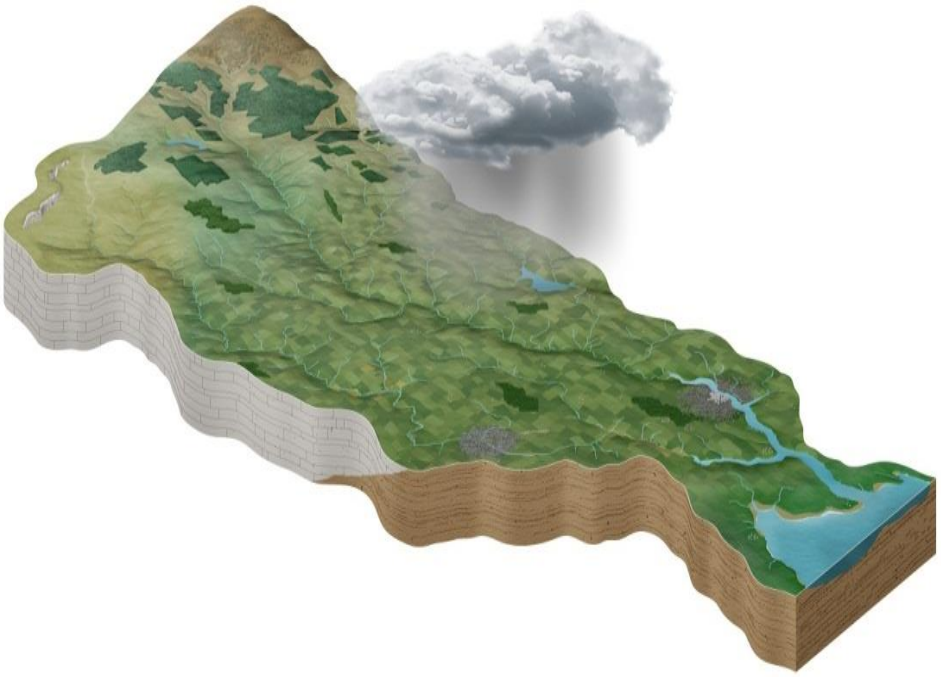
Report series:

Impacts of pressures on water quality

FORESTRY



Catchment Science & Management Unit

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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 forestry on water quality

Forestry activities as a pressure

Forestry accounts for approximately 12% of land use in Ireland. Just under 50% of the total forest area is under public ownership, mainly managed by Coillte, and just over 50% is under private ownership[1]. Historically much of the afforestation carried out by the State has taken place on relatively undeveloped marginal land in upland areas, often on organic soils.

Forestry has been identified as the third most prevalent significant pressure, impacting approximately 12% of all surface waterbodies that are '*At risk*' of not achieving their environmental objective under the Water Framework Directive (Table 1 and Figure 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.

Forestry impacts a relatively high proportion of waterbodies with a High Ecological Status objective (22%) which are often upland vulnerable catchments in the headwaters of streams. These high-status headwaters are important 'biodiversity reservoirs' that play a role in restoration further downstream.

Table 1: Number of 'At risk' surface waterbodies with forestry as a significant pressure, using data up to 2021.

Waterbody Type	No. Surface Waterbodies	No. At Risk Surface Waterbodies	No. Surface Waterbodies with Forestry identified as a significant pressure	% At Risk Surface Waterbodies (with Forestry identified as a significant pressure)
River	3192	1337	192	14
Lake	812	142	14	10
Transitional	196	60	0	0
Coastal	112	16	0	0
Total	**4312**	**1555**	**206**	**12%**

Water quality impacts from forestry activities

The most common water quality problems arising from forestry and associated activities relate to the release of sediment and nutrients to the aquatic environment, hydromorphological impacts (physical alteration to aquatic habitats) and acidification. Water quality data show that the impacts occur during major forestry operations such as afforestation, deforestation and/or thinning. During the intermittent periods, however, when the forests are stable, water quality can recover and can be maintained. Stable, well designed forests, with appropriate setback distances from watercourses, can therefore also be a measure to protect water quality.

Sediment losses

Fine sediment (such as sand, silt, clay and organic soils) fills the spaces between coarser material in the stream bed and can interfere with aquatic ecosystem functions, particularly in the more sensitive high-status waters. Juvenile individuals of the critically endangered Freshwater Pearl Mussel for example, are particularly sensitive to fine sediment. Sediment is also often the transport mechanism for chemicals and nutrients that are attached to the sediment particles. Typical sources of fine sediment from forestry activities include thinning and clear-felling, site preparation (felling and planting), road construction and drainage.

[1] gov - Forest Statistics and Mapping (www.gov.ie)

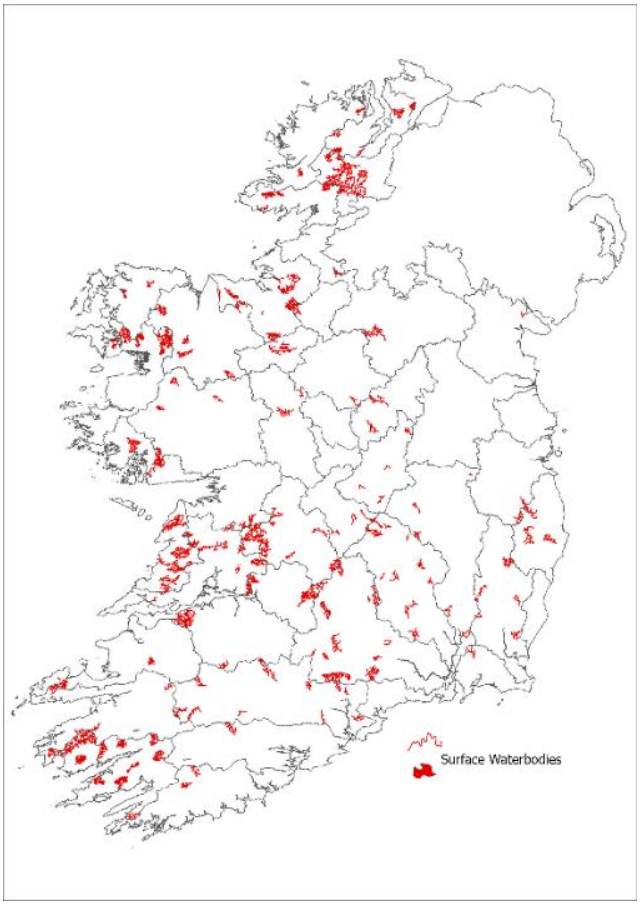

Figure 1: Surface waterbodies where forestry is a significant pressure (August 2023).

Nutrient losses

Nutrient losses give rise to eutrophication (excessive growth of plants and algae) in our waterbodies. The key nutrients causing impact from forestry are phosphorus and ammonium. Nutrient sources are often associated with specific forestry operations and can be intermittent and temporary. They may therefore be challenging to capture in water chemistry grab samples and may be better reflected in the biological sampling which provides a more integrated overview of water quality over the longer term.

Phosphorus losses from forestry can arise from the decomposition of brash after felling, fertilisation application during forest establishment (if applied) or inappropriately managed aerial fertilisation (if applicable). Ammonium losses can occur where trees have been planted in peatland soils. Drainage works and tree roots can lower the water table which allows the organic matter to break down, causing the release of ammonium. Many peat sites no longer qualify for afforestation, although reforestation remains a possibility.

Figure 2 shows the average annual concentrations of phosphate (blue) and ammonium (green) in rivers from 2007-2023 for waterbodies '*At risk*' with Forestry identified as a significant pressure and waterbodies that are '*Not at risk*'. The dashed lines represent the environmental quality standards for phosphate (0.035 mg/l) and ammonium (0.065 mg/l). The graphs show that overall there is little difference between the annual average nutrient concentrations in waterbodies that are '*At risk*', and those that are '*Not at risk*'. This reflects that nutrient influxes are not sustained on a long term annual average basis but are short lived and time-bound. Nutrient issues are also secondary to sediment and hydromorphology impacts.

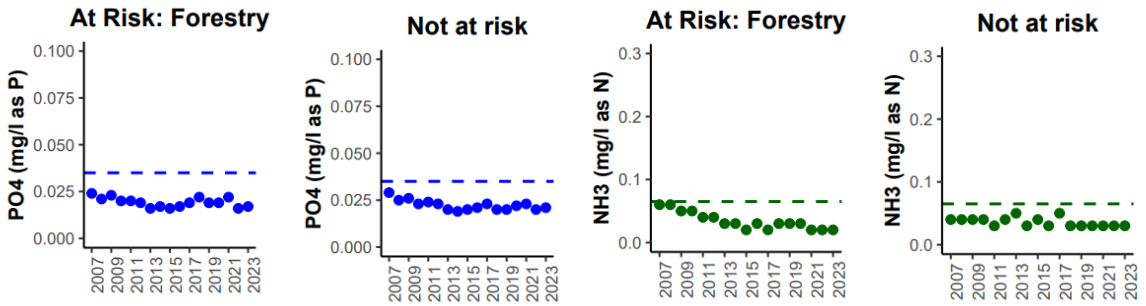

Figure 2: Average annual phosphate (blue) concentrations, and ammonium (green) concentrations in rivers from 2007-2023 for waterbodies 'At risk' from Forestry and those that are 'Not at risk'. Note that some waterbodies are also impacted by other pressures.

The EPA has modelled nutrient loads entering waterbodies from various sectors, including forestry (Figure 3). For nitrogen, the contribution from forestry is relatively small at 3%. For phosphorous, the proportion of the load is slightly higher (10%). This reflects that the dominant water quality impacts are mainly related to impacts due to excess fine sediment and changes to the hydromorphological condition, which impact approximately two thirds of '*At risk*' waterbodies where forestry is identified as a significant pressure.

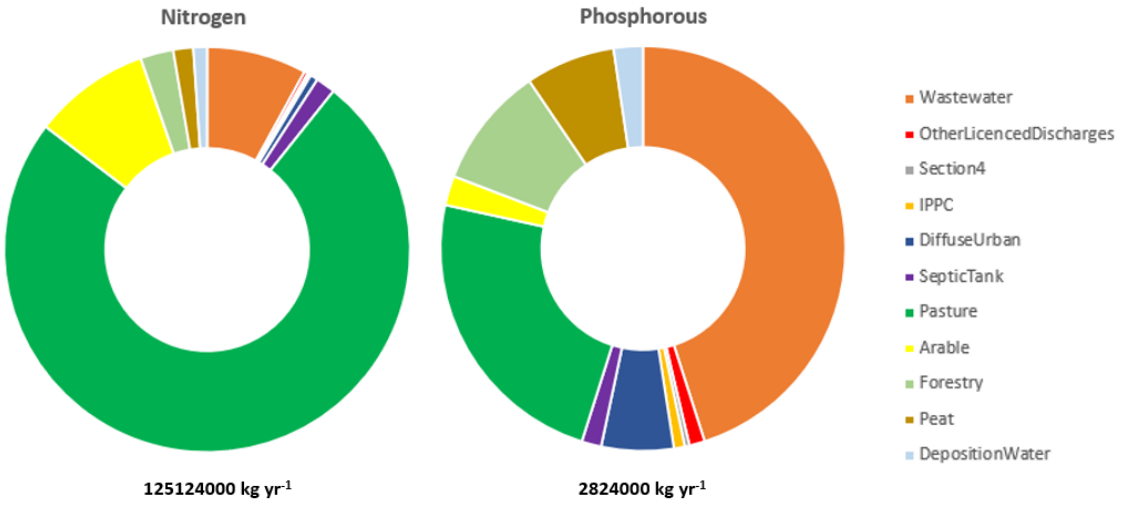

Figure 3: Load apportionment of nitrogen and phosphorous emissions to water (based on data up to 2018). Note that this is at national scale and proportions will differ for rivers and lakes at waterbody, subcatchment and catchment scales.

Impacts to hydromorphological condition

Land drainage and channel maintenance as part of forestry operations can cause physical alteration to the bed and banks of watercourses, including widening, deepening and straightening, which lead to modification of stream flow and levels, and channel forming processes. Destabilisation of banks may also occur with drainage, or where there are inadequate set back distances between plantation trees and watercourses, which can cause the release of additional fine sediment.

Acidification

Acidification impacts occur when the pH of waters drops below levels that can sustain healthy aquatic ecology, for extended periods of time. In upland forested areas, where the underlying geology and soils create an acidic environment, there are a number of different mechanisms by which this can

happen, some of which are more important than others in the Irish context, and some of which have changed over time. The are fewer than 20 waterbodies that are impacted by acidification which are located mainly in Wicklow, Connemara and parts of the Northwest.

Historically, acidification of surface waters was one of the major environmental impacts of air pollution. Conifer forests, which are often located on upland exposed areas, were known to capture and concentrate airborne pollutants that were subsequently washed into surface waters. While this is a common mechanism in Europe due to the prevalence of heavy industry, and was an issue in Ireland in the past, reductions in nitrogen and particularly sulphur deposition have resulted in a gradual decline in the degree and extent of surface water acidification in Ireland.

Forestry operations such as drainage, planting and felling can disturb the peat and cause erosion which can increase the amount of humic acids released from the peat when it rains, which in turn lowers the pH. The duration of the disturbance and the length of time that the stream is impacted by a low pH <6 is an important factor in determining the impact on the aquatic ecology. Increased and more intense rainfall with climate change may increase the severity of these impacts in susceptible waterbodies over time.

The growth and removal of trees from sensitive soils can also change the chemistry of the soil and its ability to neutralise the acidity, which in turn lowers the pH of the waters percolating through the landscape into rivers.

The EPA has developed a new acid sensitive invertebrate monitoring tool for ecological status assessments in acid sensitive areas which has been intercalibrated with other member states methods. These assessments, combined with results from a pH monitoring project being run by LAWPRO and the EPA, have allowed a better understanding of the driver of acidification failures and their impact, which are important when considering measures.

Other Impacts

Insecticides can have a significant toxic impact on aquatic ecology. A small amount can cause extreme pollution with a devastating impact to aquatic species within the river and knock-on effects on species such as birds. Insecticides are used in some reforested sites to manage pine weevil and need to be managed carefully. Herbicides, to control competing vegetation may be used in the earlier years of establishment, although new planting guidelines aim to limit this need.

Change since the second river basin management cycle (2016-2021)

Overall, the number of '*At risk'* waterbodies with forestry as a significant pressure in the assessment in 2021 has improved slightly from the assessment in 2015 (a net reduction of 22 waterbodies from 238 waterbodies to 216 waterbodies). Improvements in 74 waterbodies had occurred over that time, but these were offset by declines elsewhere.

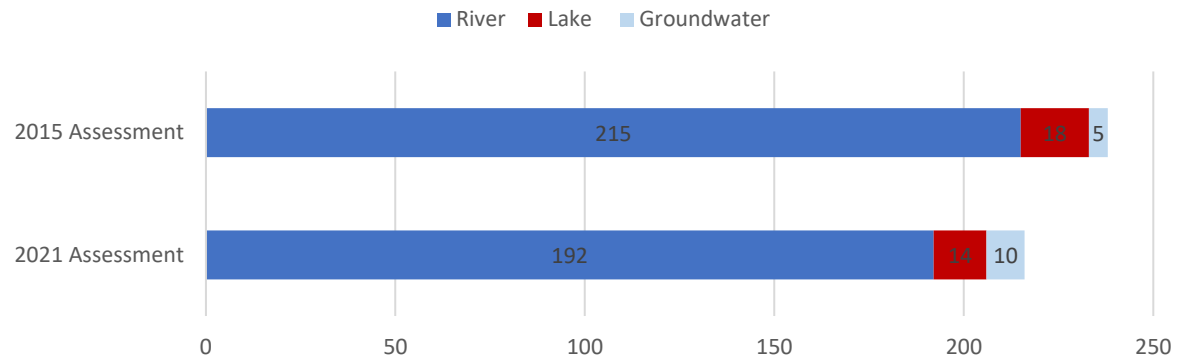

Figure 2: Change in number of waterbodies impacted by forestry pressures between 2015 and 2021

What is being done?

Although the third River Basin Management Plan has been delayed, many of the measures are already in place. The plan is expected to highlight the ongoing actions to address forestry pressures, such as implementing and updating the Department's Forests and Water document which summarises the policy context for protecting water quality, and the expansion of the grant and premium schemes to include measures that will directly benefit water quality through the Forestry Programme 2023-2027.

Forestry standards (2019) are in place for felling and reforestation which include mitigation actions to protect surrounding watercourses. Minimum setback widths from streams during the reforestation phase are included within the standards to protect instream and riparian habitat, with larger set back distances required in high status waters. Water exclusion zones during the felling and extraction phase are also set out in the standards. These zones are required around aquatic features within which brash or logs are not to accumulate as well as excluding plant equipment to prevent bank erosion. There is also a requirement to install and maintain silt traps within existing forest drains that connect with aquatic features during forestry operations. Additional mitigation actions include creation of native woodland buffers, site-specific evaluation of fertiliser needs followed by careful application and the slow-water damming of drains.

Find out more

See how the impacts of pressures on waters, including forestry activities, are assessed at www.catchments.ie/download/water-framework-directive-guidance-on-characterisation-methodology-v5-0-2024.

Information on forestry in Ireland is available at gov - Forestry in Ireland (www.gov.ie)

The 2023-2027 Forestry Programme, including information on grants and premiums, can be found at gov - Forestry Grants and Schemes (www.gov.ie)

Waterbodies where forestry is a significant pressure can be viewed on EPA Maps.