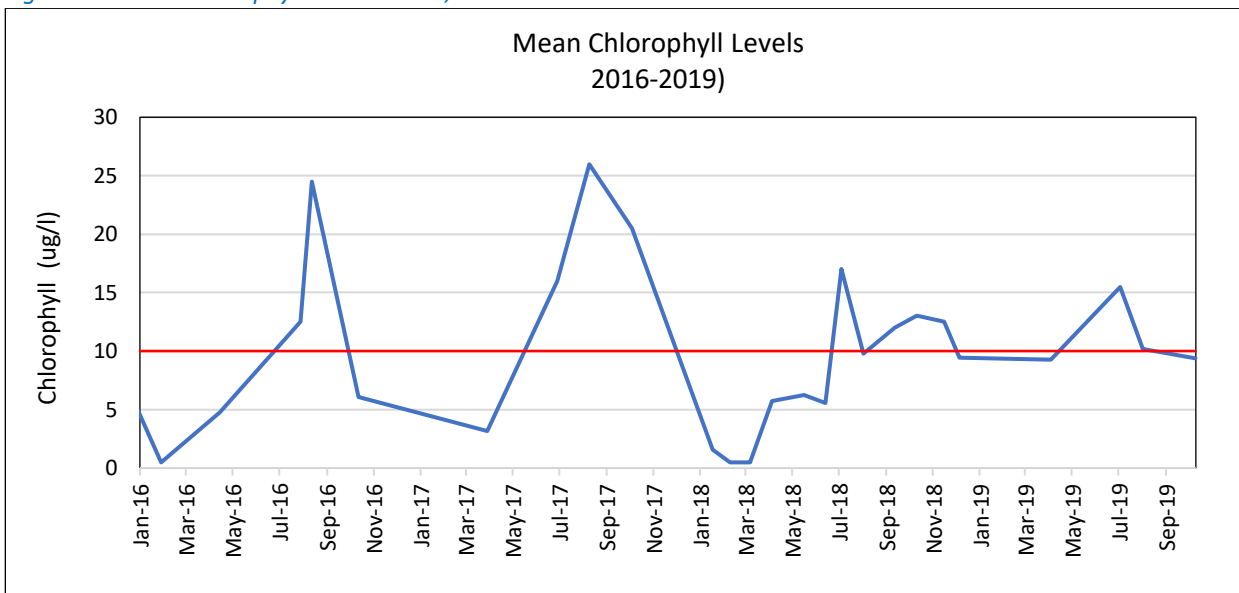


Figure 2-8: Lake Chlorophyll Levels Mean, 2016-2019



As for total phosphorus, individual chlorophyll results periodically exceed the Mean Good Status EQS of 10ug/l.

Annual average results exceeded the EQS in 2010, 2014, 2015 and 2017. Annual averages are shown in Table 2-2 below.

These results indicate that there is a nutrient issue in Lickeen Lake. This is likely to be linked to the Poor/Bad Fish status here. Other biological indicators (Macrophytes, Phytobenthos, Phytoplankton and other aquatic flora are all indicative of Good status) (see Table 2-3 below).

Table 2-2: Annual average total phosphorus and chlorophyll levels, Lickeen Lake

Year	TP (mg/l)	Chlorophyll (ug/l)
2007	0.031	9.175
2008	0.024	7.55
2009	0.023	5.883
2010	0.02	10.894
2011	0.024	4.663
2012	0.03	5.379
2013	0.02	8.7
2014	0.019	12.475
2015	0.024	15.371
2016	0.029	9.66
2017	0.032	16.413
2018	0.025	7.817

Table 2-3: Lake Biological Quality Indicators, 2013-2018

Biological Assessment Parameter	Macrophyte Status	Phyto-benthos Status	Other Aquatic Flora	Chlorophyll Status	Phyto-plankton Composition Status	Phyto-plankton Status	Fish Status	Overall Status for BQE
Score	2	2	2	3	2	2	5	5

Source: EPA

- Abstraction Pressure**

Lickeen Lake was assessed by CDM in 2008 as part of an Eastern RBD assessment of lake abstraction pressure (CDM, January 2009). The lake was classified as 1a (at risk) prior to the CDM assessment.

The CDM approach followed a three stage process to identify lakes where abstraction related programmes of measures may be required, involving i) calculation of the ratio of net abstraction to Q50 inflow (setting 0.1 as the upper limit) ii) consideration of lake bathymetry and residence times and ii) a site specific assessment of some lakes. Lickeen Lake Q50 inflow was calculated at 0.172m³/sec (lake residence time was estimated at 221 days). At the time of the assessment, the abstraction rate was 4,694m³/day or 0.054m³/sec. The report concluded that the lake remained at risk (1a) due to the abstraction, requiring more detailed monitoring and assessment. It should be noted that the abstraction rate has since increased. The 2014 abstraction rate (from an EPA audit on the 27th August 2014 was approximately 6,000m³/day. This gives an estimated ratio (based on the CDM 2008 Q50inflow estimate) of 0.4.

The CDM report also refers to the possibility that the loss of arctic char from Lickeen lake may be related to the over-abstraction.

- **Fish Status**

Lickeen Lake is currently at Bad status due to Fish. Status has been either Poor or Bad in the four WFD fish surveys undertaken from 2007, with the most recent survey (2016) results at Bad status.

Year of assessment	2007	2010	2013	2016
Fish status	Poor	Bad	Poor	Bad

The 2016 IFI report for Lickeen Lake states that a total of three fish species were recorded here in the September 2016 survey. Rudd was the dominant fish species. The report states “there has been a substantial change in lake fish population since the 1990s; char and perch are now absent from the lake, leading to the conclusion that the substantial fish kill in 1998 and the effects of continued eutrophication have contributed to their demise. The lake may also have been subject to the illegal stocking of Rudd, a non-native species over the last ten years as they have been captured in the current and previous WFD lake fish surveys but were not recorded in the lake in the 1990’s”

It is possible that the lake abstraction is also potentially impacting on fish status, as referenced in the CDM report, due to fluctuating water level and the resultant impact on macrophyte communities and also possibly due to increased lake residence time extending available time for plant/algal nutrient uptake.

2.3 Summary of Issues

Ballymacraven_010

The Poor status of Ballymacraven_010 is driven by 2015 biological monitoring results for WFD operational station ‘*BALLYMACRAVAN-Br just d/s Lickeen Lough*’ (RS28B020100). Biological status has never been better than Moderate here. The suitability of this site is questionable however because the lake abstraction is causing the site to dry up in low flow conditions. Also, the site’s close proximity to the lake outlet (30m downstream approximately) may be impacting on river biology here.

Biological results for the downstream WFD operational monitoring station at Calluragh Bridge were consistently Good (Q4) from 2006 to 2015, dropping to Moderate Q3-4* in the 2018 assessment. The biologists noted in this assessment that the river was highly coloured and turbid downstream of the water treatment plant with extensive siltation noted on the riverbed that indicated a significant departure from the ideal ‘reference condition’ for such a river. The monitoring station is approximately 500m downstream of the water treatment plant outfall and while this would normally be expected to discharge clean water only, there is anecdotal evidence of occasional losses of ferric sludge and sediment from this facility. The ferric discharge would have potential for a toxic impact on river invertebrates, depending on flow and dilution at the time of the discharge (it is noted that a toxic impact was recorded at the Calluragh Bridge site in 2003). This potential point source pressure needs to be investigated. There is a small housing development adjacent to the northern bank and close to the water treatment plant. The development is served by an onsite wastewater treatment plant. It is unlikely to be a source of sediment however.

The significant issues on Ballymacraven-010 are i) altered habitat at ‘*BALLYMACRAVAN-Br just d/s Lickeen Lough*’ (RS28B020100) which is of questionable suitability and ii) sediment issues at ‘*Calluragh Bridge*’, possibly due to a point source discharge from the water treatment plant although upstream land use also needs to be investigated for sediment sources.

Lickeen Lake

The Bad status of Lickeen Lake is driven by Fish.

Nutrients (total phosphorus) are likely to be a significant contributory factor to the lake's fish status. However, the lake abstraction is also a potential significant pressure here.

3 Significant Pressures

3.1 Significant Pressures from initial characterisation

Table 3.1: EPA Characterisation (from WFD App)

Water body Name	Id	Category	Sub-category	Name	Sig?	Pressure & impact details
Ballymacravan_010	WBP0004135	Hydro-morphology	Dams, barriers, locks, weirs	n/a	Yes	Altered habitat due to morphological changes
Lickeen	WBP0004138	Agriculture	Pasture	n/a	Yes	Nutrient Pollution
	WBP0004139	Forestry	Forestry	n/a	Yes	Nutrient Pollution

3.2 Conclusions on the Significant Pressure/s

- **Ballymacravan_010**

Of the two WFD monitoring stations in Ballymacravan_010, only the downstream station (*Calluragh Bridge*) is considered in the assessment of potential significant pressures as the upstream station appears to be unsuitable for assessment due both to its proximity to the lake outflow and (more importantly) to the fact that the site dries up in low flow conditions.

The Calluragh Bridge station is downstream of agriculture (pasture) with some forestry in the southern headwaters (see Appendix I). Soils are generally well drained here (Appendix VI) and biological monitoring results have been consistently good (Q4) with the exception of 2003 (toxic impact) and 2018 (extensive siltation). These results indicate that agriculture is unlikely to be a significant pressure here although a stream walk needs to be undertaken to rule out agriculture pressures as a cause of the excessive siltation observed in 2018.

There is a small housing development to the northeast of the Calluragh bridge station, located adjacent to the river on its northern bank and approximately 500m upstream, with its own wastewater treatment system. There is a water treatment plant on the southern bank, also 500m upstream of the monitoring point. The water treatment plant may be a significant pressure here, due to occasional discharges of ferric sludge and sediment to the river (LA information). The housing development also needs to be assessed as a potential pressure.

- **Lickeen Lake**

Lickeen Lake's Bad status is driven by Fish. Nutrients are a significant issue here and are likely to be contributing to the fish status. Pressures identified in the WFD App are agriculture and forestry

Surrounding lands are mainly under agriculture with some coniferous forestry to the south (see Appendix I and V). Soils around the lake are all either poorly draining or peat (Appendix VI) with high and moderate P susceptibility (Appendix IV). As expected, the areas under agriculture here are also high PIP rank (2 and 3) for surface phosphate loss (Appendix III).

The desk study confirms that the significant pressures here are likely to include agriculture and forestry, with risk of nutrient loss from forestry sediment runoff and from the poorly draining agricultural lands around the lake. However, the lake is also possibly under abstraction pressure, based on the findings of the CDM report of January 2009 and taking into account the increased abstraction volumes since that assessment was undertaken.

4 Pathways Information and Analysis

There are areas of high and extreme groundwater vulnerability and rock near surface to the south in the Lickeen system (see Appendix II). However, groundwater pathways are unlikely to be significant here as the entire system overlies an unproductive aquifer (LI).

Soils around Lickeen Lake are poorly draining or peaty (Appendix VI). Phosphate is the significant nutrient issue impacting on water quality in the lake and pathways will be surface and near surface. The potential abstraction pressure will be challenging to assess via the normal LCA process.

The two WFD monitoring stations on Ballymacraven_010 are impacted by different issues and pressures. There is a hydromorphological pressure impacting on water quality at the upstream station, with the lake abstraction potentially causing or exacerbating the risk of the river drying up at this location in low flow conditions. The downstream station appears to be impacted by sediment, possibly from a point source (periodic discharge of ferric sludge/sediment from the Ballymacraven water treatment plant) although upstream land use may also need to be assessed.

Considering the above points and the small size of this PAA, there is no requirement to develop a conceptual model here.

5 Interim Conclusions on the PAA

The Lickeen System Priority Area for Action includes the Ballymacraven_010 river and Lickeen Lake.

Ballymacraven_010

- Ballymacraven_010 is currently at Poor status and *At Risk* of failing to meet its WFD Good status objective.
 - There are two WFD operational monitoring stations on Ballymacraven_010.
 - Nutrients are not monitored at either station, but the conclusion of this desk study is that nutrients are unlikely to be a significant issue here.
 - Status of Ballymacraven_010 is driven by biological monitoring results for '*BALLYMACRAVAN-Br just d/s Lickeen Lough*' (RS28B020100). This station has not achieved better than Q3-4 (Moderate status) since monitoring commenced. The significant issue on RS28B020100 is altered habitat due to hydromorphological changes. The significant pressure here is the lake abstraction which is either causing or exacerbating the risk of the river drying up at this monitoring location. The site was dry between 2000 and 2009 and again in 2018 so could not be assessed. It is also very close to the lake outflow (30m downstream) so it is possible that the lake outflow is impacting on river biology. The suitability of this site for WFD monitoring purposes is questionable for these reasons.
 - The second WFD station '*Calluragh Bridge*' (RS28B020400) was consistently at Good status (Q4) from 2006 to 2015 inclusive. Status was Poor with a toxic impact in 2003 and Moderate with extensive siltation when assessed in 2018. The Ballymacraven water treatment plant is located approximately 500m upstream of the Calluragh bridge site. Occasional incidents of ferric
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sludge/sediment discharges have been reported from the facility, indicating that it may be a potential significant pressure on the Calluragh Bridge monitoring station.

- Local catchment assessment (LCA) will focus on a stream walk and assessments on lands between the Calluragh Bridge Station and the lake outflow. The LCA will include biological assessment on the main river channel upstream and downstream of the water treatment plant outflow to determine whether this is the significant pressure impacting on sediment levels at Calluragh Bridge.

Lickeen Lake

- Lickeen Lake is at Bad ecological status, with status driven by Fish.
- The lake is the drinking water supply for Ennistymon and surrounds, serving a population of 14,000.
- The lake is *At Risk* of failing to meet its WFD Good status objective.
- The significant issue impacting on water quality is total phosphorus.
- The significant pressures are agriculture and forestry, but the lake is also under potential abstraction pressure.
- The local catchment assessment will focus on all inputting tributaries, including the feeder streams and the headwaters of Ballymacraven_010, assessing biological quality and nutrient (TP) load to the lake.
- Specialist input may be required to assess the potential abstraction pressure.

6 Work Plan

6.1 Further Characterisation Actions from WFD App

The further characterisation actions described in the WFD App are as follows:

Waterbody	Action	Description
Ballymacravan_010	IA1	EPA to liaise with biologists about the location of monitoring station RS28B020100, downstream of a lake outlet that regularly dries up.
Lickeen	IA1	FI to confirm what is driving Poor/ Bad fish status on Lickeen lake and advise of appropriate measures, if any.
	IA9	IA9 to determine sources of nutrients from agriculture and forestry. Walk along the lake shore and on the tributaries feeding into the lake. Collect field parameters (DO, pH, conductivity and temperature) and water quality samples in order to define the critical source areas for nutrients to the lake.

The estimated resource for this local catchment assessment is 49 days.

6.2 Additional information requirements

Further information is needed on the lake abstraction to determine whether abstraction volumes increase in the summer months (due to increased tourism) when levels are lower and the lake is therefore more vulnerable.

Local information would be of value on the occurrence/frequency of the river being dry at the lake outlet in summer months.

Background information on the cause of the fish kill here in the 1990's would also be useful.

6.3 Local Catchment Assessment

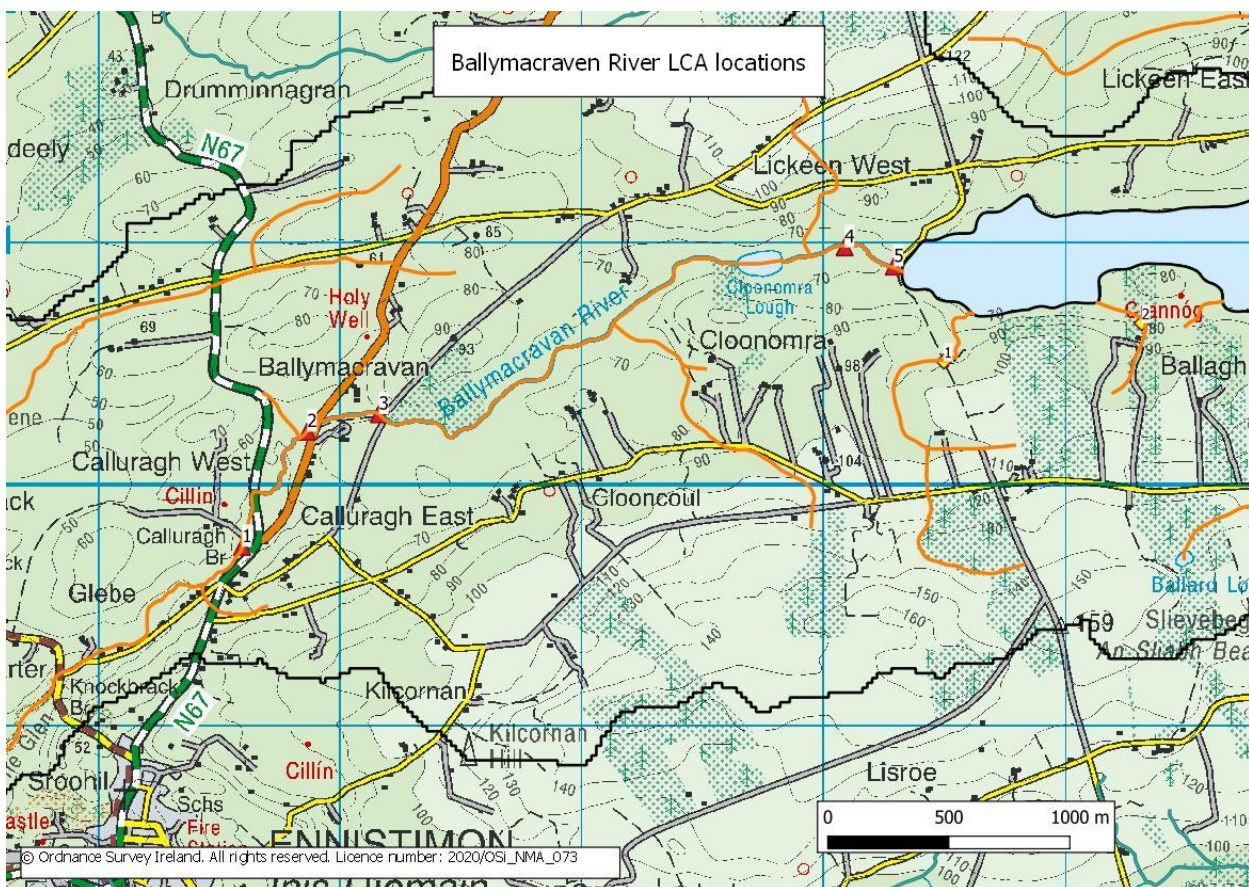
Note that the Calluragh Bridge monitoring location deteriorated from Good to Moderate in the 2018 assessment. The WFD App further characterisation actions outlined in 6.1 above pre-date this assessment and an IA1 only is specified for Ballymacraven_010. However the reason for the 2018 deterioration at Calluragh Bridge needs to be investigated and is included in the scope of this desk study and the design of the required local catchment assessment.

Ballymacraven_010

Proposed LCA locations are shown in Figure 6-1 and discussed below:

- 1) Undertake SSIS and measure field parameters at Site 1 (Calluragh Bridge) to determine whether this location is still impacted.
- 2) Undertake SSIS and measure field parameters upstream and downstream of the water treatment plant outfall (Sites 2 and 3). Look for evidence of possible iron sludge deposits here and assess sediment extent and type.
- 3) If LCA indicates impact upstream of the water treatment plant (and nearby residential development), undertake a stream walk from Site 3 upstream to the lake outlet (Site 5), looking for evidence of other sediment sources and assessing extent of impact (if any) by undertaking SSIS/RA along the main channel. If the main channel is impacted, assess inputting tributaries.
- 4) Assess biological quality and measure field parameters at Sites 4 and 5 and record potential issues associated with location of Site 5 (RS28B020100).

Figure 6-1

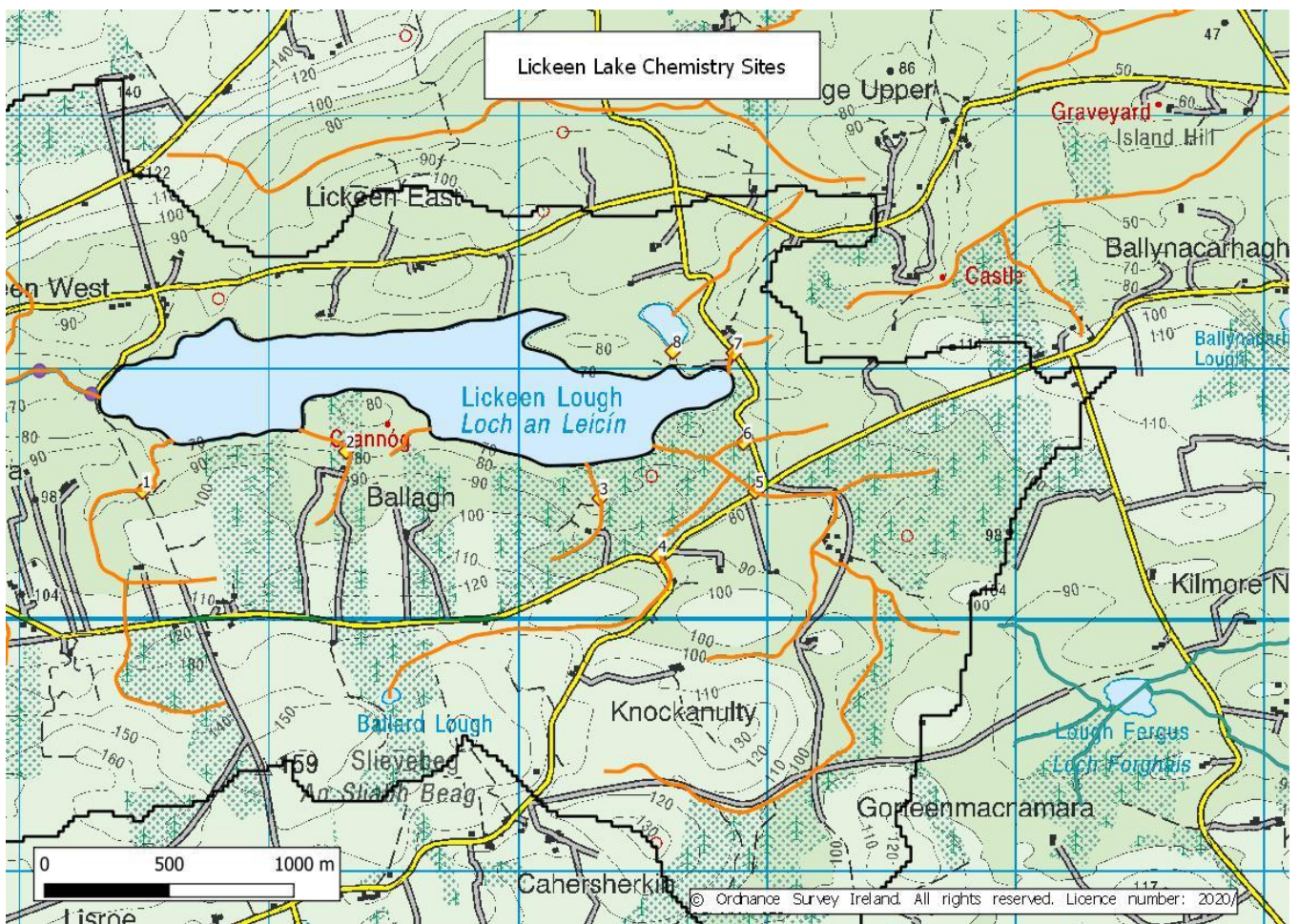


Lickeen Lake

LCA locations are shown in Figure 6-2 and discussed below:

- Undertake local catchment assessment on all inputting tributaries to the lake. Measure field parameters and sample for TP and ammonia on each of the tributary streams (Sites 1 to 8) in high, mean and low flow conditions.
- Assess biological quality on feeder streams (where possible) using SSIS or rapid assessment. This assessment is of value on the basis that evidence of impact on tributary biology may also be evidence of longer-term nutrient (and/or sediment) delivery from the tributary to the lake.
- Undertake a catchment walk on the lands to the north of the lake, looking at land use and potential nutrient pathways to the lake. If additional streams/drains are identified here, include in the assessment of chemistry and field parameters. Undertake SSIS/RA if possible.

Figure 6-2



7 Review of possible mitigation options

The nature of the mitigation measures will be determined by the significant issues and significant pressures impacting on water quality in this catchment. From the desk-based assessment, the issue in Lickeen Lake appears to be total phosphorus from adjoining forestry and agricultural lands. If ongoing nutrient inputs are identified, measures will include identifying critical source areas and blocking the pathways here.

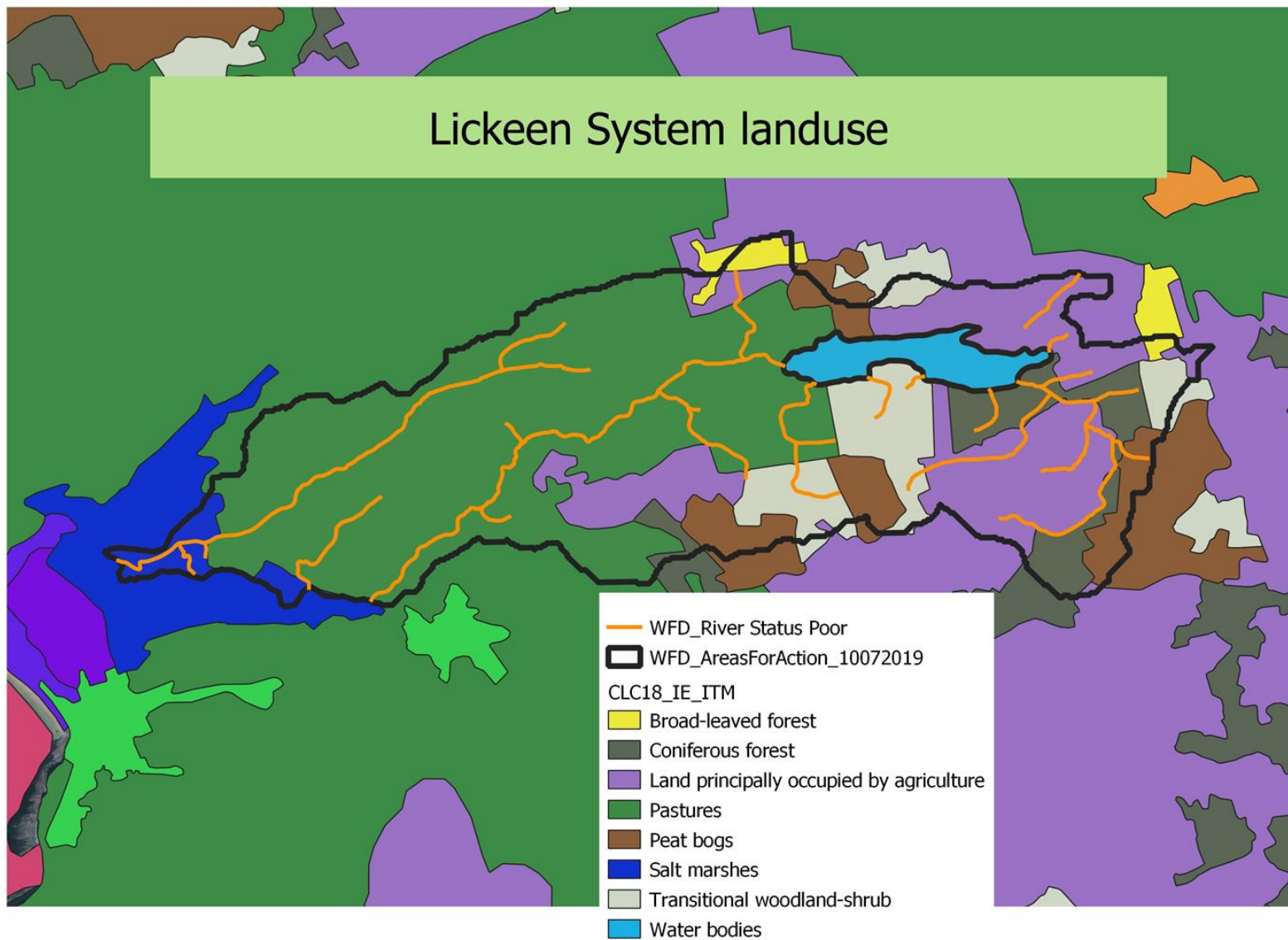
8 Communications

The normal LAWPRO approach of public meetings in the local community was not an option due to Covid 19 concerns. Instead, a virtual meeting for this PAA was held on 10th September 2020, supported by newspaper notice and public information leaflets. There was a good attendance, ca. 20 people in addition to LAWPRO and ASSAP staff. There was a high level of engagement at the meeting with many issues arising. The main concerns at the meeting included: the effects of forestry on the lake, concerns about replanting after felling, how the public will be updated after our work is complete and how we are raising public awareness about the work.

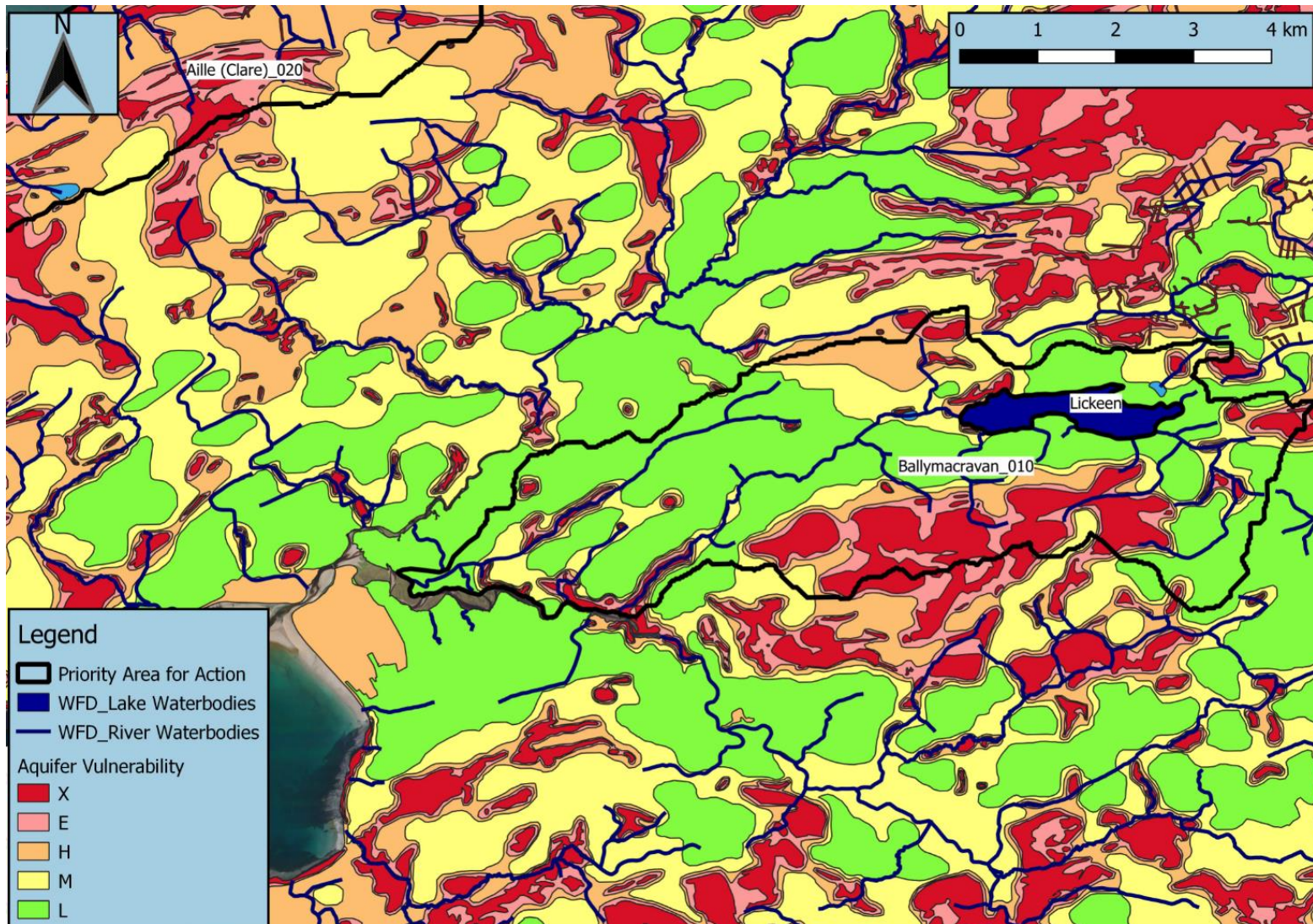
Key messages:

- Lickeen Lake is an important water supply lake, providing the drinking water supply for 14,000 people in Ennistymon town and surrounds.
 - While drinking water quality is satisfactory, Fish are at Bad status in the lake. Lake total phosphorus and chlorophyll levels are also periodically above the good status limits.
 - Forestry and agriculture are the significant pressures impacting on water quality here, but the lake abstraction is also a potential pressure.
 - Water quality in Ballymacraven_010 is generally good at the Calluragh bridge station but there was a significant sediment issue observed here in 2018. The source of this needs to be investigated.
 - The LAWPRO team will undertake local catchment assessments to confirm the significant pressures impacting on the lake and river water quality.
 - We will work with the relevant stakeholders/implementing bodies to identify the appropriate local measures for the catchment, applying *the right measure in the right place*.
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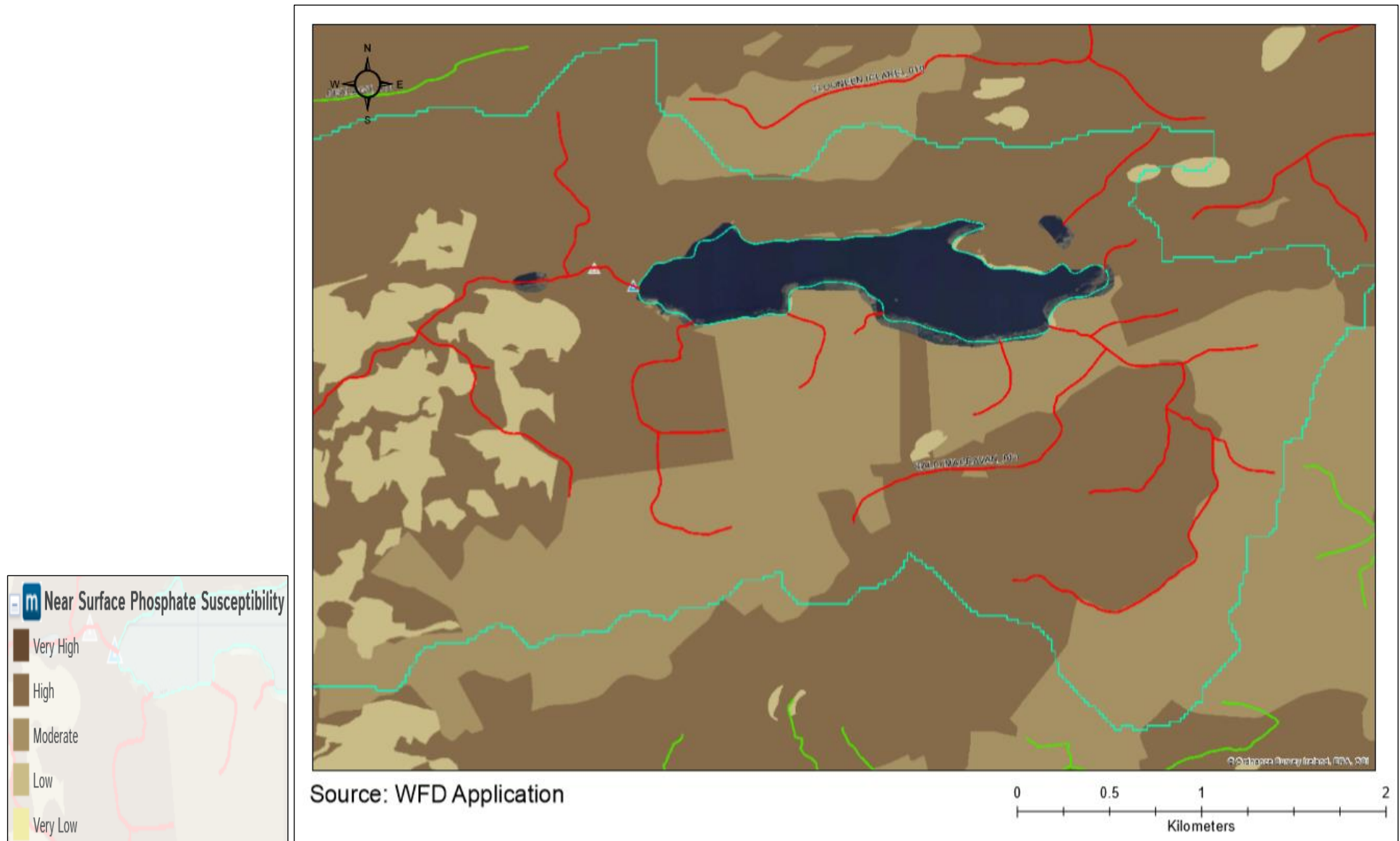
Appendix I: Lickeen catchment land use map



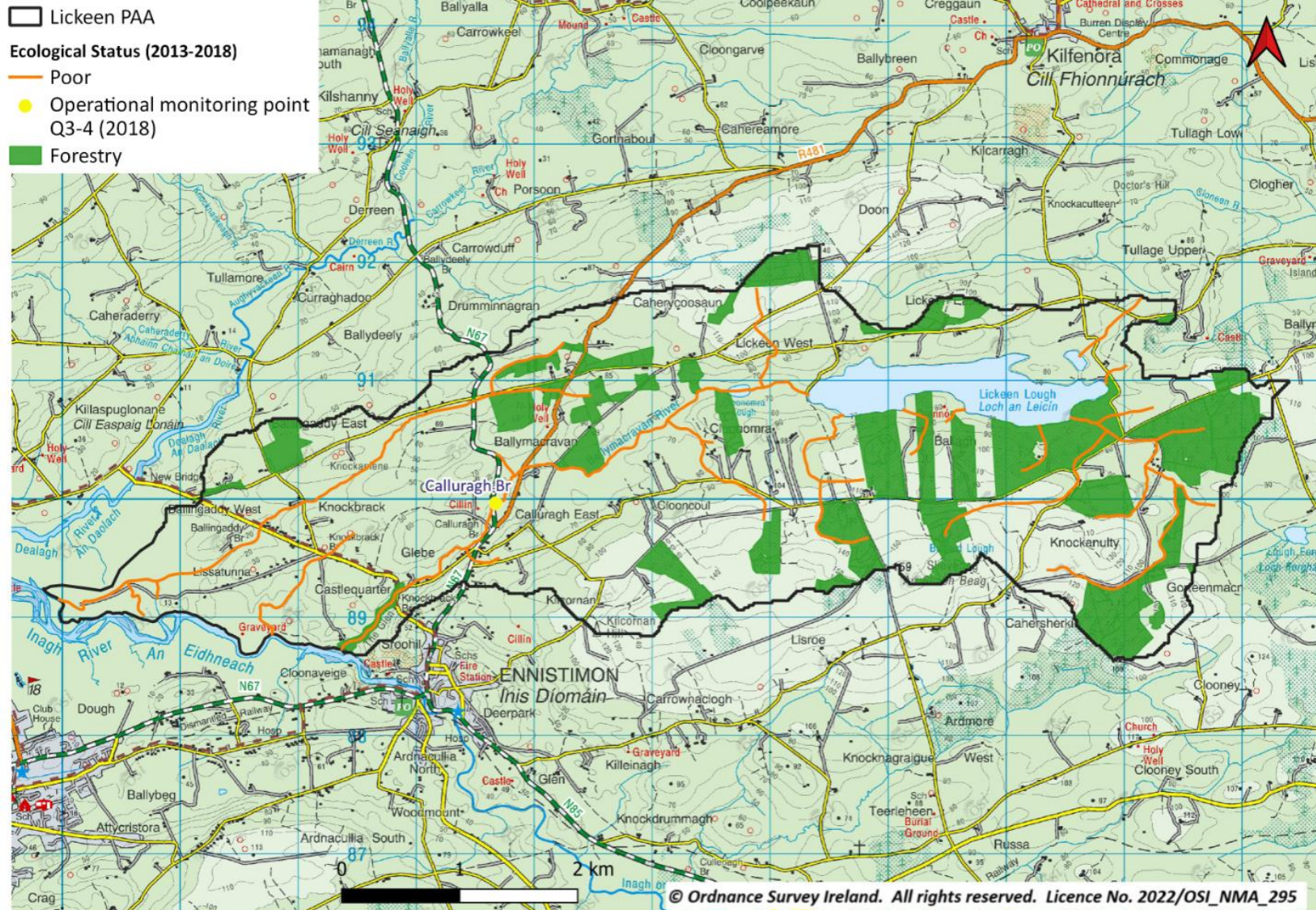
Appendix II: Lickeen catchment groundwater vulnerability map



Appendix IV: surface phosphate susceptibility map



Appendix V: Lickeen System Forestry Map



Appendix VI: Lickeen catchment soils map

