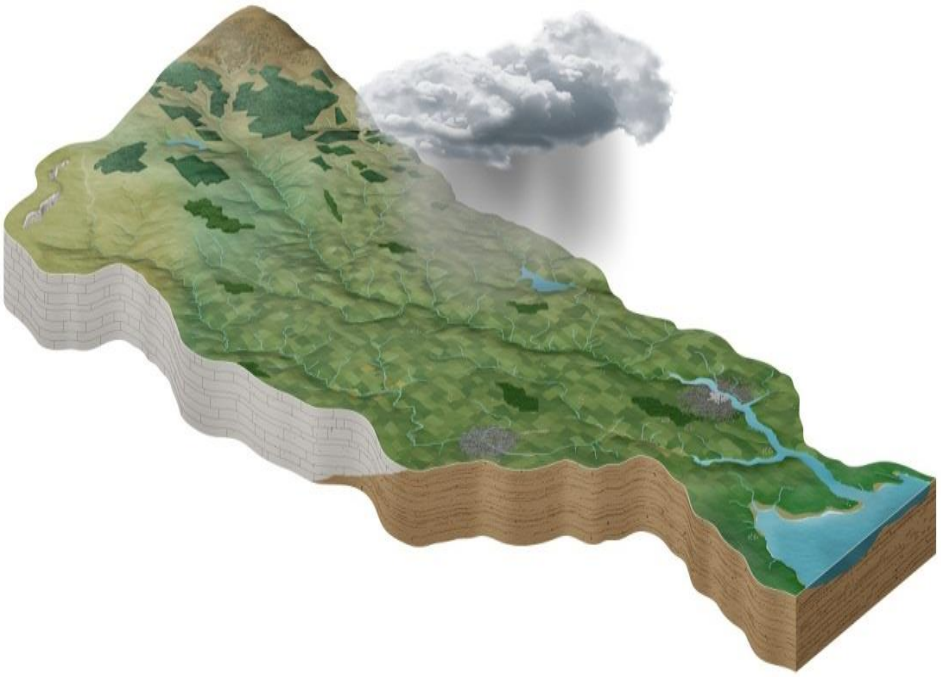
Report series:

Impacts of pressures on water quality

AGRICULTURE



Catchment Science & Management Unit

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epa Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Preface

This document is part of a report series that summarises the evidence on each of the main significant pressures that impact on water quality. The series currently includes reports on the following key pressures:

- Agriculture
- Urban waste water
- Hydromorphology
- Forestry
- Domestic waste water
- Industry
- Drained peat

This report series is complemented by a sister series of 46 catchment reports which describe the water quality, risk, pressures and other relevant data for each waterbody in each catchment. All reports are available on www.catchments.ie.

An online interactive mapping system, where the most up to date data can be viewed, is available at EPA Maps.

Data can be downloaded from the EPA geoportal site at https://gis.epa.ie/GetData.

Impacts of agriculture on water quality

Agriculture as a pressure

Agriculture is the most common land use in Ireland, covering approximately 70% of the country, the majority of which is in pasture. Agriculture has also been identified as the most prevalent significant pressure, impacting over 1000 waterbodies or approximately 60% of all waterbodies '*At Risk*' of not achieving their environmental objective under the Water Framework Directive[1] (Table 1; Figure 1). This is based on the most recent characterisation assessment using data up to 2021. In two thirds of waterbodies where agriculture is a significant pressure, additional pressures have also been identified.

Table 1: Number of 'At risk' waterbodies with agriculture as a significant pressure

Waterbody Type	No. Waterbodies	No. At Risk Waterbodies	No. Waterbodies with Agriculture identified as a significant pressure	% At risk waterbodies with Agriculture identified as a significant pressure
River	3192	1337	843	63
Lake	812	142	85	60
Transitional	196	60	40	67
Coastal	112	16	7	44
Groundwater	514	94	48	51
Total	**4826**	**1649**	**1023**	**62**

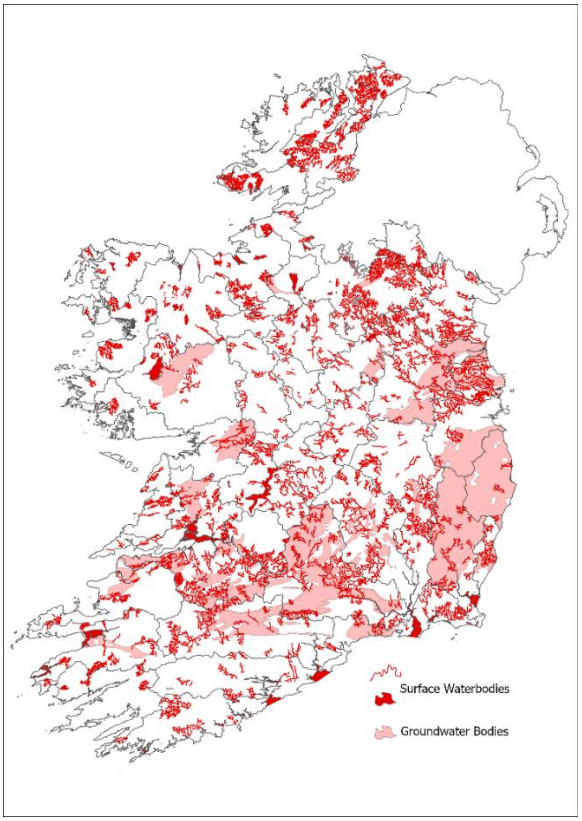

Figure 1: Waterbodies where agriculture is a significant pressure (August 2023)

[1] Waterbodies are categorised as being 'At Risk' of not achieving their WFD objectives where the monitoring data shows evidence that water quality is impacted, and actions are required to deliver water quality improvements.

Water quality issues from agriculture

The most common water quality issue arising from agriculture is the loss of excess nutrients, ie phosphorus and nitrogen, from organic and inorganic fertilisers. Excess nutrients in water can cause over growth of aquatic plants and algae which leads to eutrophication. The excessive growth out-competes other plants, uses up dissolved oxygen, and blocks light to deeper waters, leading to imbalances in the ecosystem. Both phosphorous and nitrogen play a role in eutrophication, however, management of excess phosphorus is typically the main issue for rivers and lakes, and management of excess nitrogen for groundwaters, estuaries and coastal waters.

Water quality may also be impacted from excess losses of fine sediment, for example from soil and bank erosion caused by cattle access to streams, field and channel drainage and ploughed lands. Too much fine sediment fills up the spaces between the gravels in stream beds and reduces the availability of suitable habitat for some dependent species. Drainage, dredging and other activities that impact on the diversity of habitat in the bed and banks of waterbodies is also a significant issue.

The loss of even very small quantities (eg drops) of pesticides and some animal health products into waterbodies can result in toxic effects for aquatic ecology and impact the provision of clean drinking water.

Nutrients

Nutrient losses from agriculture can come from point sources such as farmyards, or from diffuse sources such as spreading of chemical or organic fertilisers, and are controlled by three main factors: farm practices, soil type/catchment setting, and the weather. At the national scale, the proportion of the nitrogen load in our waters from agriculture (both pasture and arable) is 84%, with the remainder from urban and domestic waste water, industry and other sources (Figure 2). For phosphorus, at the national level, urban wastewater contributes a greater share of the load (45%) in comparison to 26% from agriculture. However, much of the load from the urban population discharges directly to marine waters because 40% of the population lives within 5 km of the coast, so in the rural environment, the proportion from agriculture can be higher locally. For domestic waste water systems, the proportion of both nitrogen and phosphorous is very small (2%), although the phosphorus load can be important in small streams if the systems aren't well operated.

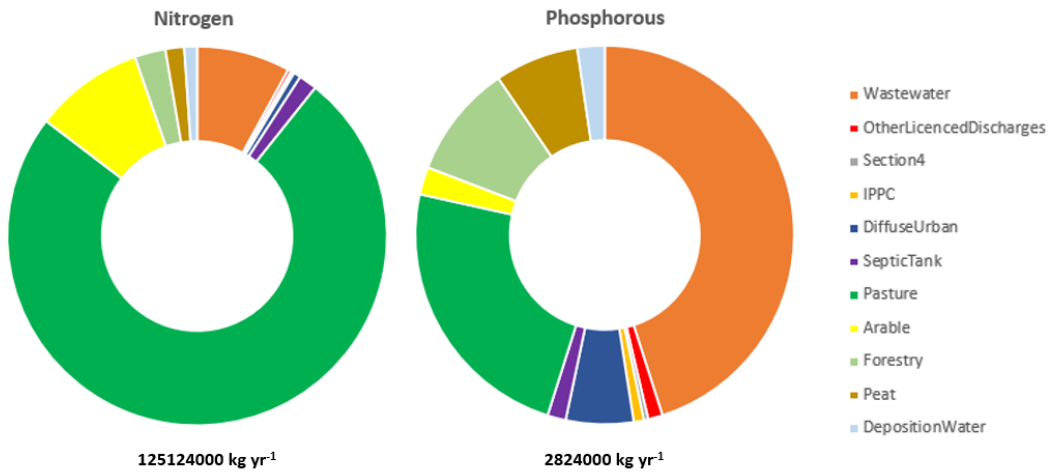

Figure 2: Load apportionment of nitrogen and phosphorous emissions to water (based on data up to 2018). Note that this is national scale; proportions will differ for rivers and lakes at waterbody, subcatchment and catchment scales.

The risk of phosphorus loss is highest on poorly draining soils and subsoils, such as those found in parts of Cavan, Monaghan, Wexford, Limerick and Meath. In these settings, overland flow pathways deliver sources of phosphorus into the watercourse network with rainfall. Phosphorus mitigation actions are best targeted at intercepting the overland flow pathways. This is because it takes a tiny fraction of the phosphorus that would normally be applied to land to cause a water quality problem, and source control measures are unlikely to be effective enough on their own. Pathway interception actions aim to reduce runoff containing excess phosphorus, and may include targeted planting of hedges and woodland along rivers, targeted riparian buffer strips, engineered ditches, and constructed wetlands and ponds. These measures may have multiple benefits for biodiversity, and may reduce other pollutant sources such as pathogens and sediment, as well as phosphorus.

The risk of nitrogen loss is highest in freely draining settings where the excess nitrogen not taken up in grass or crops (ie the nitrogen surplus) infiltrates into shallow groundwater, discharges into connected river systems and travels onward to the estuaries and coastal waters. Excess nitrate can also percolate deeper into groundwater and impact on the quality of drinking water from wells. Lands in parts of Counties Cork, Tipperary, Kilkenny, Waterford, Carlow and Wexford are particularly susceptible to nitrogen losses from agriculture. Mitigation actions are best targeted at controlling losses at source and reducing the nitrogen surplus, as the pathways into shallow groundwater are more difficult to intercept. The nitrogen surplus can be reduced by increasing the nitrogen use efficiency, and decreasing the chemical/organic nitrogen load. This may be achieved by for example, improved nutrient management planning, optimisation of soil pH and soil fertility, and the use of catch crops in arable lands. In some catchments, a reduction in the source load at the catchment scale may also be required. These measures may have multiple benefits for the reduction of greenhouse gases.

Figure compares the national annual average concentrations of phosphorous (blue) and nitrate (orange) in rivers from 2007 to 2023 for waterbodies that are 'At risk' from Agriculture and those that are 'Not at risk'. The dashed lines represent the environmental quality standards for Good Status for phosphate in rivers (0.035 mg/l), and nitrogen in waters entering the marine environment (2.6 mg/l as N). The second, lower dotted line on the nitrogen graphs is the EPA guideline value to support good ecological status in rivers (1.8 mg/l as N). Rivers with agriculture as a significant pressure consistently have higher average concentrations of both nutrients than those that are 'Not at risk'. There are also regional differences, with higher concentrations in the south, southeast and eastern regions than elsewhere.

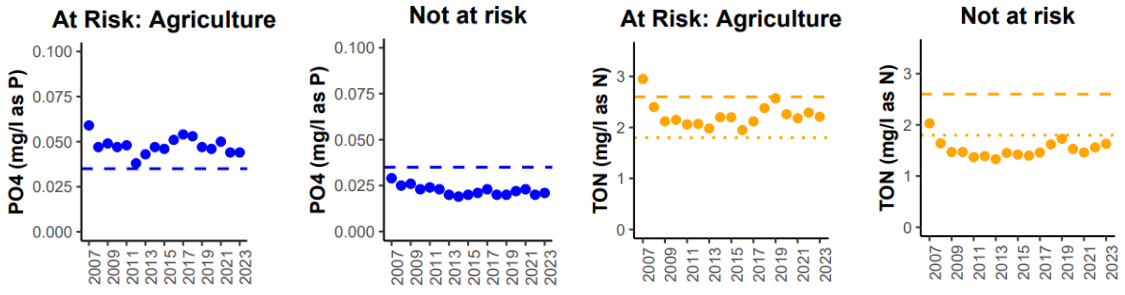

Figure 3: Average annual phosphorous (blue) concentrations, and total oxidised nitrogen (orange) concentrations in Rivers from 2007-2023 for waterbodies that are At Risk from Agriculture and those that are Not At Risk. The dashed and dotted lines are the environmental quality standards (EQS), and guideline values respectively, to protect good ecological status.

There are differences in nutrient concentrations regionally around Ireland, reflecting the variability in farming practices, soil types and weather. For phosphorus, the highest concentrations are typically

found in the south east and southwest, while concentrations in the western regions are low. For nitrogen, there are higher concentrations in the south, southeast and eastern regions than elsewhere.

Sediment

Excess losses of fine sediment can impact the condition of ecological habitats and fish spawning grounds, as well as being reservoirs and transport media for phosphorous and other contaminants. Typical sources of fine sediment from agricultural activities include runoff from farm roadways and bare ground, erosion of riverbanks at cattle access points, and land drainage and channel maintenance, and overland flow from farmland and yards in heavy rain. Mitigation options include livestock exclusion, fencing and stabilising vegetation on the riverbank, and attenuation ponds.

Chemicals

Pesticides and veterinary medicines can pose a risk to water quality and soil health, even in very small quantities, ie drops. Pesticide exposure is linked to a wide range of direct (both lethal and non-lethal) and indirect effects on biodiversity, contributing to declines in populations of insects, birds, bats, earthworms, aquatic plants, fish, and amphibians. Pesticide contamination of surface water is mostly associated with surface run off or field drainage during rainfall events. Depending on their solubility, chemicals may be dissolved in the rainwater or attached to sediment particles. Key mitigation actions are source control, such as best practice application and a reduction in pesticide use; and pathway interception measures similar to those for phosphorus and sediment.

The EPA report on Drinking Water Quality in Public Supplies 2022 found that 17 public water supplies failed to meet the drinking water standard for pesticides, an improvement from 31 supplies in 2021. The herbicide MCPA was the dominant chemical which is commonly used for control of rushes and broadleaf annual and perennial weeds in grasslands. Uisce Eireann is implementing a catchment management approach which brings all stakeholders together to promote responsible pesticide use, to mitigate the issues.

Change in the extent of pressures over time

Overall, the number of *At Risk* waterbodies with agriculture as a significant pressure increased by approximately 200, to just over 1000 waterbodies, between 2015 and 2021 (Figure 4). Increases occurred across all waterbody types except coastal waters. While improvements were achieved in 153 waterbodies over that period, they were offset by a greater number of declines elsewhere.

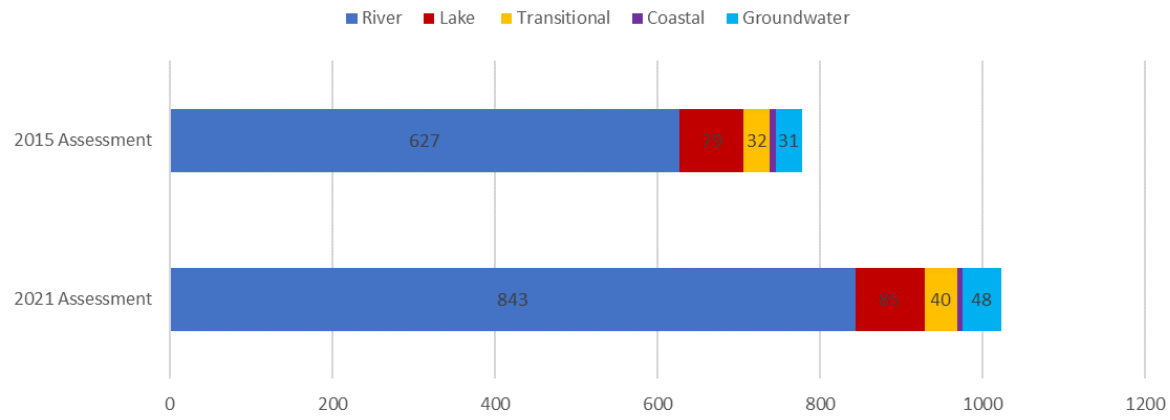

Figure 4: Change in Agriculture Pressures across all waterbody types between 2015 and 2021

What is being done?

The National River Basin Management Plan, which is developed under the Water Framework Directive, sets out a Programme of Measures for all sectors, including agriculture, to protect and restore water quality. While the third cycle plan has been delayed, many of the key actions are already in progress. The key measures for agriculture are:

- implementing and strengthening the Nitrates Action Programme, including the Good Agricultural Practice for the Protection of Waters Regulations 2022;
- developing and implementing an enhanced Local Authority national agricultural inspections programme with oversight by the EPA;
- continuation of the Local Authority Waters Programme (LAWPRO) and Agricultural Sustainability Support and Advice Programme (ASSAP) approach to addressing specific water quality issues in an increased number of Priority Areas for Action;
- provision of a new funding mechanism for farmers for on-farm measures to protect and restore water quality (the Farming for Water EIP);
- implementing the ACRES agri-environmental scheme which includes a high proportion of the high status objective waters in the 8 Cooperation Project areas; and
- development of an online web-based tool by Teagasc to deliver Farm Sustainability Plans.

Targeting action

The EPA has developed a number of maps to support the targeting of action and measures.

Targeted Agricultural Measures map

A Targeting Agricultural Measures map (Figure 5) has been developed to identify where actions by the agricultural sector are needed to address specific water quality issues. Three types of water quality issues are identified using coloured flags: phosphorus and sediment issues (navy flag), nitrate issues (orange flag) and point sources (red flag). The white flag indicates areas where either water quality is satisfactory, or water quality is not satisfactory but agriculture is not identified as a significant pressure. In these areas, ongoing best practice agricultural measures, to protect existing good water quality, are required to prevent deterioration.

Pollution Impact Potential maps

Pollution impact potential (PIP) maps have also been developed to identify and rank the highest risk areas in the landscape for loss of nitrate and phosphorus from farming (Figures 6 and 7). The maps combine the nutrient loading from the farming activities on the land surface, with the capacity of the underlying soils and geology to hold or release nutrients to waters via their respective pathways. The phosphorus PIP maps also include two additional layers to help visualise the movement of phosphorous losses with overland flow across the landscape:

(a) Focused delivery flow paths identify areas of converging runoff and are ranked according to the relative amount of surface runoff they deliver. Where these flow paths coincide with highly ranked phosphorus risk areas, higher P losses would be expected.
(b) Flow delivery points are locations where focused flow paths enter a watercourse. The size of the point indicates the relative volume of flow delivered to the water.

These layers together highlight areas for targeting pathway interception actions, e.g. hedgerows, riparian buffer zones, woodlands, and engineered ditches.

The PIP maps are currently being used by LAWPRO and ASSAP as part of the decision-making process for targeting measures, and as part of the National Agricultural Inspection Plan for targeting

inspections. They can be used as a guide to what is happening in the landscape and will always need to be ground-truthed with the most recent information at local scale.

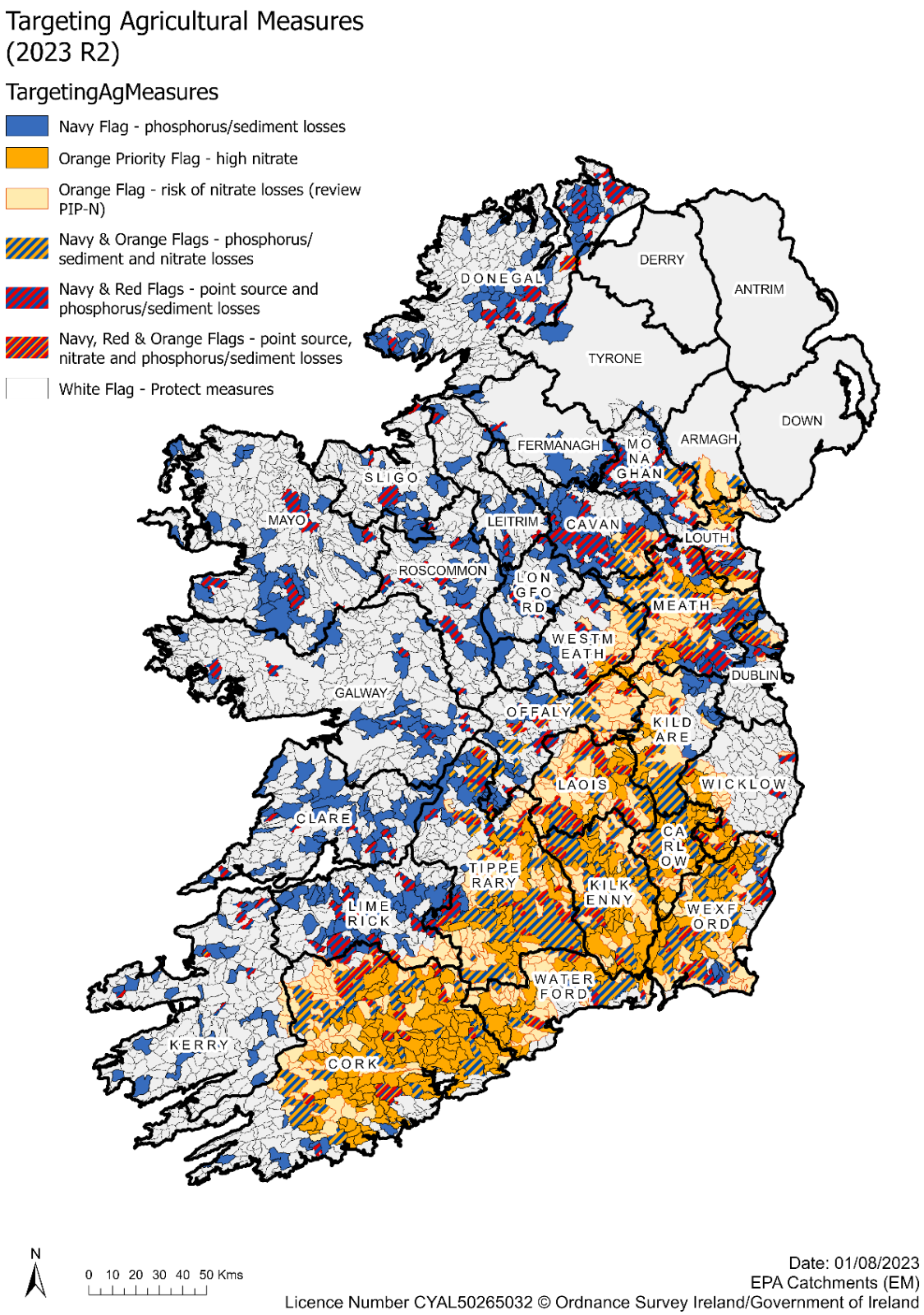

Figure 5: Targeted Agricultural Measures map (R2 2023)

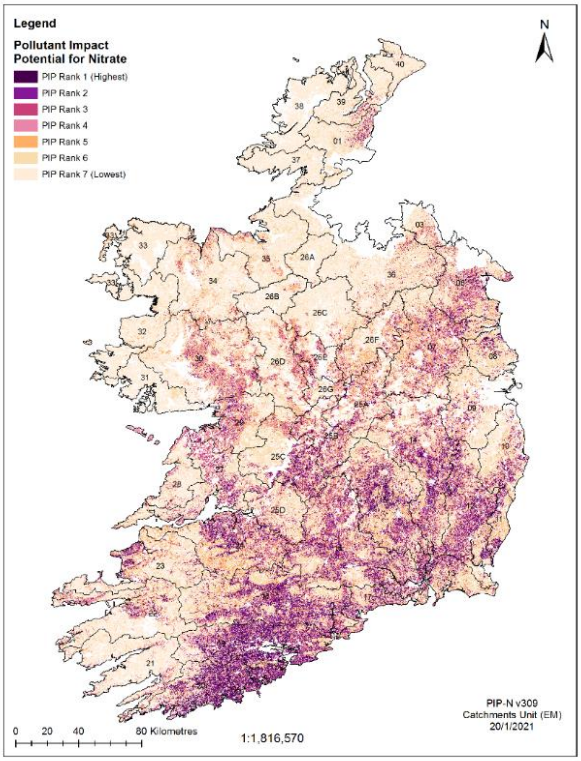

Figure 6: Pollution Impact Potential Map for Nitrate (zoomed out to national scale)

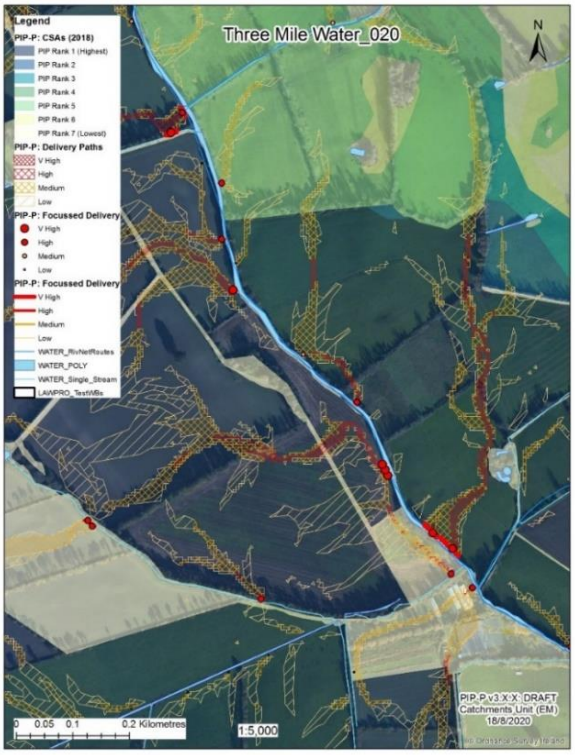

Figure 7: Pollution Impact Potential Map for Phosphorus, including flow delivery paths and points (zoomed in to local scale)

Find out more

Further information on agriculture and water, and links to relevant EPA reports is available at: https://www.epa.ie/environment-and-you/freshwater-and-marine/water-quality-and-agriculture/.

A comprehensive interactive mapping system is available to view information for each waterbody, including water quality, risk, pressures, Priority Areas for Action where LAWPRO and ASSAP are working, the PIP maps and the Targeting Agricultural Measures map at EPA Maps/Water.

A simplified map viewer for farmers and landholders to view local water quality data and the maps for targeting measures is available at EPA Maps/agriculture.

Data are available for download at https://gis.epa.ie/GetData/Download under Water/Water Framework Directive > General Information.

A guidance video on how to use and interpret the Pollution Impact Potential maps is available at https://www.youtube.com/watch?v=YVEGin-2PKg.