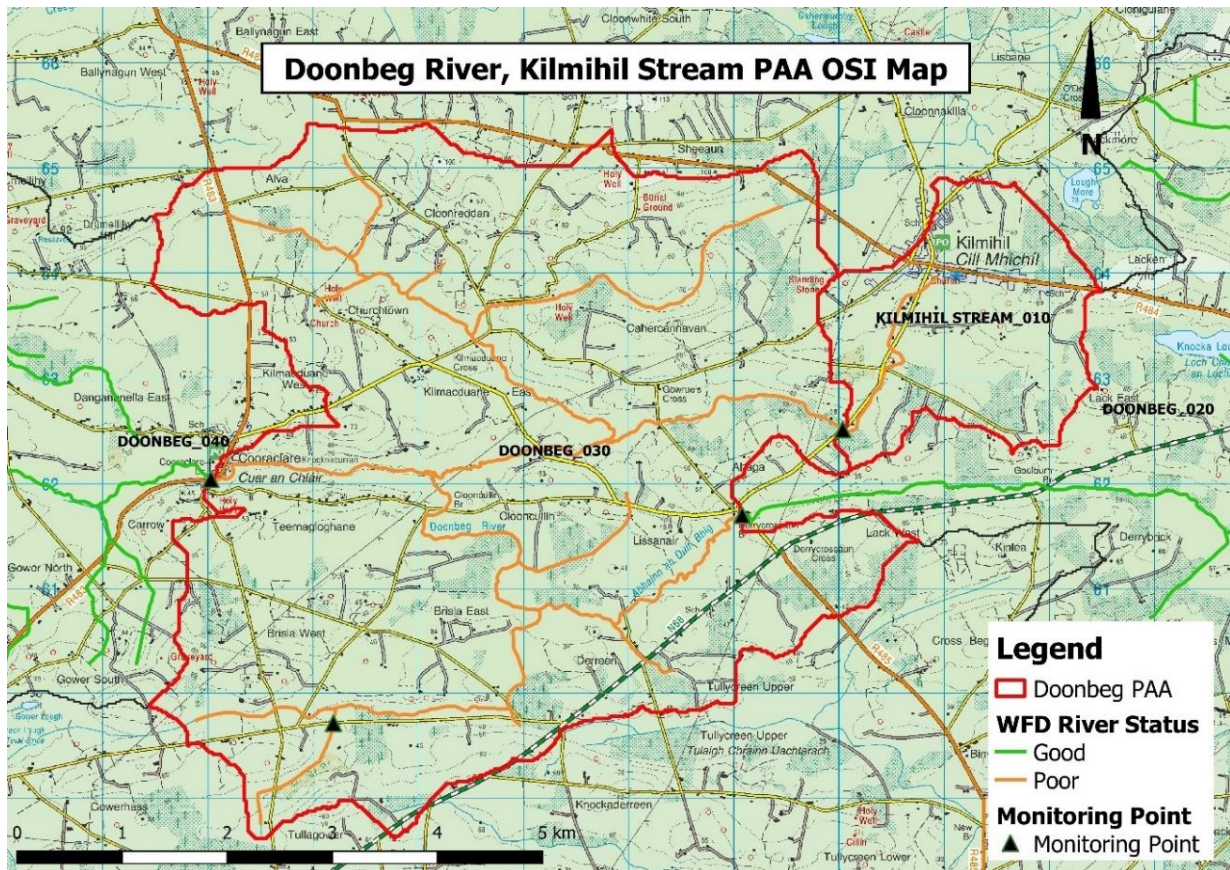


Doonbeg System Priority Area for Action

Desk Study



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Acknowledgements

The authors would like to acknowledge the contributions of Clare County Council who have carried out a significant amount of work in the Doonbeg System catchment in recent years. We also wish to thank them for their support of the Local Authority Waters Programme.

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)

Summary

The Doonbeg river contains six EPA waterbodies: Doonbeg_010, Doonbeg_020, Doonbeg_030, Doonbeg_040, Doonbeg_050 and Kilmihil_010, the headwaters to Doonbeg_030. Lough Naminna (*Not at Risk*), headwaters to Doonbeg_010 (*Not at Risk*) is a water supply to a private group water scheme. Ballard_010 waterbody (*Review*) is also part of the sub-catchment but is not influenced or influencing the Doonbeg PAA.

The Doonbeg Priority Area for Action comprises of Doonbeg_030 and Kilmihil stream_010, headwaters to Doonbeg_030. Both rivers are classified under the EU Water Framework Directive as being at Poor status and *At Risk*, therefore prioritising these sub-basins as an area for action.

The four other EPA waterbodies, Doonbeg_010, Doonbeg_020, Doonbeg_040, and Doonbeg_050 are characterised at Good status and *Not at Risk*. Doonbeg_010 flows into Doonbeg_020 from a North-Easterly direction which subsequently flows into Doonbeg_30, with both waterbodies currently at Good status.

Doonbeg_030 flows into Doonbeg_040 at Cooraclare where status recovers to good. Doonbeg_050 eventually flows into Doonbeg estuary, which is in *Review* under the EU Water Framework Directive risk calculation.

Kilmihil stream_010 is currently at Poor status and flows into Doonbeg_030 from an easterly direction.

The data from the WFD app shows the water quality at Kilmihil stream_010 is at Poor status due to elevated nutrient concentrations. The ortho-phosphate (as P), with a 2014 baseline concentration of 0.120 mg/L is in excess of the threshold of ≤ 0.035 (mean) and displaying an upwards trend, at monitoring point RS28K020200. The phosphate is likely to be reaching the river through discharge from UWWTP. However overland flow pathways cannot be ruled out, as the surface water receptor phosphate PIP map indicates. (See Appendix III). Contributions from other point sources and diffuse must also be considered.

Water quality in the Doonbeg PAA has deteriorated at 2nd Br u/s Doonbeg R confl/Br d/s Quarry Monitoring Station: RS28T010400 from Moderate in 2009 to Poor in 2015. Macroinvertebrates are driving the Poor status here. Information from the WFD app indicates that sediment is the significant issue and the pressures are possibly forestry and/or an operational quarry upstream of this monitoring point. Peat and point sources may also be contributing.

EPA assessments indicate that the significant pressures are:

- Doonbeg_030 - Focus on sources of sediment from forestry and quarry operations upstream of monitoring station: RS28T010400
- Kilmihil_010 – Possible Kilmihil Urban Waste Water Treatment Plant.

Recommended Actions:

- On Kilmihil stream_010, undertake SSIS upstream and downstream of the urban wastewater treatment plant to confirm whether the treatment plant is the sole significant pressure. The Phosphate surfacewater PIP map indicates the possibility of diffuse sources of phosphorus, therefore overland flow pathways may need to be investigated upstream of the monitoring point RS28K020200, to eliminate these and other point sources of contamination.
- On Doonbeg_030, the EPA monitoring station RS28T010400 is located on a small tributary stream positioned in the southerly reaches of the sub-catchment. The significant issues may

be forestry on peat and/or an operational quarry. Undertake SSIS upstream and downstream of this station, assessing sedimentation and hydromorphology.

- Considering the presence of endangered freshwater pearl mussel in the Doonbeg river, work upstream from the monitoring point at Cooraclare bridge, carrying out SSIS and using the catchment walk surface water field sheet to assess the hydro-morphological / physical characteristics especially channel bed sediment and sediment inputs to establish if sediment is being delivered to this point with potential to deteriorate habitat quality downstream.

The initial information gathered by the local catchment assessment team will be collated and used to develop further schedules of targeted assessments and river walks. Where significant pressures are identified, appropriate mitigation measures will be discussed and referred to the relevant agency.

1 Background

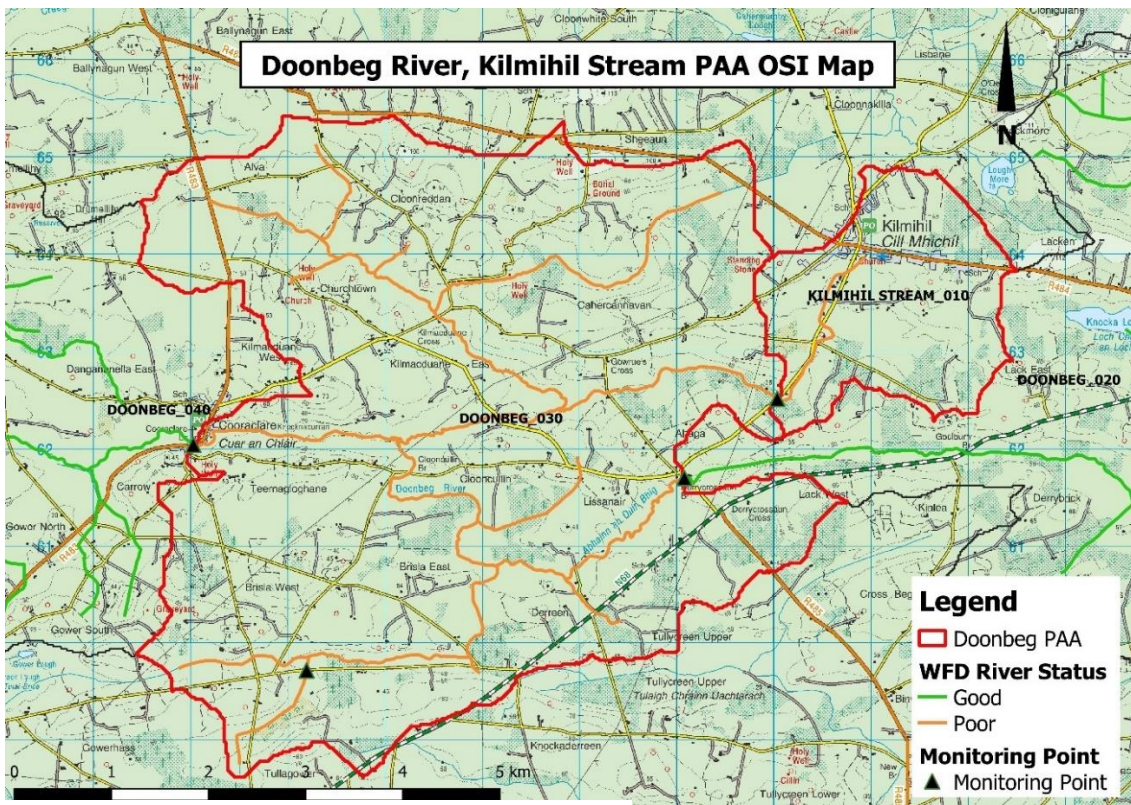
Table 1-1: Background information on the Doonbeg PAA

Priority Area for Action	Catchment Number	Catchment Name	Sub catchment	Region	Local Authority
Doonbeg System	28	Mal Bay	28_3 Doonbeg_SC_010	Southwest	Clare

Priority Area for Action	No. of At Risk WBs	No. of Review WBs	No. of dRBMP Prioritised WBs	No of WBs for Status Improvement:		
				2021	2027	Beyond 2027
Doonbeg System	2	0	1	0	2	0

Reasons for selection	<ul style="list-style-type: none"> • Manageable area. • Important for salmon and sea trout. • Active community group in Doonbeg. • One deteriorated water body.
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Figure 1-1: Doonbeg System Priority Area for Action Ecological Status (2010-2015).



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Figure 1-2: Doonbeg System Priority Area for Action WFD Risk Map.

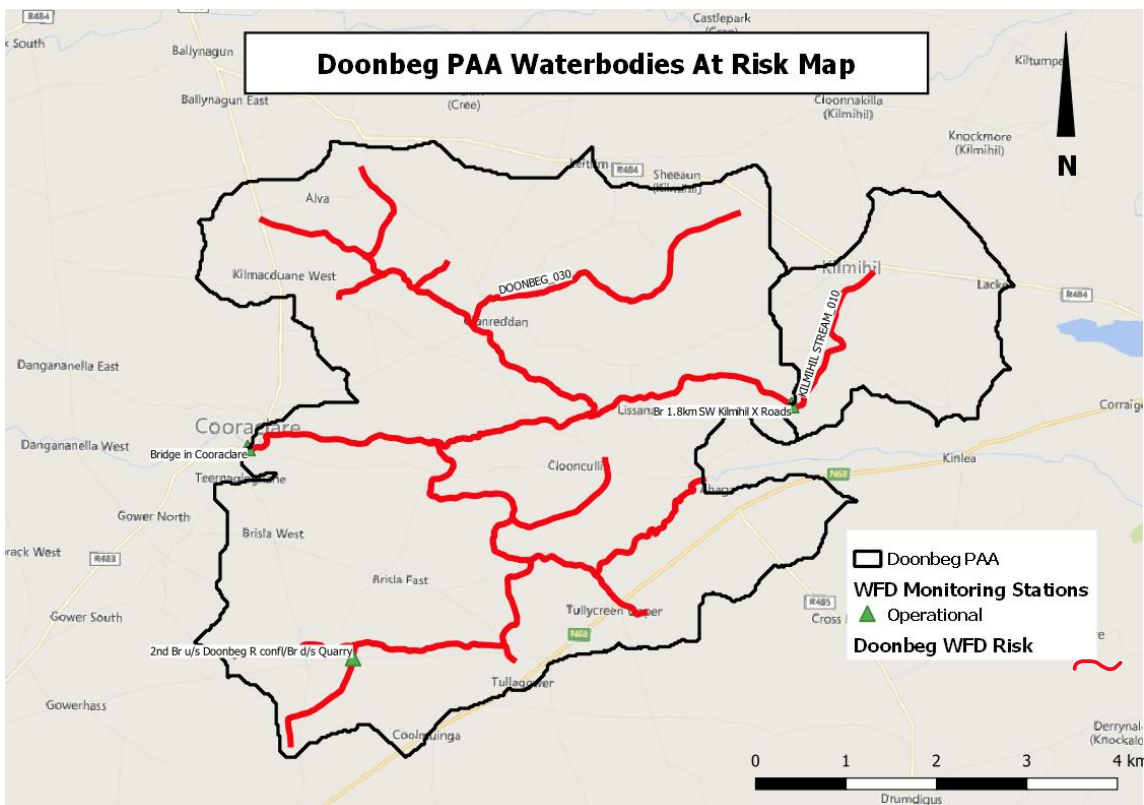


Table 1-2: Summary table of individual waterbodies within the Doonbeg System PAA (local river names in parentheses)

Water body Code	Water body Name	Risk	Obj.	Ecological Status			Pressures		
				2009	2012	2015	Category	Subcategory	Sig? (Y/N)
IE_SH_28K020200	Kilmihil Stream_010	<i>At risk</i>	Good	Poor	Poor	Poor	UWWTP	Agglomeration PE < 500	Y
IE_SH_28D020650	Doonbeg_030	<i>At risk</i>	Good	Moderate	Good	Poor	Forestry Agriculture Extractive Industry	Forestry Agriculture Quarry	Y

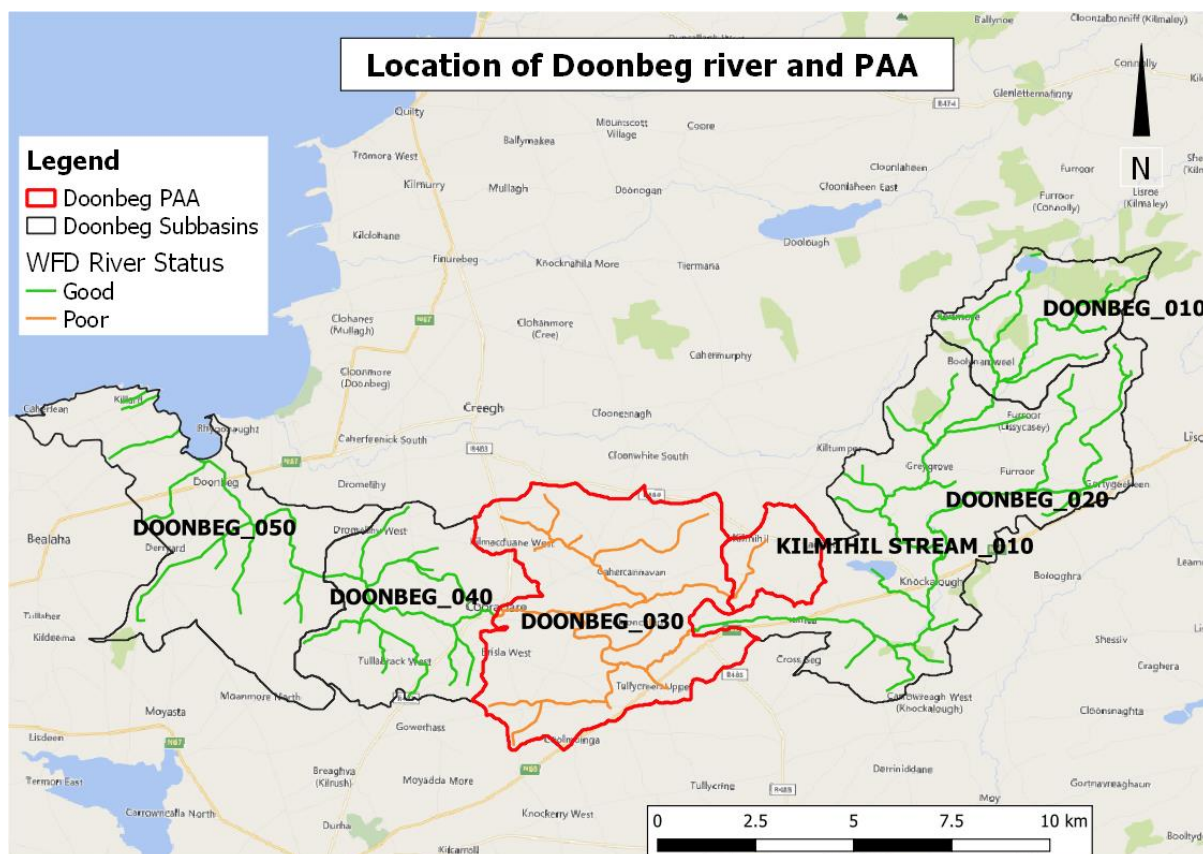
Source: Summary information from WFD App

2 Receptor information

2.1 Waterbody information

The five waterbodies on the Doonbeg river (010, 020, 030, 040 and 050), along with Kilmihil stream_010, combine to form the Doonbeg sub catchment Doonbeg_SC-010, sub-catchment code 28_3 in catchment area 28 (Mal Bay). Lough Naminna (water supply to a private group water scheme), headwaters to Doonbeg_010 (*Not at Risk*) and the Ballard_010 waterbody (*Review*) are also part of the sub-catchment but are not influenced or influencing the Doonbeg PAA. Doonbeg_010, Doonbeg_020, Doonbeg_040, and Doonbeg_050 are at Good ecological status and are categorised as *Not at Risk* of failing to meet the objectives of the Water Framework Directive (WFD). Doonbeg_030 and the Kilmihil Stream_010 are deteriorated waterbodies and are at poor status and *At Risk*.

Figure 2.1 Doonbeg waterbodies and Kilmihil stream



Overview table

Table 2-1: Receptor information for Doonbeg System PAA

	Figures/ Tables	Kilmihil Stream_010	Doonbeg_030		
Monitoring Point No. Name	Y	RS28K020200 Br 1.8km SW Kilmihil X Roads	RS28T010400 2nd Br u/s Doonbeg R confl/Br d/s Quarry	RS28D020650 Bridge in Cooraclare	
Risk Category	y	At Risk	At Risk		
Biological Status	2010-2012 2010-2015 trends in Q values	Poor	Not monitored	Good	
		Poor	Poor (2015)	Good	
		Consistently poor since 2007.	Decline at monitoring point RS28T010400 (Kilmihil Stream) from moderate in 2009 to poor in 2015.	Stable Good to 2015	
	Fish status (where rel)	NA	NA		
Hydrochemistry Data					
Ortho-P (mg/l P)	Baseline indicative quality Trends - significant? Dist to threshold	y	0.120 Bad No Far	0.008 High No Far	NA
NH4-N (mg/l N)	Baseline indicative quality Trends - significant? Dist to threshold	y	0.387 Moderate No Far	0.053 Good No Far	NA
TON (mg/l N)	Baseline indicative quality Trends - significant? Dist to threshold		0.844 Good No Far	0.434 Good No Far	NA
Monitoring Point No.		RS28K020200	RS28T010400	RS28D020650	

	Figures/ Tables	Kilmihil Stream_010	Doonbeg_030	
Supporting Chemistry Conditions		DO Pass. Nitrate and Ammonia: High. P: moderate. Note annual exceedances in BOD since 2007 to date (July2017 17mg/l)	DO: Pass. Other determinands for oxygenation conditions: High. Nutrients nitrate, ammonia and phosphate: High	NA
Hydromorphology				
RHAT score				
Evidence of Arterial drainage		No	No	No
Ecological Status (2010–2015)	y	Poor	Poor	
Elements driving status		Inverts	Inverts	
Protected Areas		No	No	No
WFD Objective		Good	Good	
EPA biologist notes (if any)		2015 – (Q3) One sensitive mayfly, high numbers of tolerant taxa	Not monitored in 2015	2015-(Q4) Sensitive taxa were found in high abundance. key tolerant taxa: Simuliidae (Few), Gammarus (Common) and Baetis rhodani (Numerous).
Significant issue/impact for receptor		ortho P, ammonia, BOD	Sediment	NA

Source: Summary information from WFD App

Table 2.2: Table of Q values

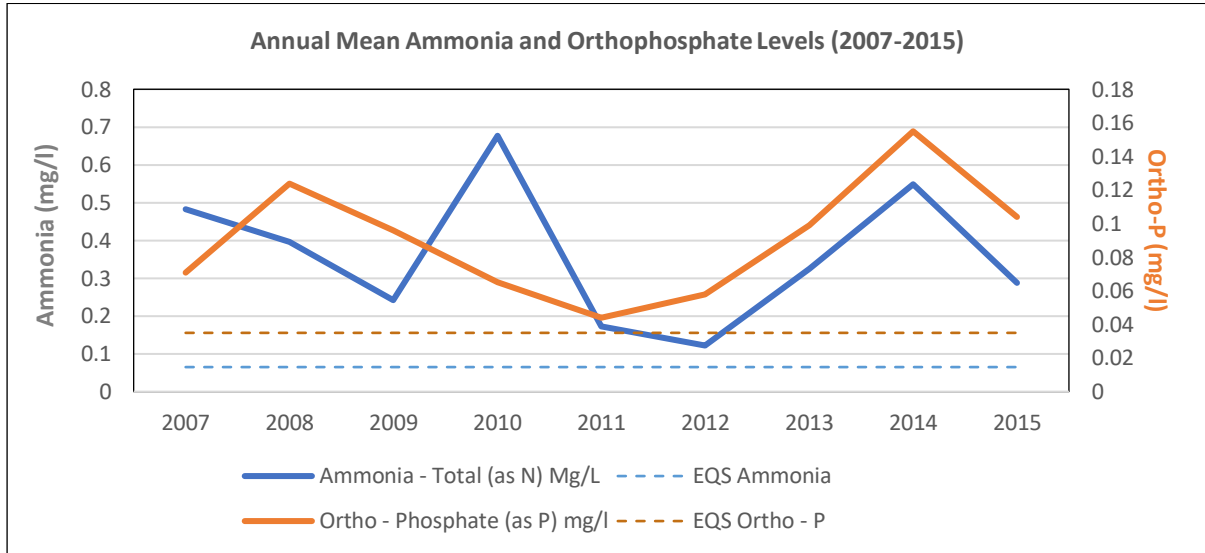
<u>Water body Name</u>	<u>Monitoring point</u>	<u>1980</u>	<u>1982</u>	<u>1985</u>	<u>1988</u>	<u>1991</u>	<u>2007</u>	<u>2009</u>	<u>2012</u>	<u>2015</u>
Kilmihil Stream_010	RS28K020200 Br 1.8km SW Kilmihil X Roads	Good	Mod	Good	Poor	Good	Poor		Poor	Poor
Doonbeg_030	RS28T010400 2nd Br u/s Doonbeg R confl/Br d/s Quarry							Mod	Poor	
Doonbeg_030	RS28T010500 TULLAGOWER STREAM - 1st Br u/s Doonbeg R confl									
Doonbeg_030	RS28D020650 Bridge in Cooraclare				Good	Good	Good	Good	Good	Good

Source: Summary information from WFD App

2.2 Hydrochemistry

Kilmihil Stream

Figure 2-2: Annual average orthophosphate and ammonia levels, Kilmihil stream_010

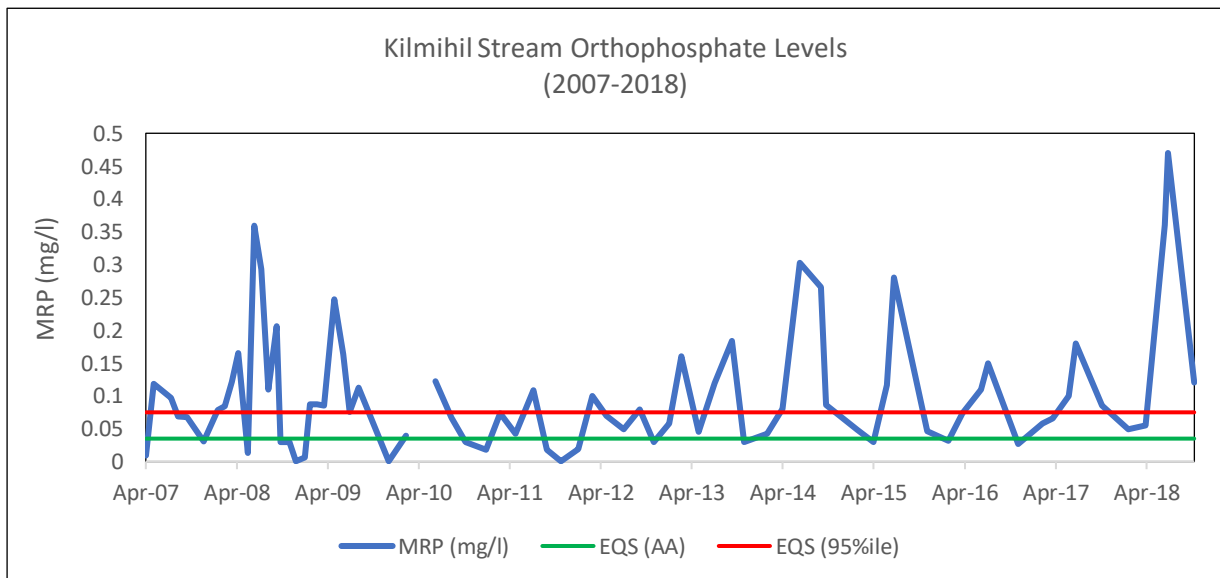


The Environmental Quality Standards for ammonia and ortho-phosphate are taken from S.I. No. 272 of 2009, European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended.

As can be seen from Figure 2.2, annual mean ortho-phosphate and ammonia levels exceeded their Good Status EQS consistently between 2007 and 2015.

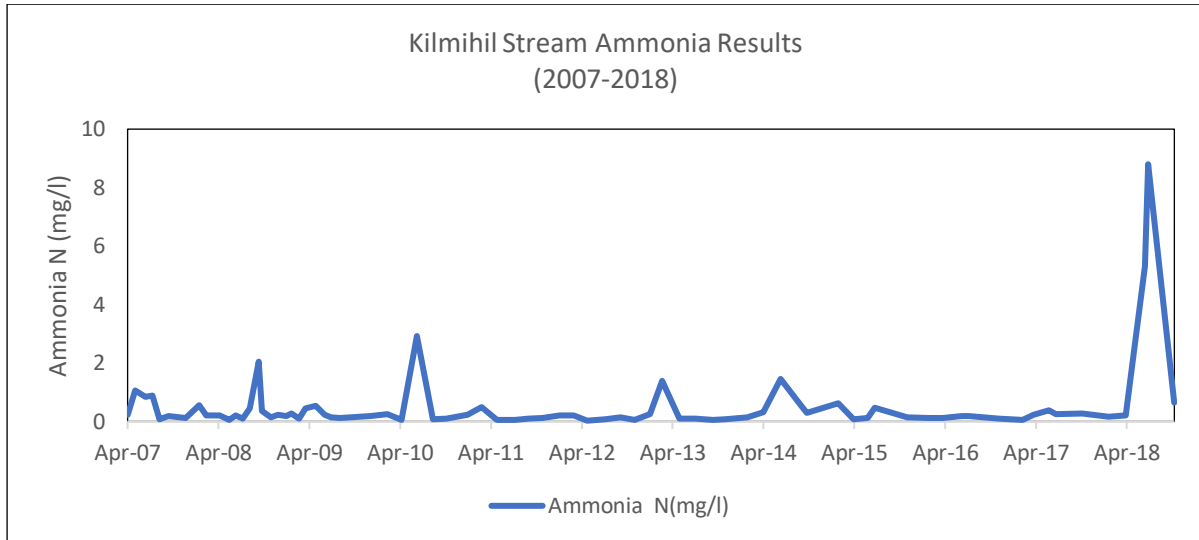
Individual orthophosphate results between 2012 and 2018 are graphed below in Figure 2-3. As the graph shows, the 95%ile limit of 0.075mg/l was frequently exceeded in this period (47% of results). Peaks generally occurred during Summer months with the highest result of 0.47mg/l obtained during the July 2018 drought.

Figure 2-3: Orthophosphate results for Kilmihil Stream, reported as MRP



Individual ammonia results are graphed in Figure 2-4. Sixty six percent of results exceeded the 95%ile limit of 0.14ppm. The result obtained during the July 2018 drought was 8.8mg/l.

Figure 2-4: Ammonia results for Kilmihil Stream



Kilmihil Stream BOD and dissolved oxygen levels are graphed in Figures 2-5 and 2-6.

Figure 2-5: BOD results for Kilmihil Stream

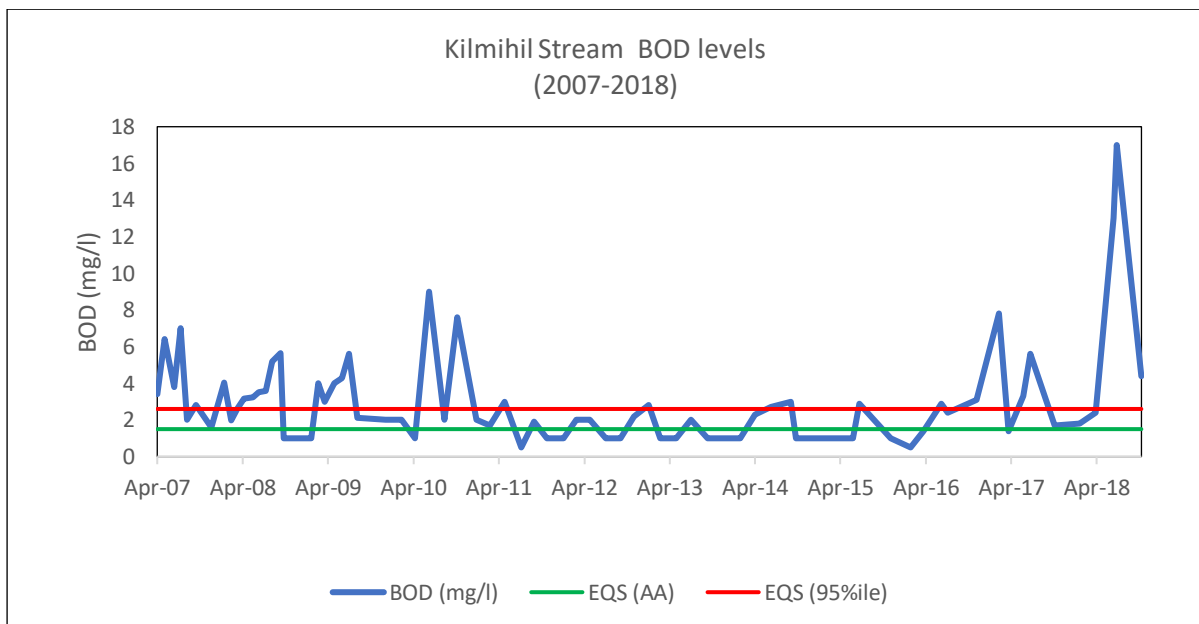
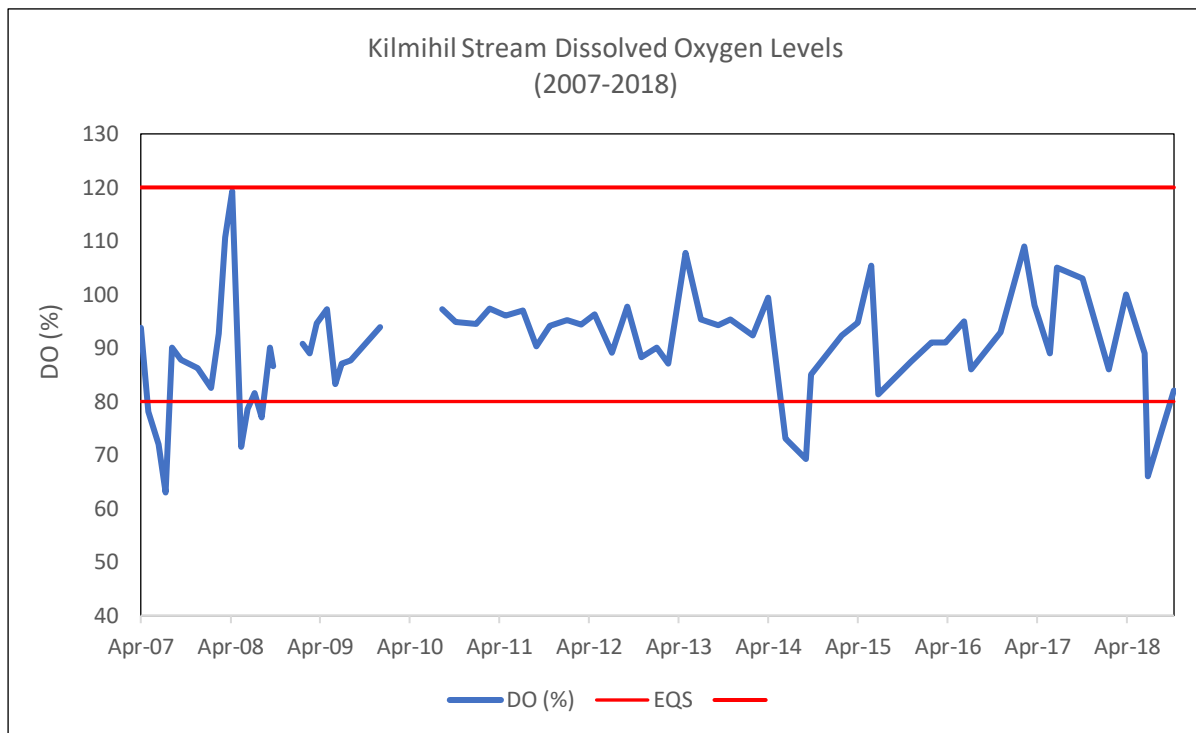


Figure 2-6: DO levels, Kilmihil Stream



The 95thile BOD EQS of 2.6mg/l was exceeded for 43% of individual BOD results. As for ammonia and orthophosphate, peaks generally occurred in summer months with the highest result (17mg/l) obtained during the July 2018 drought. DO levels were generally within the 80-120% range; results only occasionally dropped below 80%. However, it is possible that algal/plant growth in the stream may be contributing oxygen during daylight.

Kilmihil wastewater treatment plant was identified in the EPA initial characterisation as the sole significant pressure on the Kilmihil Stream waterbody. This is discussed further in Section 3 of this report.

Doonbeg_030

One site on the Doonbeg_030 waterbody is monitored for nutrient levels, '2nd Br u/s Doonbeg R confl/Br d/s Quarry'. This site is on Tullagower Stream, downstream of a Section 4 licensed facility (former quarry, now a waste recycling/recovery facility). There are no data available for nutrient levels at the 2nd WFD operational station on Doonbeg 30 (Cooraclare bridge). The poor WFD status of the Doonbeg 30 waterbody is driven by the biological monitoring results on Tullagower Stream.

Annual average orthophosphate and ammonia results for the Tullagower stream monitoring point are shown in figure 2-7. Individual results are graphed in figures 2-8 and 2-9.

Figure 2-7: Orthophosphate and ammonia results for Tullagower Stream

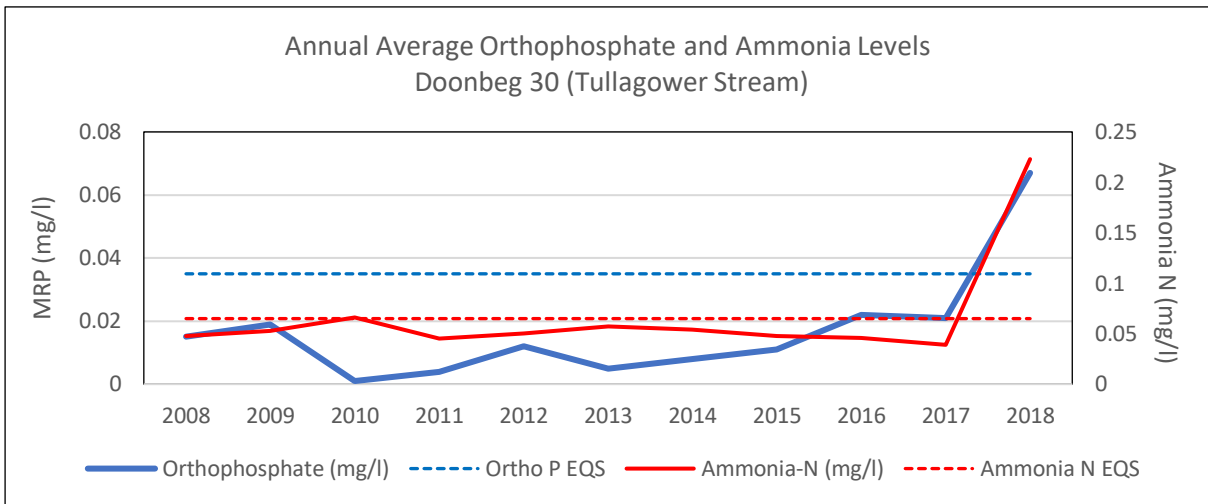


Figure 2-8: Orthophosphate results for Tullagower Stream

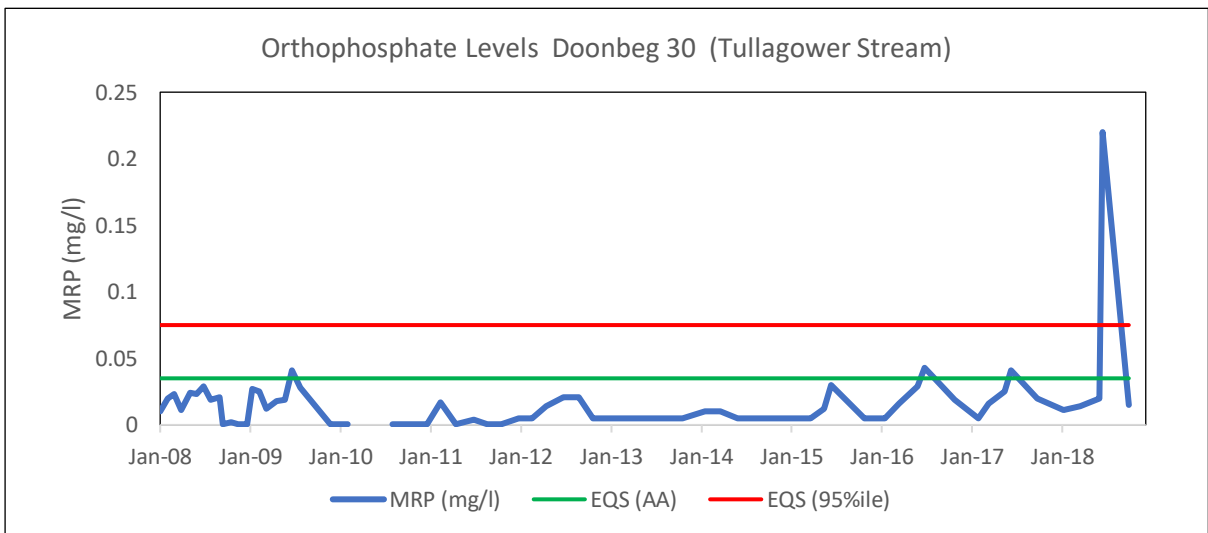
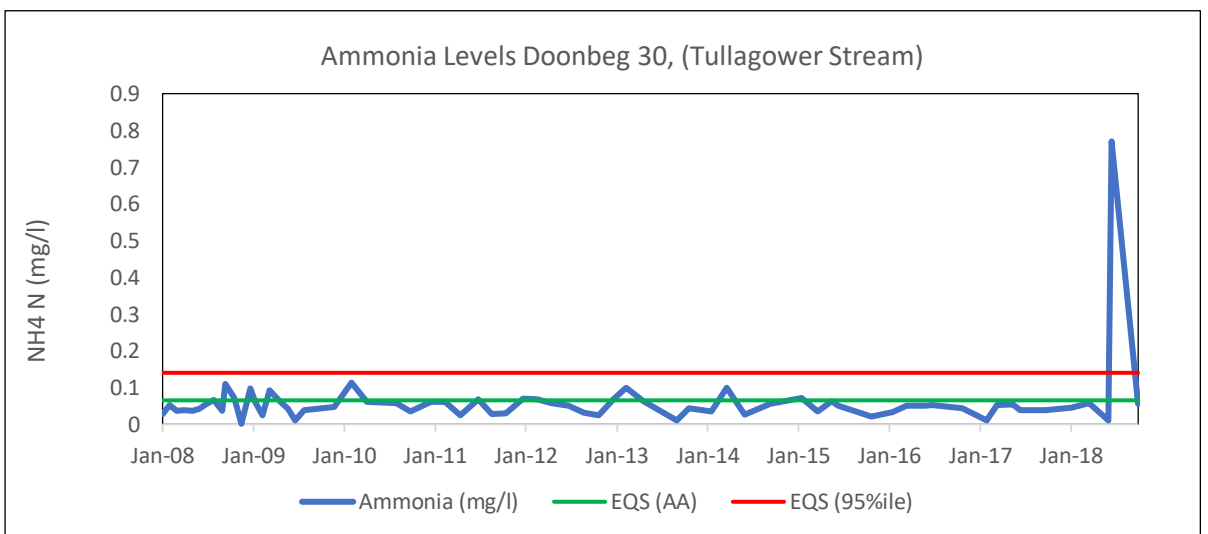


Figure 2-9: Ammonia results for Tullagower Stream



As can be seen from Figure 2-7, annual average orthophosphate and ammonia results were below the relevant EQS from 2008 to 2017 inclusive. The 2018 exceedence was due to peaks in both parameters during the July 2018 drought (see figures 2-7 and 2-8). There is a licensed (S4) facility located on Tullagower stream, upstream of the EPA nutrient monitoring station '2nd Br u/s Doonbeg R confl/Br d/s Quarry'. The discharge from this facility during a period of low dilution by receiving water, is a possible cause of the July 2018 spike. In terms of individual results, only one orthophosphate result and two ammonia results exceeded the relevant 95%ile EQS between January 2008 and October 2018.

These results indicate that nutrients are not the significant issue on Tullagower Stream.

3 Significant pressures

3.1 Initial EPA characterisation

Table 3-1: Initial EPA characterisation

Water body Name	Id	Category	Sub Category	Name	Significant?	Pressure & Impact details
Kilmihil Stream_010	WBP0002165	Urban Waste Water	Agglom PE < 500	Kilmihil	Yes	Nutrient Impact
Doonbeg_030	WBP0002177	Forestry	Forestry	N/A	Yes	Sediment

Source: Summary information from WFD App

3.2 Conclusion on Significant Pressures

Significant Pressures on Kilmihil Stream

Kilmihil wastewater treatment plant (A0091-01) discharges to Kilmihil Stream approximately 0.9km upstream of the WFD operational monitoring station Br 1.8km SW Kilmihil X roads (RS28K020200). Monitoring results indicate that nutrients (specifically orthophosphate and ammonia) are the significant issue in this waterbody. Results of EPA Load Apportionment Modelling give the WWTP as the most significant phosphorus contributor to the waterbody (see table 3-2 below).

Table 3-2: EPA LAM results for Kilmihil Stream (from EPA sub catchment storyboard:28_3):

	Pressures				
	Kilmihil COA	Pastures	Diffuse Urban	Forestry	Historic Landfill
P Load cont. (%)	41	26	15	11	0

EPA report 'Urban Wastewater Treatment in 2017' states that the wastewater discharge at Kilmihil stream_010 from the WWTP is the sole significant pressure on the waterbody at risk of pollution.

The EPA 2018 inspection report for the WWTP (visit date 5th July 2018) states that the plant is overloaded and not achieving its design criteria. Extract from the report reads "a second inlet stormwater overflow (SWO) was installed two years ago, as surcharging frequently occurred at the inlet works of the WWTP. There are currently two inlet SWOs at the WWTP. The original SWO is screened and the new SWO is unscreened. The original screened SWO activates first and the new screen activates if the influent exceeds an estimate flow rate of 87 m³/day. It was noted during the site visit, that in the winter months, this flow rate is exceeded on a regular basis. From reviewing the influent records, an overflow occurred every day during January 2018". The report goes on to state "a plume was evident from the discharge point. The plume extended to the location that the downstream sample was taken EPA monitoring of water samples taken upstream and downstream of the discharge point during the site visit found that water quality deteriorated between the upstream and downstream locations. This is attributed to the discharge".

Kilmihil Stream monitoring results from the EPA inspector's visit referred to above, are reproduced for key parameters in Table 3-3. Note that this monitoring was undertaken during dry weather flow conditions in the river.

Table 3-3: EPA monitoring results for Kilmihil Stream (5th July 2018)

	Parameter		
	Ammonia (mg/l N)	BOD (mg/l O ₂)	o-phosphate (mg/l P)
Kilmihil Stream, upstream of WWTP	<0.02	<1	0.021
Kilmihil Stream, downstream of WWTP	8.5	11	0.99
EQS (Good Status) from SW regulations	0.065	1.5	0.035

The EPA (draft) Mal Bay Catchment Assessment (HA 28) report stated (in June 2017) that the wastewater treatment plant was not scheduled to be upgraded (At that time). Section 2.2 of the EPA inspector's 2018 report requires that Irish Water progress (these) upgrade works without delay.

In terms of other potential pressures on Kilmihil-010 waterbody, there are areas upstream of the plant which are ranked high risk for diffuse phosphate loss to surface waters (see Appendix III). However, the EPA's load apportionment model output gives the P contribution from pasture as 26% of the total, versus 41% for the WWTP discharge. The WWTP calculation is presumably based on the assumption that 100% of the raw sewage is treated in the plant. If raw sewage is discharging untreated or partially treated to the river, this would increase the P contribution from the plant to greater than 41%.

Significant Pressures on Doonbeg 30

Ecological status on Doonbeg 30 is driven by biological status on the Tullagower stream monitoring location RS28T010400.

Nutrient monitoring data are available for this site and indicates that aside from one peak in July 2018 when river flows were extremely low, nutrients are not an issue on Tullagower stream. Lands upstream of the WFD operational station are ranked medium to low risk for diffuse phosphate loss to surface waters. Upstream of the site, there is forestry in the headwaters and a Section 4 licensed quarry/waste recovery and recycling facility downstream of the forested area. Both of these land uses are potential sources of sediment and therefore local catchment assessment will be need to determine the source of the sediment.

3.3 Significant Issues

Kilmihil Stream

Chemistry monitoring data indicate that the significant issues on Kilmihil Stream are nutrients (phosphate and ammonia) and possibly organic pollution (elevated BOD).

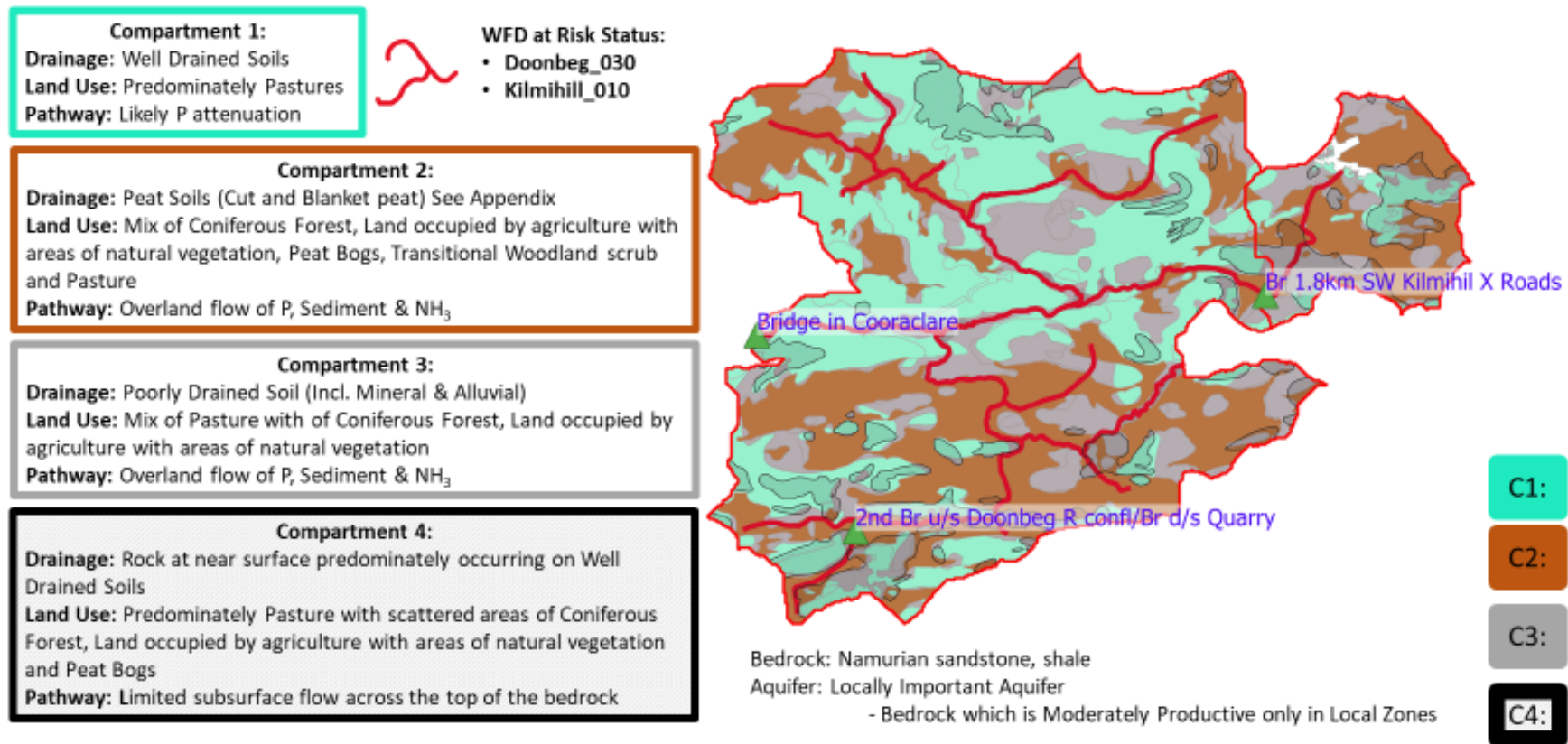
Doonbeg 30

Status at Doonbeg 30 is driven by biological quality on Tullagower Stream. Sediment is the most likely significant issue here; chemistry data indicate that nutrient levels are generally low. Upstream areas are ranked low risk for surface phosphate pathways (see Appendix III below).

4 Pathways information (diffuse pollution)

Figure 4.1: Doonbeg PAA conceptual model compartments

Doonbeg PAA Conceptual Model



4.2 Pathways description

Kilmihil stream_010

Regarding the nutrient issues on Kilmihil Stream, EPA load apportionment modelling and nutrient monitoring data indicate that the wastewater treatment plant is the significant pressure on this waterbody. However, the possibility of diffuse phosphate loss via overland flow pathways cannot be ruled out. Compartment 2 (peat) and compartment 4 (rock at near surface) are predominant in this area, favouring surface water pathways for phosphorus with limited to no attenuation opportunities. The surface P PIP map (Appendix III) shows areas of high PIP Rank (1 to 3) along both banks of Kilmihil stream_010 also.

Doonbeg_030

In terms of the suspected sediment issue, areas of poorly draining soil and peat are the focus for assessment. A stream walk to identify the nature of the sediment (peaty or mineral) will help to identify which of these compartments to focus on for further assessment.

5 Interim conclusions on the PAA

The Doonbeg PAA comprises Kilmihil Stream_010 and Doonbeg_030.

Kilmihil Stream_10

- At Risk.
- Poor WFD Status (driven by biological quality).
- Information from the WFD App indicates that the significant issue is elevated nutrients. Nutrients of concern are ammonia and orthophosphate. BOD also possibly a significant issue.
- The significant pressure is identified (from the WFD App) as urban wastewater, agglomeration PE <500 in the outskirts of Kilmihil village.
- The surface water receptor phosphate PIP map indicates areas at high risk for surface phosphate runoff from agriculture. This will be considered in the field assessment, in addition to other sources of point source nutrient contamination. SSIS and chemistry will be undertaken as well as a stream walk as part of the local catchment assessment process.

Doonbeg_30

- At Risk.
- Poor WFD Status (driven by macro-invertebrates).
- Sediment likely to be the significant issue in this waterbody; elevated levels of ammonia and ortho-phosphate were observed on only one occasion (July 2018).
- Information from the WFD App indicate that Forestry is the significant pressure identified.
- Full local catchment assessment will be needed in this waterbody to confirm the significant issue/s and significant pressures.

6 Workplan

6.1 Table EPA further characterisation actions

WB Name	Id	Action	Responsible Organisation	Further Characterisation Action details
Kilmihil Stream_010	FC001529	IA1 Provision of Information	Irish Water	Aim: Watching brief to monitor for a decline in nutrient concentrations and improvement in ecological status following the upgrade of the wastewater treatment plant.
Doonbeg_030	FC001530	IA5 Multiple Sources in defined rural area (1km) or waterbody or rural town	Local Authority Waters Programme (LAWPRO)	Aim: Focus on sources of sediment from forestry and quarry operations upstream of monitoring station RS28T010400. Start at the monitoring station and walk upstream. Identify point (drains, discharge pipes) and diffuse (inadequate buffer strips) sources of sediment. Collect field parameters, water quality and SSRS in order to confirm the critical source areas for sediment in the subbasin.

Source: WFD App

6.2 Local Catchment Assessment

Initial field investigations to be undertaken at seven locations as outlined below and as shown on figure 6.1 and 6.2.

Points 1,2,3 (Kilmihil stream_010, nutrient issue)

Carry out SSIS at point 1 to establish a benchmark as we work back upstream to point 2 (downstream of the WWTP), where another SSIS should be undertaken. To establish water quality upstream of Kilmihil WWTP, undertake SSIS assessment at point 3 to identify if other source of diffuse or smaller point sources are an issue also. Based on the findings of the SSIS assessments, a river walk may be required upstream from the monitoring point Br 1.8km SW Kilmihil X Roads, to investigate if sources of diffuse or smaller point sources are an issue for nutrient contamination and again upstream from Kilmihil WWTP depending on the results of the SSIS assessments.

Points 4,5 (Doonbeg_030).

Status of Doonbeg 30 is driven by water quality on Tullagower Stream. However the reasons for selection of this waterbody as a PAA included the presence of freshwater pearl mussel in the Doonbeg river. Conducting SSIS at points 4 and 5 will give a broader understanding of the overall condition of the catchment. SSIS assessment at point 5 will determine the condition of the waterbody downstream of the confluence with Doonbeg_020 and may indicate whether other pressures or different issues are present downstream of Tullagower Stream. Assessment at point 4 will pick up the full extent of Tullagower Stream and will determine if there is impact from this (southerly) area of the catchment.

Points 6,7 (Doonbeg_030, suspected sediment/hydromorphology issue).

Main focus for Doonbeg 30 is on the Tullagower Stream monitoring point as this is driving status on the waterbody as a whole. Undertake SSIS/RA here (point 6) to establish whether there has been a change in water quality since the last EPA monitoring round. Undertake a stream walk from point 6 to point 7 (and further upstream if necessary). Look for risk areas, hydromorphological changes and sources of sediment. Note sediment type (mineral or peat).

Figure 6.1: Bridge hop and sample locations, Kilmihil Stream_010

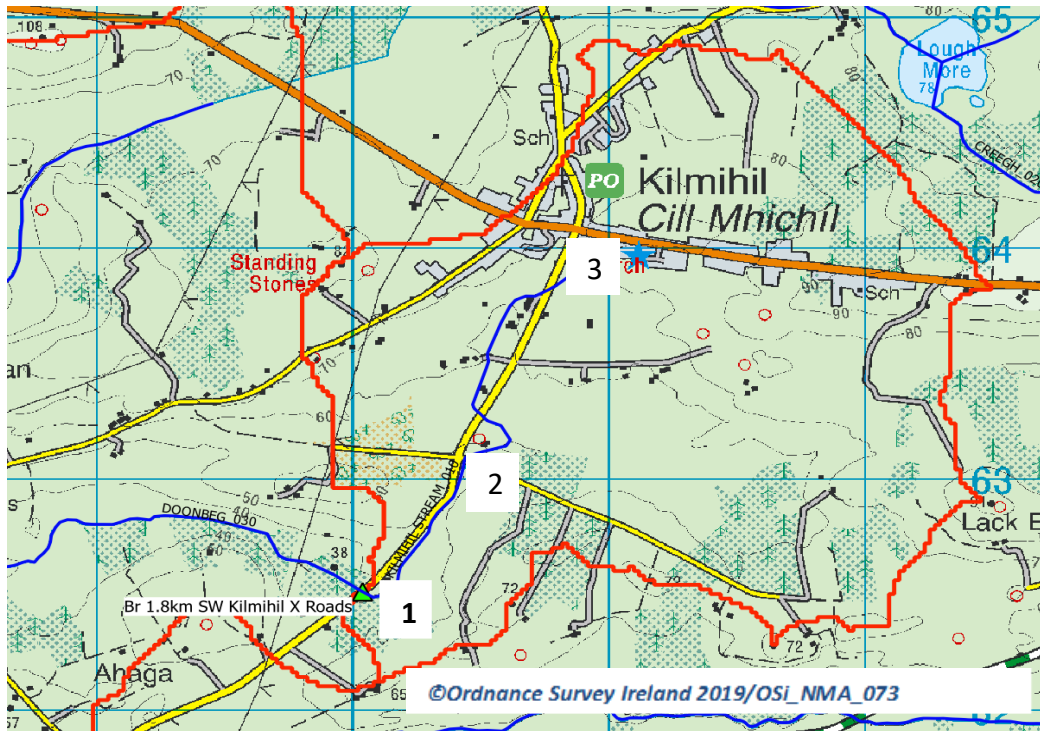
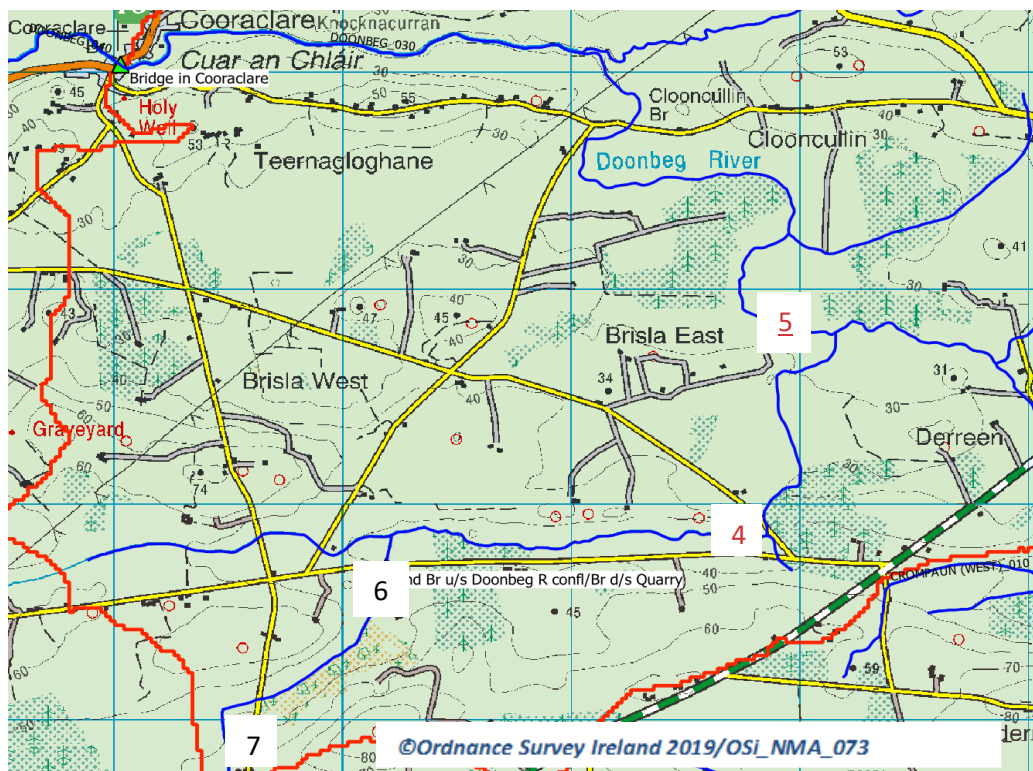


Figure 6.2: Bridge hop and sample locations, Doonbeg_030



7 Review of possible mitigation options

Local Catchment Assessment is needed to identify the sources of nutrients and sediment to the river. Referrals to the relevant agencies will be made based on the evidence gathered from the investigative assessments carried out.

Mitigation options will centre on the main pressures in the catchment: Forestry, as well as point source from UWWTP. If agriculture is identified as a significant pressure, mitigation measures will focus on breaking pathways for diffuse pollution.

8 Communications

LAWPRO held a community information meeting in Cooraclare on the 31st January 2019 to tell the public about our work and to hear about water quality concerns from people living in the area.

Issues raised at the meeting included:

- general water quality questions
- Point sources and absence of a waste water treatment facility in the village of Cooraclare
- Cleaning the river, pros and cons
- River bank erosion and stabilisation
- What funding is available and how is funding managed
- Comment that agriculture is accountable for their actions when other state agencies appear not to be
- Which public body investigates fish kills
- A request for further communication to update the community on LAWPRO's progress.

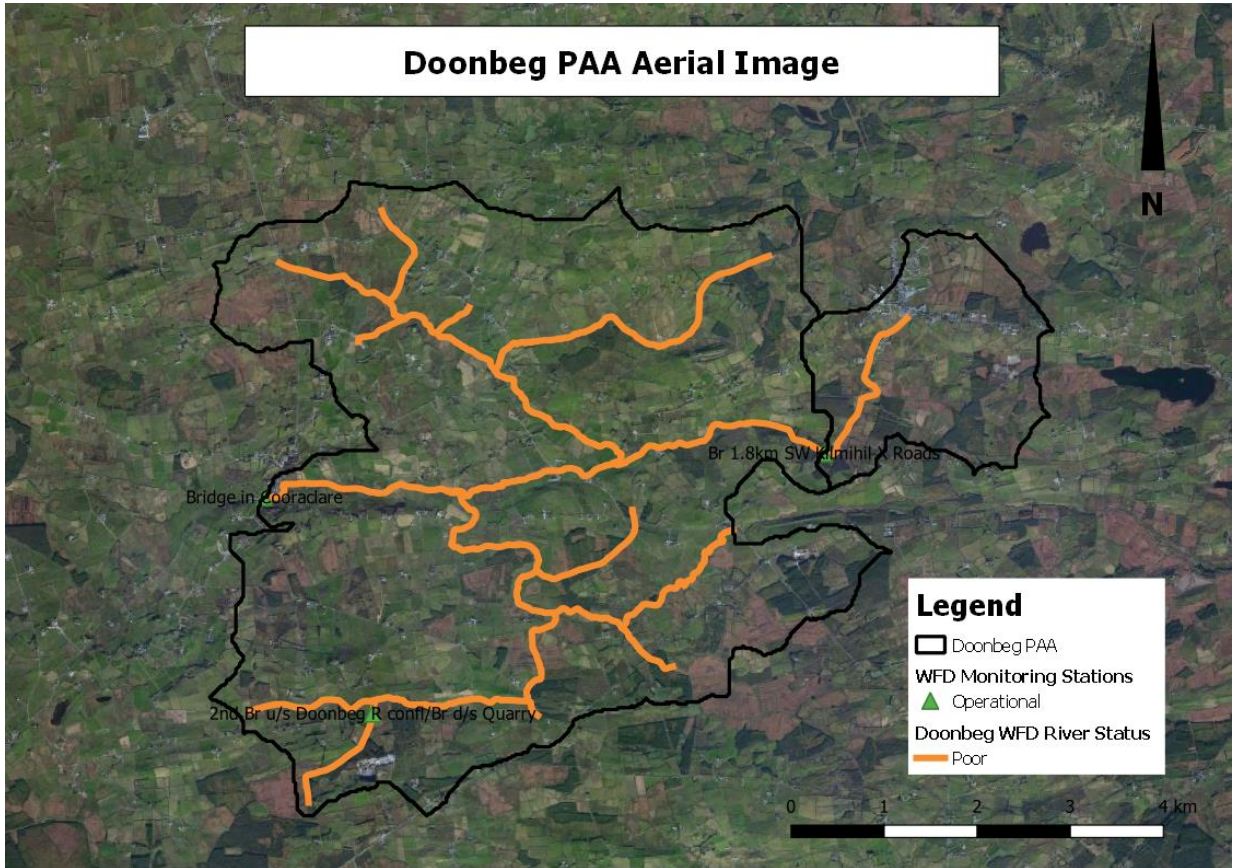
If Agriculture is identified as a significant pressure, farm engagement will also be required. ASSAP are working with contacts to encourage attendance by farmers at public meeting. Follow up farm meeting may be required (to be arranged by ASSAP).

We will work with the relevant stakeholders/implementing bodies to identify the appropriate local measures for the catchment, using the *Right measure in the right place*.

Date of completion of desk study: 20th December 2018

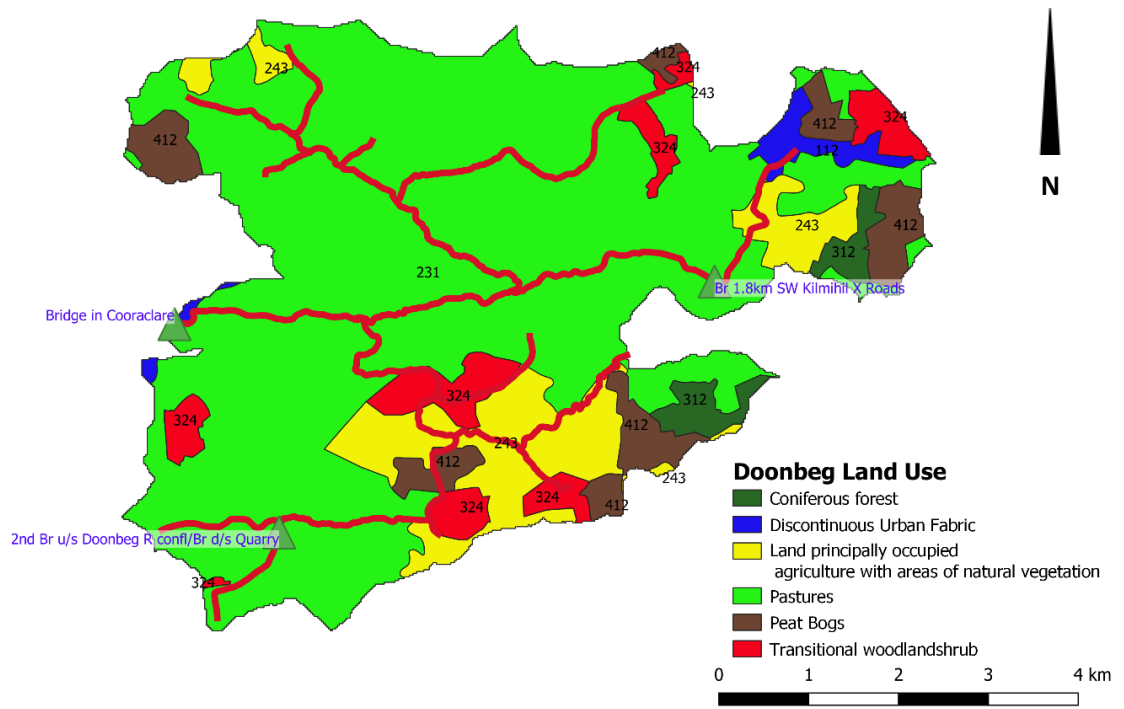
Appendices

Appendix I: Doonbeg Aerial Imagery

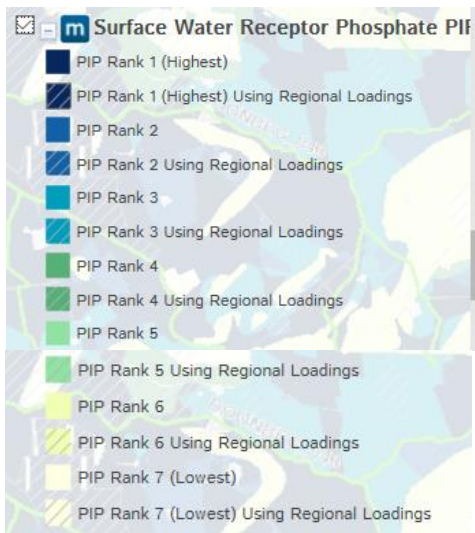
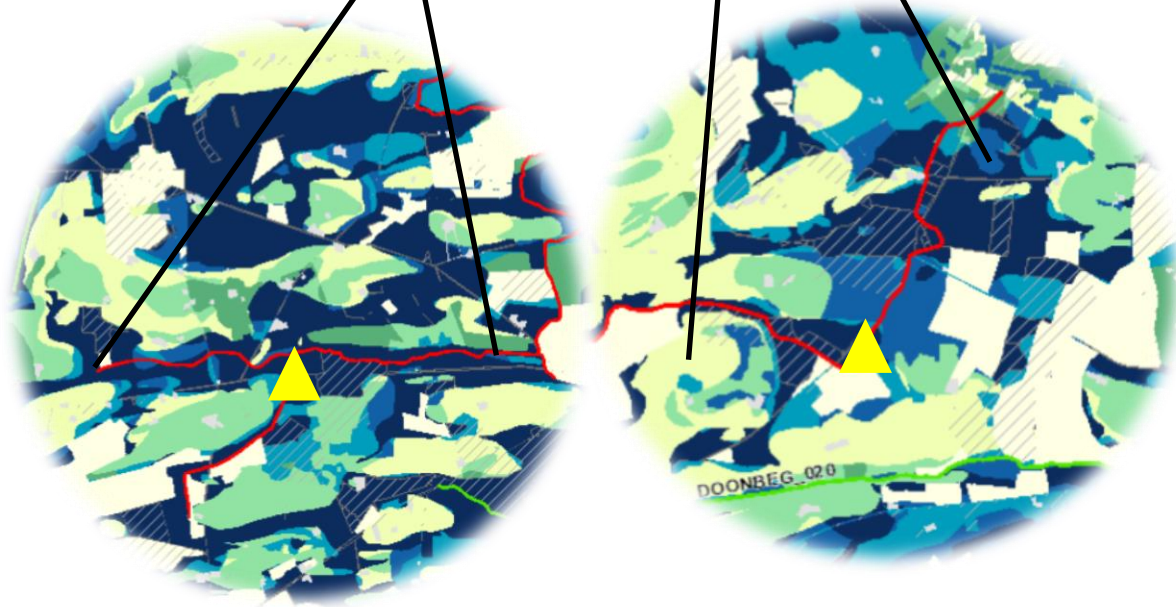
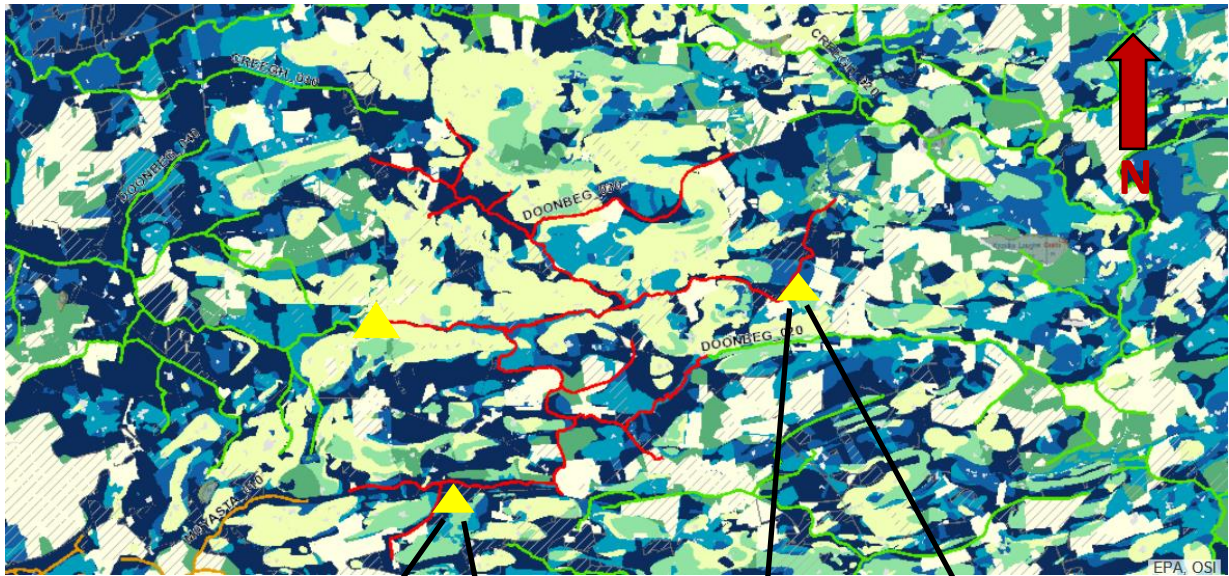


Appendix II: Land Use maps

Doonbeg PAA Corine Land Usage Map

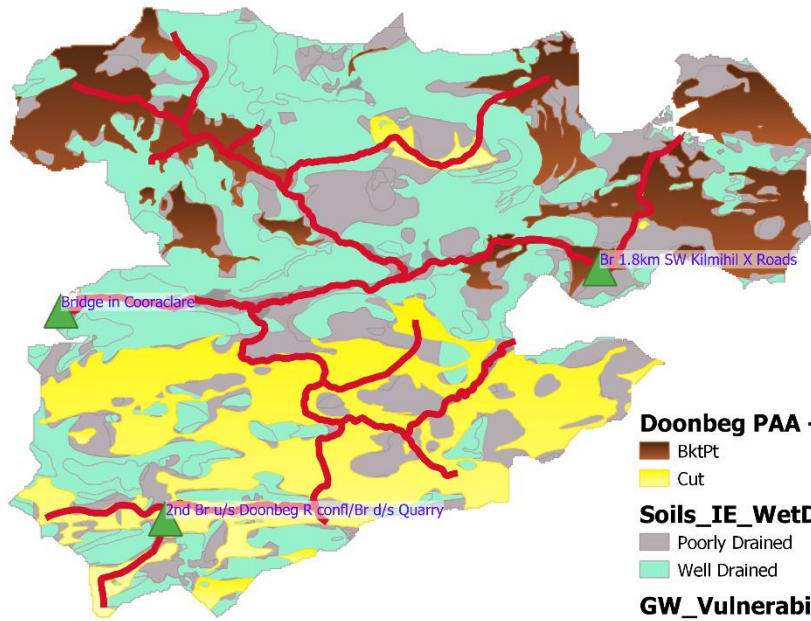


Appendix III: Pollution impact potential map for phosphate risk to surface waters.



Appendix IV: Doonbeg PAA Soils Map

Doonbeg PAA - Sub-classification of Peat Soils



Doonbeg PAA - Sub-classification of Peat Soils

BktPt

Cut

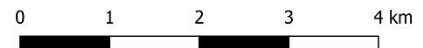
Soils_IE_WetDry_SW

Poorly Drained

Well Drained

GW_Vulnerability2

Rock at or near Surface or Karst



AlluvMIN - Mineral Alluvium

AminDW - Deep well-drained mineral soil, Derived from mainly acidic parent materials

AminPD - Deep poorly drained mineral soil derived from mainly acidic parent materials

AminPDPT - Poorly drained mineral soils with peaty topsoil derived from mainly acidic parent materials

AminSP - Shallow poorly drained mineral soil derived from mainly acidic parent materials

AminSPPT - Peaty shallow poorly drained mineral soil derived from mainly acidic parent materials

AminSRPT - Shallow reasonable drained mineral soil derived from mainly acidic parent materials

AminSW - Shallow well drained mineral soil derived from mainly acidic parent materials

BminDW - Deep well drained mineral soil derived from mainly basic parent materials

BminPD - Poorly drained mineral soils derived from mainly basic parent materials

BminPDPT - Peaty poorly drained mineral soils derived from mainly basic parent materials

BminSP - Shallow poorly drained mineral soil derived from mainly basic parent materials

BminSPPT - Peaty shallow poorly drained mineral soil derived from mainly basic parent materials

BminSRPT - Peaty shallow reasonable drained mineral soil derived from mainly basic parent materials

BminSW - Shallow well drained mineral soil derived from mainly basic parent materials