# PHOSPHORUS IN THE RIVER WYE: EVIDENCE BASE FOR WALES

## Evidence base and options appraisal.

Report for: Herefordshire Council

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River Wye Nutrient Management Plan: Evidence Base for Wales

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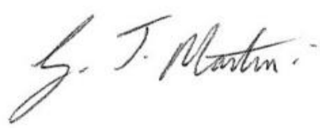

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# EXECUTIVE SUMMARY

The River Wye Special Area of Conservation (SAC) holds international conservation status and supports notable species including native White-Clawed Crayfish, and Lamprey, Bullhead, European otter, and Atlantic Salmon. The river is failing to meet SAC and WFD water quality targets for phosphorus, which is affecting the ecological functioning of the river. This report aims to collate the existing evidence base, identify phosphorus concentration reductions (based on fair share principals) required to achieve SAC and WFD compliance, appraise a range of mitigation measures to reduce phosphorus loading, and provide recommendations for the Welsh Wye catchment to achieve SAC and WFD compliance that could be considered as part of an updated NMP.

On the Welsh side of the Wye catchment there are a total of 45 waterbodies with SAC targets and 34 waterbodies with a WFD target for phosphorus. In 2024, 58% of waterbodies with an SAC target failed for compliance (26 out of 45 waterbodies) and 35% of waterbodies with a WFD target did not achieve *'good status'* (12 out of 34 waterbodies). Failure to meet phosphorus targets has correlated with poor ecological health. Several published data sources attributed failing phosphorus targets to diffuse and point source pollution inputs from agriculture, wastewater and urban inputs.

SAGIS model outputs attributed sources of phosphorus in the failing waterbodies only to be primarily from agriculture (87%), followed by wastewater (7%), other (private sewerage systems, urban and industry) (2%) and intermittents (CSOs) (<1%). Significant geological and soil influences were thought to impact phosphorus loading from agriculture, including the impermeability of the mudstone geology, erodible soils, and steep topography.

To understand the sources of phosphorus from the agricultural sources, baseline phosphorus loading from individual farm types was modelled in Farmscoper V5. Extensive grazing contributed to the highest phosphorus load of 36%, believed to be due to a large area of the catchment having extensive livestock farms. This was followed by pigs and poultry farms contributing 32% of agricultural loading, believed to be due to significant manure production with higher phosphorus concentrations per tonnes compared to other farm types. Arable farms were contributing 21% of agricultural loading, believed to be due to high P index soils and soil erosion. P index is the measure of phosphorus concentration in agricultural soils. For wastewater, inputs were identified from the Permitted Discharges Register with 7% of total concentrations in the Welsh Wye attributed to final treated effluent from 73 Sewerage Treatment Works (STW). Inputs from other sources included registered private sewerage systems (PSS) identified using the Permitted Discharges Register and the Water Quality Exemptions register, highlighting a total of 107 PSS with a permit to discharge phosphorus to controlled waters.

To mitigate phosphorus loading from agriculture, over 120 individual mitigation measures derived from Farmscoper V5 were categorised into eight mitigation scenarios. The load reductions that could be achieved from implementing these measures were modelled for the whole of the Wye catchment: existing regulatory compliance (13%) maximum regulatory compliance (18%), best practice (32%), existing welsh agri-environment measures (39%), all possible agri-environment measures (44%), all possible mitigation measures (45%). Two further scenarios were developed by altering the baseline data used to model baseline loading from agriculture: all possible measures + low phosphorus index soils (47%) and all possible measures + 5% land use change (50%). Regulation delivered the highest cost-benefit, followed by best practice and welsh agri-environment schemes. When applied to all the failing waterbody catchments, the mitigation measure scenarios assessed are estimated to achieve *"fair share"* phosphorus concentration reductions required from agricultural sources in 76% of the failing waterbody catchments (25 out of 33). Individual measures were appraised and the top ten most effective measures recommended specific to farm type and fertiliser practices at the individual waterbody catchment scale, categorised by annual rainfall.

For wastewater measures, STW upgrades undertaken between 2020 and 2025 have reduced phosphorus loading by 8,974 kg phosphorus per year in the Welsh Wye across five STW. Planned STW upgrades between 2025 and 2030 at ten STW within failing waterbody catchments will achieve a total load reduction of 877 kg phosphorus per year. This will achieve their *"fair share"* concentration reductions, as approved by NRW for AMP8 investments. Backstop limits are also being implemented by DCWW at seven sites without a current phosphorus condition contained within the permit to prevent deterioration. For *"Other"* sources of phosphorus (from ST and urban sources), upgrading PSS can reduce phosphorus concentrations in discharge by up to 97% in failing waterbodies where PSS with a phosphorus permit to discharge to controlled waters is identified. However, upgrades may not be economically feasible when compared to the potential monetary benefit for water quality, and PSS contribute less than 10% of nutrient loads in 37 out of 38 failing waterbodies. It is important to note that the number of total PSS is unknown and therefore phosphorus inputs from this source may be underestimated, which can lead to an overestimation of contributions from diffuse sources such as agriculture.

An action plan of high-level recommendations for the Welsh Wye that could be considered for the Wye Nutrient Management Plan and the Wye Catchment Plan has been provided. A monitoring framework describes potential monitoring components, including methods for reporting progress and impact, potential risks and mitigation strategies that could be considered with the Wye Nutrient Management Plan and Wye Catchment Plan.

Nitrate and ammonia risks were also assessed to see if there are any increasing concerns. WFD waterbodies all passed for ammonia in 2024, and since 2020 no waterbodies were observed to have increasing ammonia trends. One SAC waterbody failed for ammonia, however water quality sampling data from 2020 to 2024 at this site did not show a significant increasing trend overtime. Citizen science water quality sampling did show higher nitrate concentrations in some of the headwaters of the Upper Wye catchment. NRW sampling for nitrate showed a very small significant increasing trend in nitrate in one waterbody that was not sampled by Citizen Science, however all other waterbodies did not have significant increasing trends. Current regulations are in place specifically to reduce nitrate polluting the water environment. In addition, the measures recommended here for the agricultural sector which reduce sedimentation of watercourses and nutrient run off will likely reduce nitrate and ammonia inputs from agricultural sources, as well as phosphorus.

This evidence base and options appraisal draws together the existing evidence related to phosphorus pollution in the Welsh Wye and outlines a range of mitigation measures that could be implemented across the Welsh Wye catchment to reduce phosphorus concentrations from a range of sources. The mitigation measures presented here can be appraised for inclusion in the Wye Nutrient Management Plan to improve compliance with SAC and WFD targets, the ecological health of the river, safeguard wildlife, support resilient and sustainable agricultural practices, and improve the quality of our water supplies.

# 1. INTRODUCTION

The River Wye and the lower parts of it's main tributary, the River Lugg, hold international conservation status as a Special Area of Conservation (SAC) under the Habitats Directive. Environmental monitoring conducted by the Environment Agency (EA) and Natural Resources Wales (NRW) shows that water quality and ecosystem health are failing to meet the SAC or WFD target for some parts of the Wye catchment. This is primarily due to excessive nutrient levels, which has negatively impacted the ecological health of the SAC.

A Nutrient Management Board (NMB) was established in 2014, with an aim of achieving favourable condition status and to enable sustainable housing development in the Lugg catchment. However, a significant legal shift occurred in 2018 with the Dutch Nitrate Judgment, which reinforced the principle that internationally designated sites already exceeding environmental limits should not receive additional pollutants unless effective, measurable mitigation could be demonstrated. In response to this, Natural England (NE) advised in 2019 that the existing Nutrient Management Plan's (NMP) goal of achieving compliance by 2027 was no longer sufficient.

Following this ruling, NE and the EA revised the NMP in 2021, developing a Phosphate Action Plan aimed at defining concrete, legally compliant measures. However, by 2023, it became evident that the complexity of pollution sources (such as legacy phosphorus deposits and diffuse sources) made it unlikely that the plan could fully meet the stringent requirements of the Habitats Regulations. Consequently, the focus of the NMP shifted towards broader river restoration efforts. NE has recently conducted a high-level review of the plan to reflect this change and assess progress within the English portion of the Wye catchment. Following this an SAC compliance assessment was conducted in 2021 and 2024 by NRW, which showed that not all water body catchments achieved a pass for SAC targets.

As part of the 2023 NMP update, improvements to infrastructure at Dŵr Cymru Welsh Water's (DCWW) sewage treatment facilities were included, shifting regulatory attention towards managing diffuse pollution, which falls under the EA's jurisdiction. Following a Judicial Review, the EA has begun developing a Diffuse Water Pollution Plan to mitigate nutrient runoff from agricultural land.

In addition, Welsh Government have allocated funding to update the NMP using data collected from the Welsh catchment by NRW and citizen science groups. Since nutrient pollution remains the primary concern, the NMP will form a central focus of the broader Wye Catchment Plan, ensuring alignment between all related initiatives. The NMB members require the evidence base from both the Welsh and English sides of the Wye catchment to develop a whole catchment NMP, which brings forwards an aligned set of priority actions. This report will aim to collate and appraise the evidence base for Wales and undertake an options appraisal to recommend a range of mitigation measures that could be taken forward as part of the updated Wye NMP to achieve SAC compliance for the Welsh Wye catchment.

## 1.1 OBJECTIVES

The objectives of this report are to:

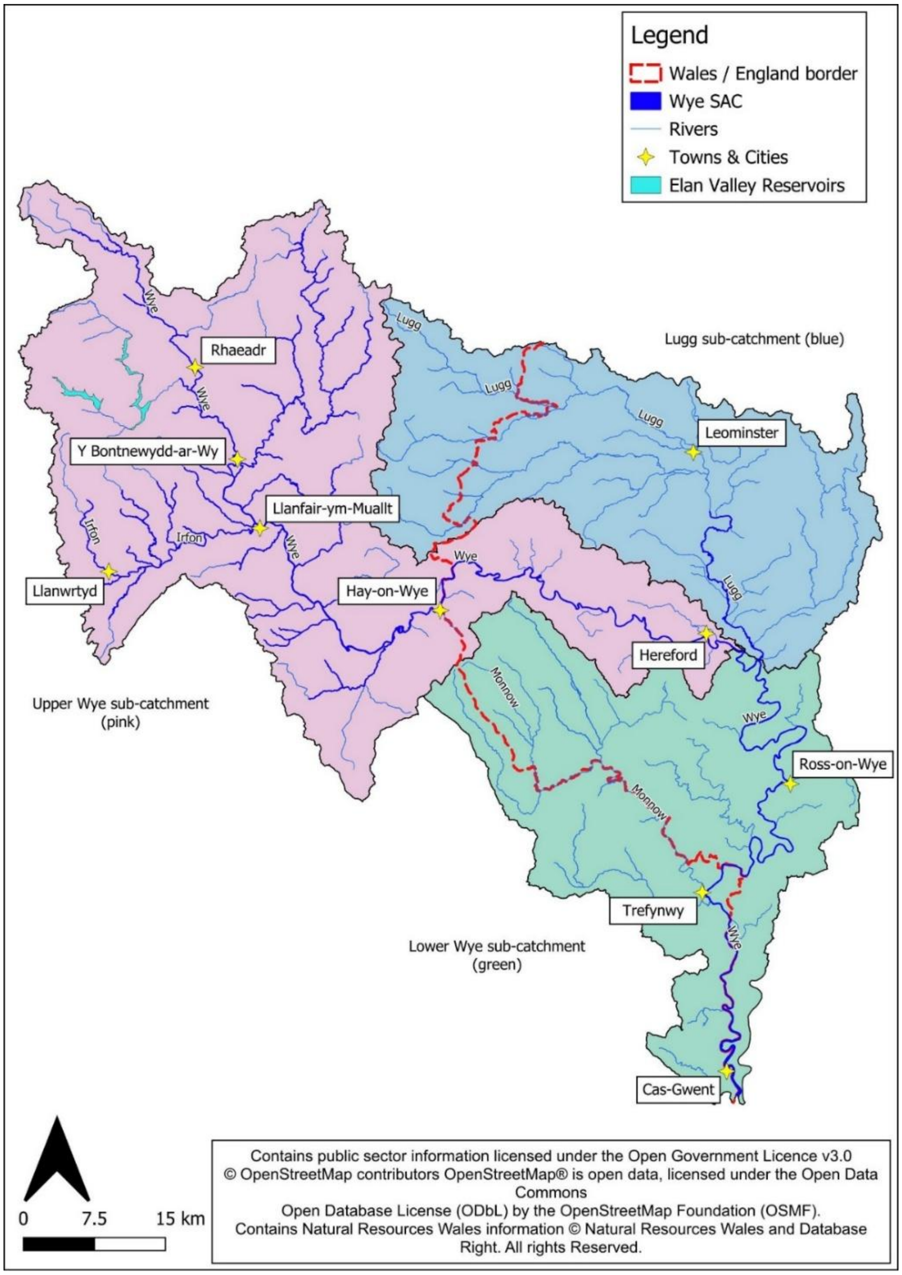
1. Draw together the Welsh catchment evidence base related to the sources and pathways of phosphorus in the Welsh part of the Wye catchment including NRW and Citizen Science data.
2. Summarise the main sources of phosphorus and concentration reductions required to achieve SAC and Water Framework Directive (WFD) targets in Wales.
3. Review the current projects being undertaken in the Welsh side of the Wye catchment to reduce phosphorus pollution.
4. Undertake an options appraisal of mitigation measures that can be implemented to reduce nutrient pollution in the Welsh Wye catchment and appraise the extent to which these measures can achieve phosphorus reductions.
5. Provide recommendations that can be considered as part of an updated NMP to restore the SAC to favourable conservation status, including a monitoring framework.

# 2. THE WYE CATCHMENT

The source of the River Wye originates on the eastern slopes of Plynlimon, which forms part of the Cambrian Mountains in Mid-Wales. This nationally important river flows 215km in a south-easterly direction from Wales into England, before flowing back into Wales at Monmouth, and then forming part of the Welsh and English border before flowing into the Severn Estuary in England. The River Wye and parts of its main tributary the River Lugg, are both designated a Site of Special Scientific Interest (SSSI) and form the River Wye SAC, with widespread habitats characterised by bryophyte-dominated vegetation and notable species including native White-Clawed Crayfish, and Lamprey, Bullhead, European otter, and Atlantic Salmon (Natural England, 2023; JNCC, 2025b). In addition, the River Wye forms part of the Wye Valley Area of Outstanding Natural Beauty (AONB).

The Wye catchment spans 4,017km$^2$ and can be sub divided into three main operational catchments; the Upper Wye, the Lugg and the Lower Wye (Figure 1).

Figure 1: Wye sub-catchments and the River Wye SAC



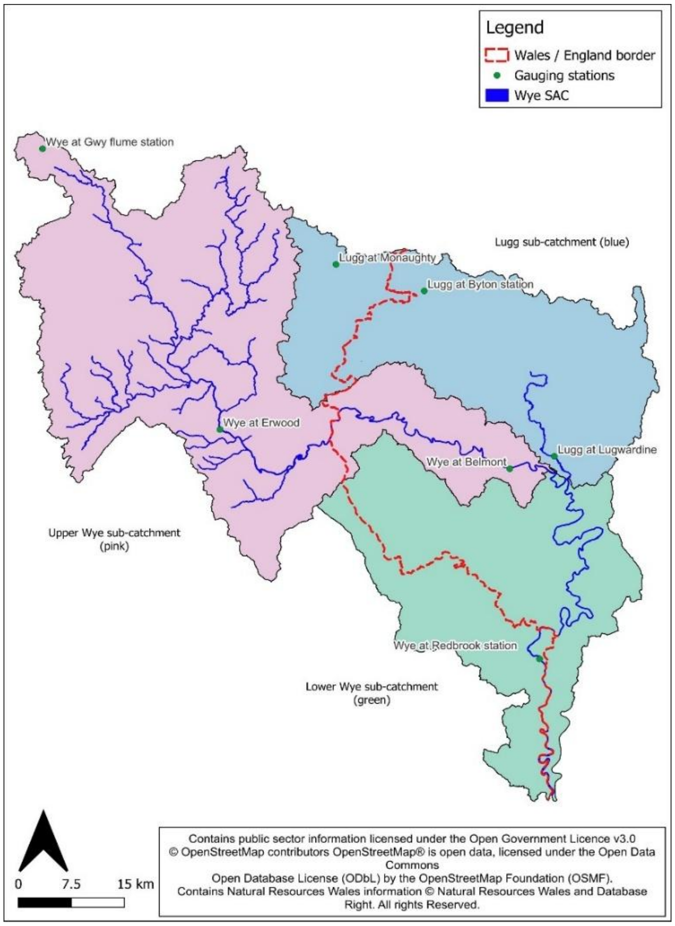
## 2.1 GEOLOGY, SOILS AND HYDROLOGY

The Upper Wye catchment in Wales is characterised mainly by Silurian and Ordovician mudstones, interspersed with some siltstones and sandstones (BGS, 2025). Soils at the source in the uplands are peaty and slowly permeable or wet (Soilscapes, 2025). Mean flow increases from 1.66m$^3$/s, with average river levels of 0.05 – 0.70m near the source (Wye at Gwy flume station, NGR: SN824853) to average river flows of 37.49m$^3$/s at Erwood in the lower part of the Upper Wye (Wye at Erwood NGR: SO075444) which represents the point at which the catchment changes from upland to lowland catchment, (NRFA, 2025).

In the Lugg catchment into England the bedrock geology changes to Devonian sandstones (BGS, 2025), overlaid with mainly freely draining loamy soils in the west and clayey loam soils in the east which can be suspectable to erosion and nutrient run-off (Soilscapes, 2025). Average river levels at the most upstream gauging station of the Lugg (Lugg at Monaughty (NGR: SO2391068450) range from 0.13m – 0.57m, flow is not measured at this gauging station. At Leominster average flow increases to 5.79m$^3$/s with an increased river level range of 0.76m – 2.60m (Lugg at Byton station, NGR: SO364646). At the last gauging station upstream of the River Lugg/River Wye confluence (Lugg at Lugwardine NGR: SO548405), flow rate increases to an average of 10.75m$^3$/s, with a decreased rainfall average of 882mm/yr and a river level range of 0.15m – 2.40m (NFRA, 2025). Close to Hereford, river levels range from 0.18m to 3.80m, with an average flow of 47.30m$^3$/s and rainfall decreases to 1,269mm/yr (station: Wye at Belmont, NGR: SO485387).

The Lower Wye in the south, sandstone lithology changes to Carboniferous limestone, this rock is more resistant to erosion and as a result gorges and caves are formed (BGS, 2025). The soil types are characterised by mainly freely draining loamy soils (Soilscapes, 2025). At the last station before the river meets the sea (Wye at Redbrook station, NGR: SO527110) average flow increases to 73.35m$^3$/s, with a decreased rainfall average of 1,054mm/yr, and a slight increase of river level, ranging 0.23m to 4.09m (NRFA, 2025).

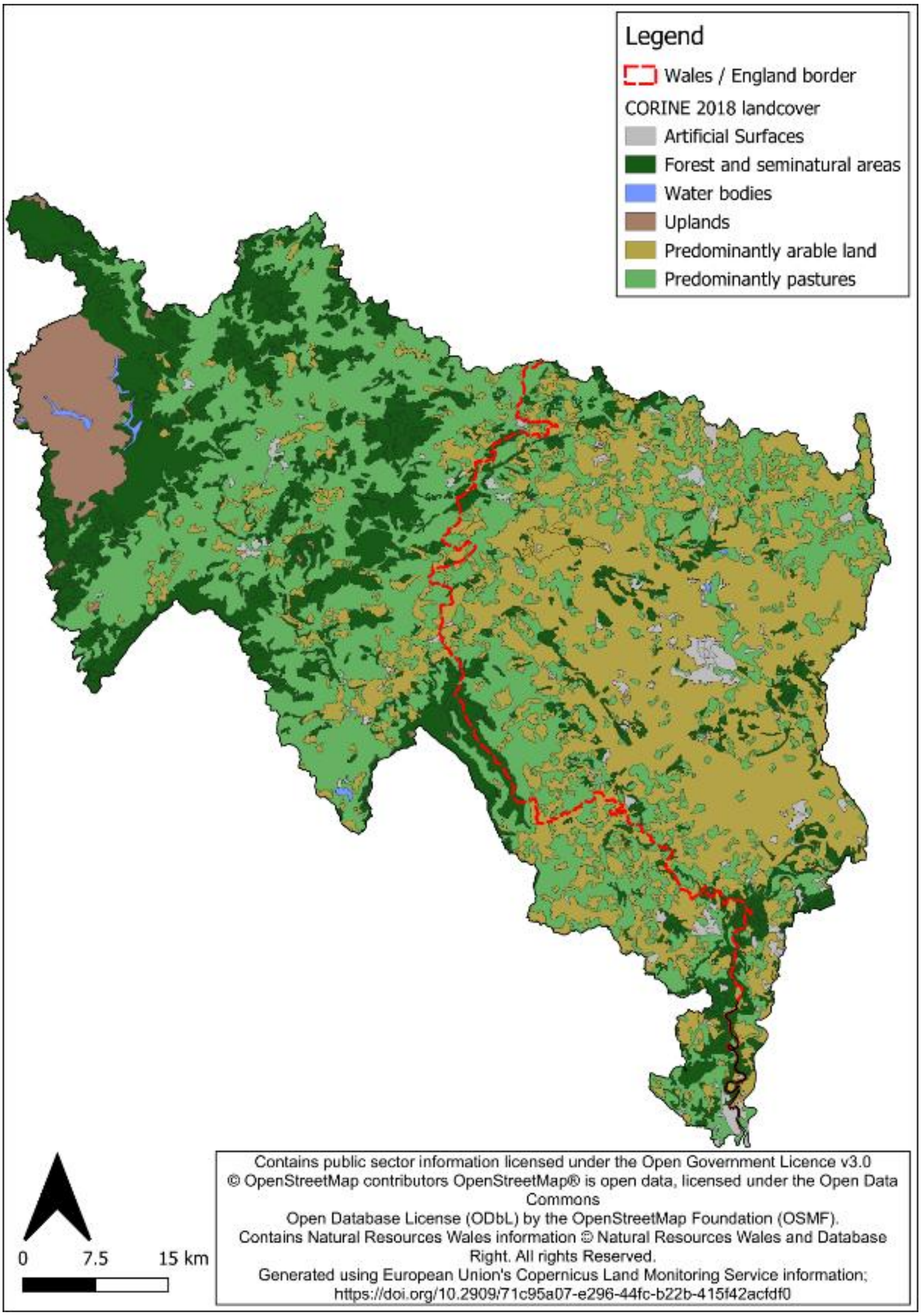
Figure 2: Wye flow gauging stations



## 2.2 LAND USE

In the Upper Wye catchment, land use is predominantly semi-natural (Figure 3), consisting of woodland and moorland, predominantly grazed by sheep. This area is sparsely populated with smaller settlements. Moving eastwards, land use changes from predominantly grassland to mixture of arable and dairy farms. The Lugg catchment has upland areas of sheep grazing in the higher reaches, which changes to more intensive arable land towards Leominster. In the lowlands of the Lower Wye, arable and poultry farms are the primary land use, with some industrial land uses in Hereford. The main towns of the Wye include Hereford, Monmouth, Leominster, Rhayader, Hay-on-Wye, Ross-on-Wye and Chepstow (Jarvie *et al.,* 2003; Bussi *et al.,* 2018) (See Figure 1).

Figure 3: Wye catchment CORINE 2018 landcovers



Agriculture is the major land use, with pastoral farming (sheep and beef) in the uplands, and more intensive arable/mixed farming (cereals, potatoes, hops, soft fruit, dairy, and poultry) on the fertile and highly productive soils in the lowlands. Poultry farming, in particular, has expanded rapidly in the region in recent years along with maize and potatoes (Withers *et al.,* 2022a). In the last ten years arable and grassland areas, and livestock numbers have remained the same; with the exception of poultry numbers, which are estimated to be nearing 30 million chickens (Herefordshire Council, 2024) across the Wye catchment (representing a 12% increase in the last five years) (Natural England, 2025).

## 2.3 WATER QUALITY

The following sections outline the water quality of the River Wye across England and Wales related to phosphorus.

### 2.3.1 Phosphorus and phosphate

Phosphorus is an essential element for all organisms and is often a limiting nutrient in freshwater, however elevated phosphorus can cause excessive plant and algal growth, which can reduce oxygen concentrations in the river and lead to reduced ecological status and fish kills (Hilton *et al.,* 2006). Phosphorus does not occur naturally in its elemental state due to its high reactivity, therefore, it readily forms other compounds under normal environmental conditions.

Many compounds containing phosphorus exist within waterbodies, with the ratio of forms dependent upon its source, environmental conditions and its location within the water column. Not all forms are available for algal, plant or cyanobacterial growth. The main compound typically of concern in relation to increased risks of cyanobacterial or algal growth is orthophosphate. Phosphate (any compound having one or more $PO_4$ units) and orthophosphate (phosphates with only one $PO_4$ unit) are an example of such compounds which are biologically available to algae, higher plants and cyanobacteria. Therefore, the higher the phosphate concentrations within a body of water, the higher are the risks of water quality deterioration as a result of an algal or cyanobacterial bloom. Inorganic phosphorous (phosphate) has been found to instigate and fuel cyanobacterial blooms, however, both nitrogen and phosphorus are essential in the establishment of cyanobacteria. Phosphorus may be accumulated on the sediment surface following senescence of an organism, be bound to redox-sensitive iron compounds or fixed in labile organic forms. As a result, the release of phosphorus into the water from the sediment may be triggered by various environmental conditions. Such releases may include the mineralisation of organic matter, the desorption and dissolution of phosphorus-bound in precipitates and inorganic materials and the diffusion of dissolved phosphorus from sediment pore waters (Moore *et al*., 1998), potentially resulting in continued eutrophication (Hou *et a*l., 2013).

An increase in cyanobacteria or algae within a river may deteriorate water quality through altering the water environment, for example, by increasing turbidity and decreasing available oxygen and sunlight penetration, which can reduce the ecological health of a river. Additionally, some cyanobacteria are capable of producing toxins which may be harmful to the health of both animals and humans, whereas other strains of cyanobacteria may produce compounds such as geosmin and 2-MIB (2-methylisoborneol) in response to favourable growing conditions, which can be challenging to treat for human consumption and increase treatment costs.

### 2.3.2 Water quality of the River Wye

Several organisations have published literature and research on the water quality issues in the River Wye SAC related to phosphorus (P), as well as the potential sources and pathways of phosphorus. The main findings and key points of various publications are outlined in Table 1.

Table 1 Published literature in relation to the whole Wye catchment.

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| Tackling Phosphorus Pollution in Special Area of Conservation | • 67% of the River Wye water bodies failing to meet phosphorus targets.<br>• Phosphorus pollution has also negatively impacted housing development, halting | Phosphorus inputs by each sector were attributed to:<br>• Rural land use (72%),<br>• STW (23%), |

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| (SAC) Rivers: information and evidence pack (Welsh Government, 2022a). | many schemes due to high phosphorus levels. | • Storm overflows (2%),<br>• ST and urban run-off (3%). |
| Lancaster University Rephokus Report (English Side) (Withers *et al.,* 2022a). | Lancaster University undertook a three-phase study on the eastern half of the Wye catchment to investigate potential links between:<br>• livestock manure,<br>• the potential linkages between surplus phosphorus in soil from manure spreading and phosphorus concentration in the rivers and tributaries.<br>The report highlights that there is a strong link between catchment phosphorus input pressures, manure phosphorus loadings to the land surface and build-up of soil phosphorus across the English part of the Wye. | Livestock farming has had a major impact on land use patterns and phosphorus cycling in the Wye catchment over the last 150 years, traditionally with cattle (dairy and beef) and sheep farming but more recently due to the rapid expansion of the poultry industry. An historic analysis of census-derived land use and livestock numbers indicates the Wye catchment has been in phosphorus surplus for the last 150 years. Historic applications of phosphorus indicate that more has been added to the land than crops can use. The soil phosphorus legacy is equivalent to 1.86 tonnes per hectare in the arable and productive grassland, which could take a decade to reduce if no phosphorus fertilisers are applied and all livestock manures are exported outside the catchment. |
| Lancaster University Rephokus Report Re-focusing Phosphorus use in the Wye Catchment (Withers *et al.,* 2022a). | • Analysis of long-term river P concentration data for the Wye catchment outlet at Redbrook suggests river P pollution may be gradually rising again, but more consistent and higher frequency water quality monitoring is required to confirm.<br>• Annual P surplus of ca. 3000t (17kg P/ha), 60% above national average.<br>• Clear evidence of positive links between annual P input pressure (and P surplus) and river P concentrations and loads exists at regional and catchment scales. | • High livestock numbers.<br>• Livestock manure production.<br>• Accumulation of soil P in agricultural soils.<br>• Poorly-buffered and highly dispersible P-rich soils .<br>• Steep slopes and moderate to high rainfall.<br>• Inadequate water quality monitoring programs.<br>• Lack of fine resolution census data.<br>• Insufficient support for catchment stakeholders. |
| Lancaster University Soil Phosphorus Status and Water Quality in the River Wye Phase 1 (Withers *et al.,* 2022b). | • Orthophosphate concentrations in runoff are 0.1mg/l at mid soil P index 2, and 0.17mg/l at mid soil P Index 3.<br>• Lower Wye soils release more P into solution than many other soils because they are poorly buffered and easily erodible. | • River flow is a key driver of phosphorus load.<br>• Soil erosion is a driver of phosphorus loads to rivers (particulate P) which main be retained in river sediments.<br>• Storm events increase phosphorus load from sewage and septic tanks (ST). |
| Lancaster University Soil Phosphorus | • The 2021 phosphorus surplus in six sub-catchments of the English Wye varied from 1.9kg P/ha in Yazor Brook to 16.2kg P/ha | • Maize areas have increased in the Welsh Wye, which increases risk of soil erosion. |

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| Status and Water Quality in the River Wye Phase 2 (Withers *et al.*, 2022c). | in Garren Brook, there is a wide variation in manure P production across the catchment.<br>• Phosphorus sampling on the English Wye showed 55% of fields above P index 2. | • Poultry farms have increased across the whole Wye catchment which have a higher phosphorus content.<br>• Manure production drives surplus phosphorus.<br>• River phosphorus export was higher in sub-catchments with higher P surpluses. |
| Severn River Basin Management Plan summary and cross border catchments (England and Wales) (EA, 2022). | • Only 139 out of 740 waterbodies in the Severn River Basin achieved good status in 2022. | • Key drivers of poor status included invasive species, pollution from agricultural, rural areas, urban areas, sewage and industry.<br>• The Wye and Usk foundation are working to eradicate invasive species in the Wye catchment.<br>• NMB, DCWW and the Storm Overflow Taskforce are reducing phosphate pollution from sewage in the Wye catchment.<br>• The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 have been introduced in Wales to reduce losses of pollutants from agriculture. |
| River Wye Special Area of Conservation 2023 growing season monitoring summary report (EA, 2023). | • One site on the main stem of the River Wye has exceeded its phosphate target in 2023, but this is due to one abnormally high reading in July 2023. The River Lugg failed at all five sites in 2022 and failed at three in 2023.<br>• | • The River Lugg is known to have issues with eutrophication and efforts are ongoing to better understand and reduce nutrient pollution in the catchment. |
| River Wye Special Area of Conservation 2024 growing season monitoring summary report (EA, 2024) | • One site on the main stem of the River Wye has exceeded its phosphate target in 2024, due to one abnormally high reading in May 2024.<br>• The River Lugg waterbodies all fail phosphate targets in 2024. | • None identified. |

The previous research indicates that the Wye catchment experiences high livestock densities, phosphorus-rich soils, and annual phosphorus surpluses 60% above the national average, exacerbated by steep slopes and high rainfall. The research also indicates that phosphorus pollution in the River Wye primarily originates from diffuse agricultural sources (72%), including nutrient run off from livestock manure spreading and soil erosion, with additional contributions from sewage treatment works (23%), storm overflows (2%), and ST/urban runoff (3%).

# 4. EVIDENCE BASE IN WALES

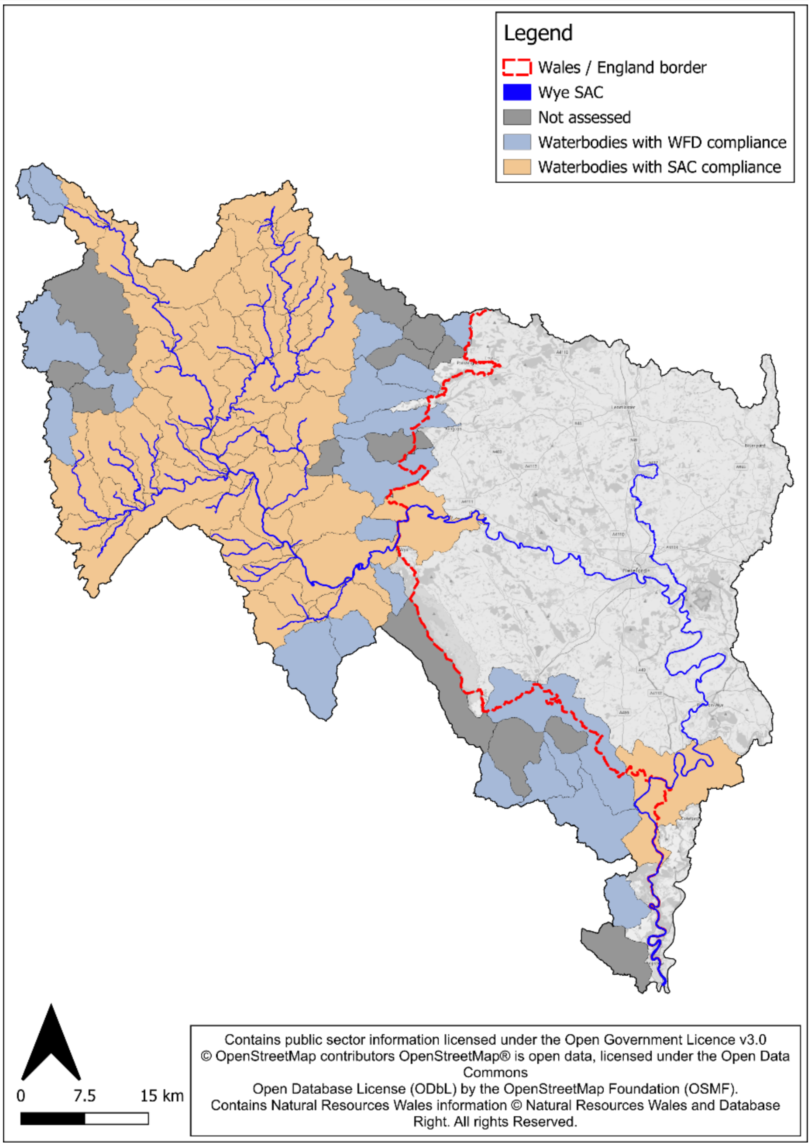
The following section aims to outline the current evidence underpinning the condition of the Wye waterbody catchment within Wales in relation to the concentration, sources and pathways of phosphorus.

## 4.1 WATER QUALITY

### 4.1.1 Official NRW compliance with targets

Achieving or maintaining SAC and WFD compliance for all water bodies in the Wye catchment is a key priority. WFD targets are the primary measure of river health in the UK, under The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (referred to as WFD Regulations 2017), which aims to achieve *“good”* status of all ground and surface water bodies. The River Wye is designated a SAC under the Conservation of Habitats and Species Regulations, 2017. Due to this designation the River Wye SAC has tighter phosphorus targets than WFD targets, known as common standards monitoring (CSM) targets, aimed at protecting the ecological health of the site by providing a simple measure of condition (JNCC, 2025a). Each water body is assigned a specific phosphorus target for SAC compliance. For all other waterbodies outside the SAC area WFD targets apply. In the Welsh part of the Wye catchment, there are 45 waterbodies with SAC targets with the remaining 34 waterbodies having WFD targets. Figure 4 highlights the waterbodies that are subject to SAC compliance targets or WFD compliance targets.

Figure 4: Summary map of waterbodies in the Welsh evidence base, including whether SAC or WFD targets apply



A compliance assessment of waterbodies against their SAC and WFD targets was conducted by NRW in 2021 and 2024. In 2021, 29 out of 45 waterbodies failed the SAC phosphorus targets, this reduced to 26 out of 45 in 2024. . In 2021 there were 11 out of the 34 waterbodies failing WFD targets, with five waterbodies not assessed. In 2024, the number of failing waterbodies increased to 12 out of 34 (due to *Gilwern Bk - source to conf R Arrow* being not assessed in 2021 and assessed in 2024).

Figure 5 and Figure 6 presents a spatial representation of the SAC and WFD compliance assessment results.

Figure 5 SAC phosphorus compliance assessment 2021 and 2024 comparison

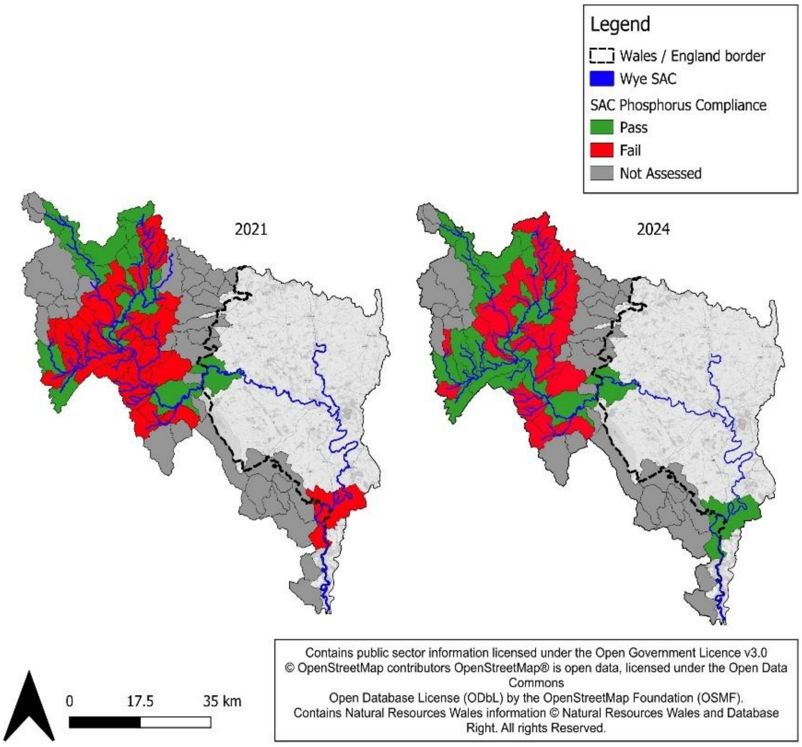
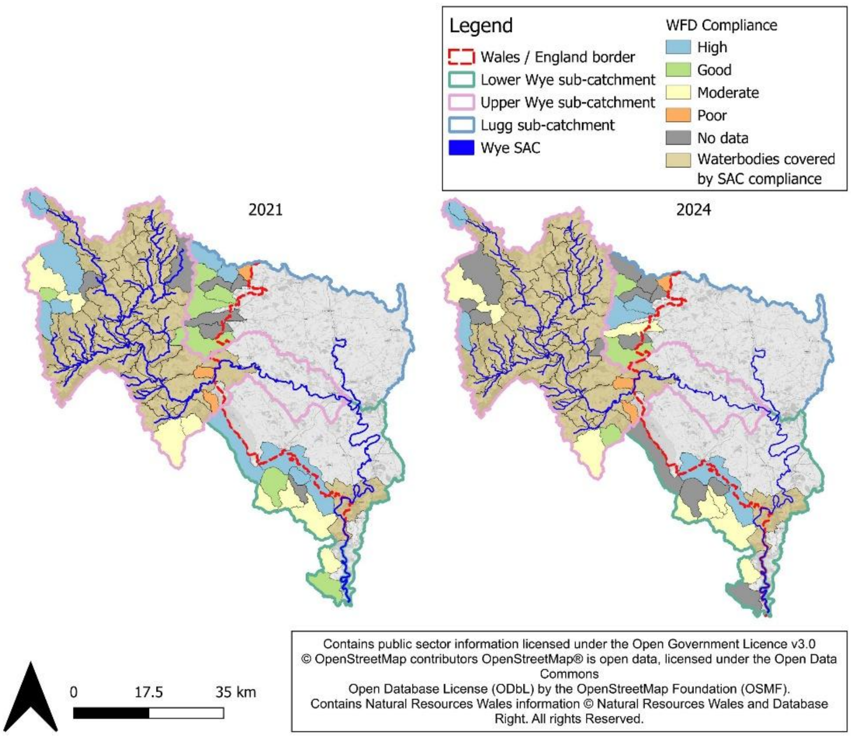



Figure 6: WFD phosphorus compliance for remaining waterbodies not covered by SAC compliance, 2021 and 2024 comparison



Water quality across the Welsh Wye has improved significantly since 2021, as demonstrated through the increases in compliance for phosphorus targets for WFD and SAC. NRW have advised that these improvements may have been driven through an increase in regulatory compliance visits on farms, support from Farming Connect to enhance the rural environment, and the Wye and Usk Foundations work improving habitat condition and riparian fencing. However, the average annual phosphorus concentration can be easily affected by sample outliers as outlined by NRW sensitivity testing, which can also lead to compliance changes (NRW, 2025c).

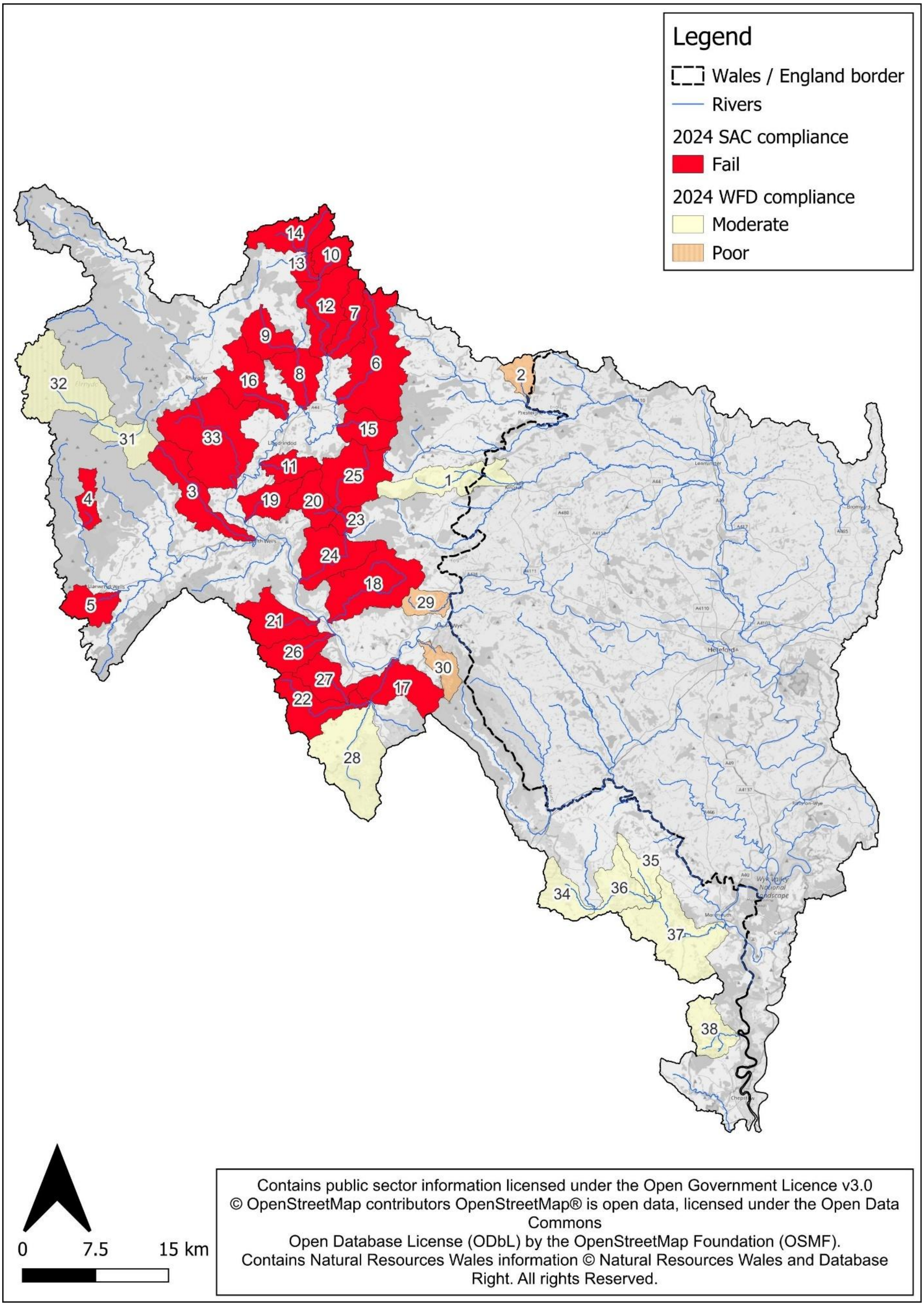
In total, for all waterbodies with a WFD or SAC assessment, there are 38 out of 79 waterbody catchments failing their phosphorus targets in 2024 (see Figure 7 and Table 2).

Table 2 Summary of SAC and WFD waterbodies failing phosphorus targets in 2024.

| Wye sub-catchment | Operational catchment | Failing WB reference number | Waterbody name | SAC or WFD Target | 2024 compliance |
|---|---|---|---|---|---|
| Lugg | Arrow, Lugg and Frome | 1 | *Gilwern Bk - source to conf R Arrow* | WFD | Moderate |
| | Lugg | 2 | *Norton Bk - source to conf R Lugg* | WFD | Poor |
| Upper Wye | Irfon | 3 | *Afon Chwefru - source to conf R Irfon* | SAC | Fail |
| | | 4 | *Afon Gwesyn - source to conf R Irfon* | SAC | Fail |
| | | 5 | *Cledan - source to conf R Irfon* | SAC | Fail |
| | Ithon | 6 | *Aran - source to conf R Ithon* | SAC | Fail |
| | | 7 | *Camddwr Bk - source to conf R Ithon* | SAC | Fail |
| | | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | SAC | Fail |
| | | 9 | *Clywedog Bk - source to conf Bachell Bk* | SAC | Fail |
| | | 10 | *Gwenlas Bk - source to conf R Ithon* | SAC | Fail |
| | | 11 | *Howey Bk - source to conf R Ithon* | SAC | Fail |
| | | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | SAC | Fail |
| | | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | SAC | Fail |
| | | 14 | *Ithon - source to conf Llaethdy Bk* | SAC | Fail |
| | | 15 | *Mithil Bk - source to conf R Ithon* | SAC | Fail |
| | | 16 | *Nantmel Dulas - source to conf R Ithon* | SAC | Fail |
| | Ithon to Hay | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | SAC | Fail |
| | | 18 | *Bach Howey Bk - source to conf R Wye* | SAC | Fail |
| | | 19 | *Builth Dulas Bk - source to conf R Wye* | SAC | Fail |
| | | 20 | *Camnant Brook - source to confluence R Edw* | SAC | Fail |
| | | 21 | *Clettwr Bk - source to conf R Wye* | SAC | Fail |
| | | 22 | *Dulas Bk - source to conf Afon Llynfi* | SAC | Fail |
| | | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | SAC | Fail |
| | | 24 | *Edw - conf Clas Bk to conf R Wye* | SAC | Fail |
| | | 25 | *Edw - source to conf Colwyn Bk* | SAC | Fail |
| | | 26 | *Scithwen Bk - source to conf R Wye* | SAC | Fail |
| | | 27 | *Triffrwd - source to Dulas* | SAC | Fail |
| | | 28 | *Afon Llynfi - source to conf Dulas Bk* | WFD | Moderate |
| | | 29 | *Clyro Bk - source to conf R Wye* | WFD | Poor |

| Wye sub-catchment | Operational catchment | Failing WB reference number | Waterbody name | SAC or WFD Target | 2024 compliance |
|---|---|---|---|---|---|
| | | 30 | *Digedi Bk - source to conf R Wye* | WFD | Poor |
| | Wye source to Ithon | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | WFD | Moderate |
| | Wye source to Ithon | 32 | *Afon Claerwen - source to conf Afon Arban* | WFD | Moderate |
| | Wye source to Ithon | 33 | *Wye - conf Afon Elan to conf R Ithon* | SAC | Fail |
| Lower Wye | Trothy | 34 | *Llanymynech Bk - source to conf R Trothy* | WFD | Moderate |
| Lower Wye | Trothy | 35 | *Llymon Bk - source to conf R Trothy* | WFD | Moderate |
| Lower Wye | Trothy | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | WFD | Moderate |
| Lower Wye | Trothy | 37 | *Trothy - conf Llymon Bk to conf R Wye* | WFD | Moderate |
| Lower Wye | Wye OC | 38 | *Tintern Bk - source to conf R Wye* | WFD | Moderate |

Figure 7: Map of all waterbody catchments in Wales failing phosphorus compliance in 2024



### 4.1.2 Analysis of monitored data

Further analysis undertaken for this study uses the average concentration per waterbody, based on all available NRW monitored phosphate concentration data between 2020 and 2024 and is provided in Appendix A Additionally, a visual representation of phosphate concentration over time compared to their corresponding WFD or SAC target is presented for each waterbody in Appendix B. Overall, most failing waterbodies show average orthophosphate concentrations well above the target, some samples were very low but with numerous samples with concentrations substantially above the target indicating some temporal variation in P loading.Samples taken in four WFD waterbodies and two SAC waterbodies show that the majority of monitored samples were below the threshold and only exceeded the target on some occasions (see Appendix B). The waterbodies with concentrations of phosphorus below the target except for occasional samples are:

- 2. *Norton Bk - source to conf R Lugg* (WFD).
- 30. *Digedi Bk - source to conf R Wye* (WFD).
- 5. *Cledan - source to conf R Irfon* (SAC).
- 38. *Wye - conf Afon Elan to conf R Ithon* (SAC).

Additionally, all NRW reported concentrations at *Afon Claerwen - conf Afon Arban to Caban-coch* are below the target concentration of 0.028mg/l (the 2024 failure is a roll-forward from 2021 which used a 2017-2019 dataset).

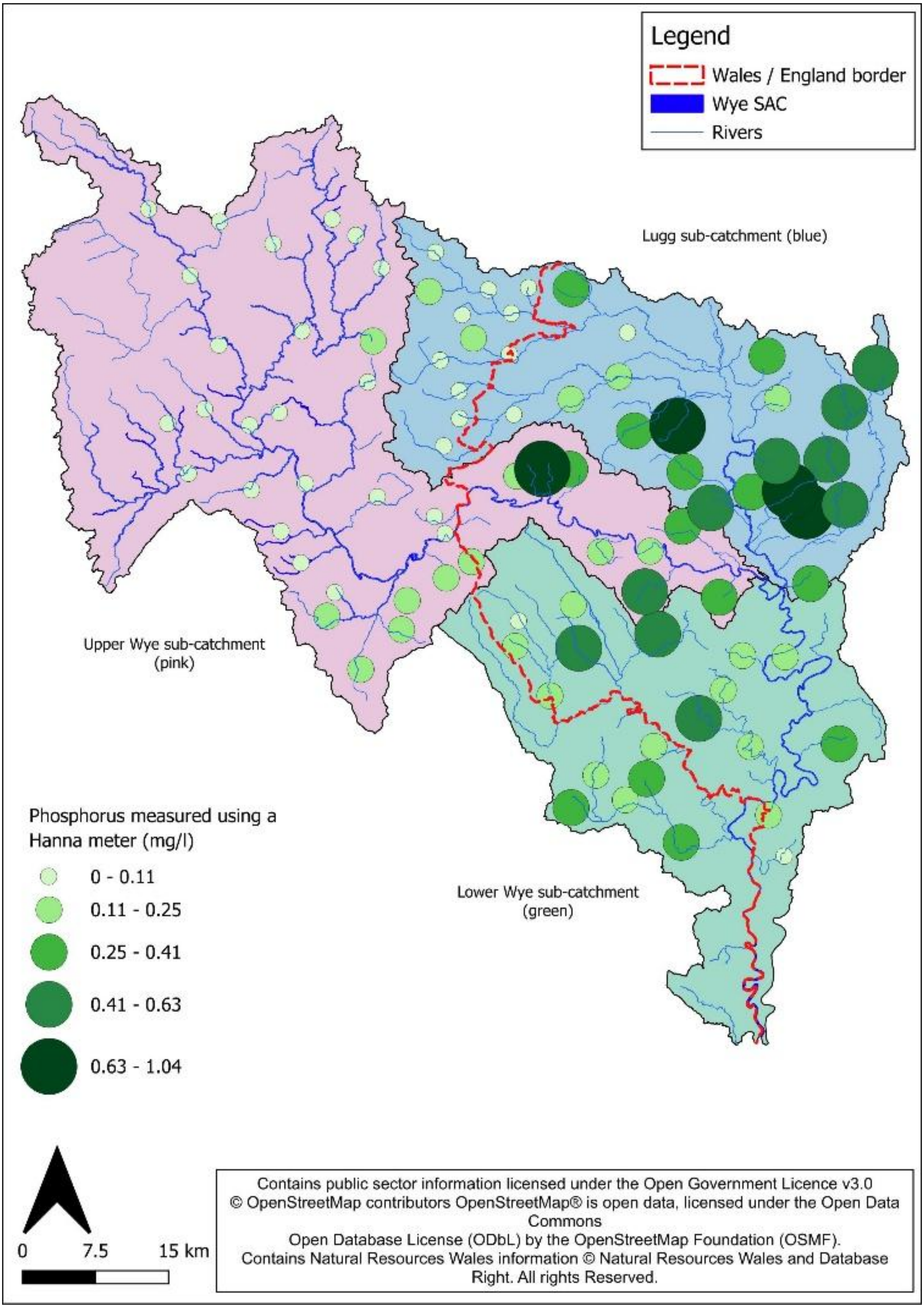
It should be noted that *Norton Bk*, *Clyro Bk*, *Llymon Bk* and *Afon Claerwen* present a limited number of samples, between seven and 14; while average number of samples range from 20 to 60 samples over the selected time period, with up to 100 samples in *Afon Llynfi - source to conf Dulas Bk* and *Llanymynech Bk - source to conf R Trothy* WFD water bodies and 79 at *Afon Llynfi - conf Dulas Bk to conf R Wye* SAC waterbody. WFD sampling frequency is typically quarterly and SAC monthly, higher frequencies are likely due to investigations and may not have been used in formal classification and status assessments.

*Norton Bk* historically had a higher number of samples above target before Norton STW was diverted to Presteigne in 2021.

### 4.1.3 Wye Alliance Citizen Science

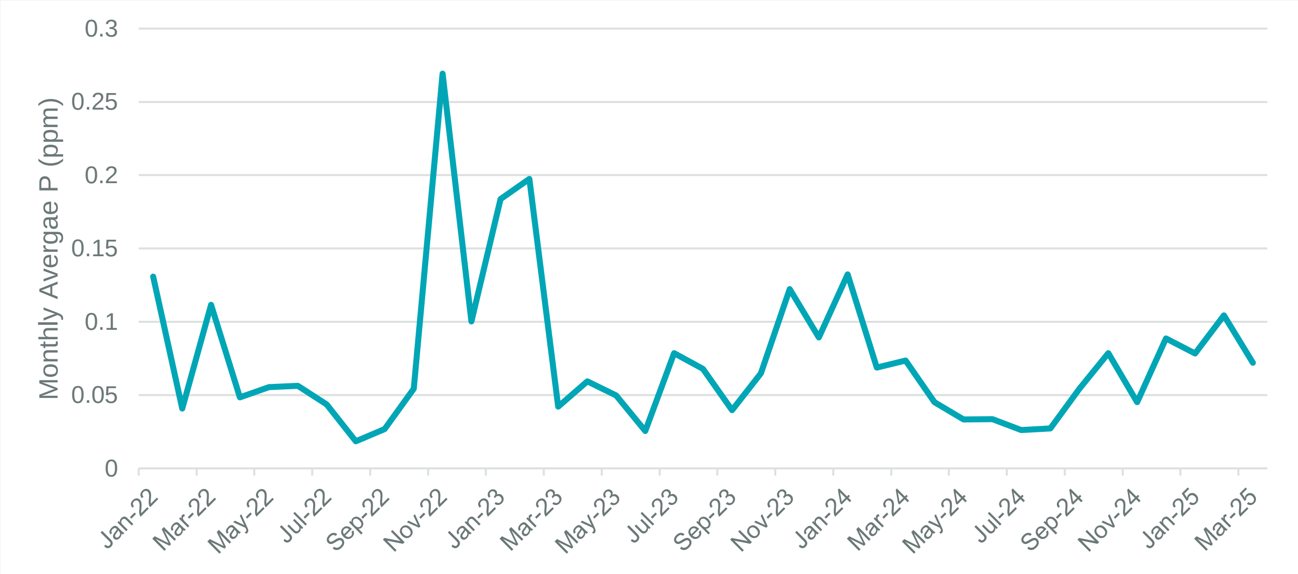
In addition to regulatory sampling, the Friends of the River Wye provide an array of water quality sampling data across the Wye catchment. The data has been collated from samples collected through a citizen science programme using Hanna phosphorus meters at various locations along the River Wye and its many tributaries. Figure 8 displays the sampling locations and concentrations of phosphorus measured across the catchment. The data show that in the upper reaches of the Upper Wye catchment have lower phosphorus concentrations than the lower Upper Wye catchment (between 0 – 0.11mg/l in the upper reaches compared to 0.62mg/l in the lower reaches). The Lugg catchment has high concentrations of phosphorus in the eastern part of the catchment (0.63 to 1.04mg/l). In the Lower Wye catchment there are several locations with concentrations between 0.25 and 0.63mg/l. The analysis shows that phosphorus concentrations are lower in Wales and in the uplands, whilst the lowlands and the majority of the English Wye catchment have higher phosphorus concentrations. Note that phosphorus concentrations are measured as orthophosphate by the Hannah metres used by Citizen Scientists whereas NRW measures as orthophosphate-as-P and therefore, there will be disparities in phosphorus concentrations in mg/L between the two datasets. As a molecule of orthophosphate (PO43-) weighs 3.06 times more than a molecule of just phosphorus (P), the Hannah results need to be divided by 3.06 for a direct comparison.

Figure 8: Phosphorus concentrations measured by Citizen Science in mg/l



Analysis of the mean phosphate concentrations within the River Wye at dedicated sampling locations indicated increases in mean phosphate concentrations during both the growing season (March to September inclusive) and out-of-growing seasons (October to February inclusive) (Figure 9). The moving average remained below 0.2ppm over the sampling period, except for one sample of 0.26ppm in November 2022.

Figure 9: The monthly average phosphate measurement across the River Wye and tributaries located in Wales from January 2022 to March 2025 (n=1,760 samples)




(Source: adapted from WyeViz, 2025).

### 4.1.4 Published literature

In addition to the water quality sampling and compliance assessments, there are several organisations who have published literature and research on the water quality issues in the River Wye SAC related to phosphorus, as well as the potential sources and pathways of phosphorus pollution. The main findings and key points of various publications which relate to the Welsh side of the Wye specifically are outlined in Table 3.

Table 3 Summary of published literature on the water quality issues as well as the key sources and pathways of phosphorus pollution identified by various organisations.

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| NRW Welsh part of the Severn River Basin Management Plan (2021-2027) (NRW, 2022a). | • Widespread phosphorus breaches in River Wye SAC.<br>• 33% of water bodies achieved good or better overall status in the Welsh section of the Wye catchment in 2015, increasing to 35% in 2021. | • Diffuse agricultural pollution from use of fertilizers and manure use.<br>• Sewage discharges from treatment plants and combined sewer overflows (CSOs) releasing untreated or partially treated sewage containing phosphorus into the river during heavy rainfall events. |
| NRW Core Management Plans (NRW 2022b). | • White-clawed crayfish are a key species present in the system. Major decline in the distribution and abundance of the invasive white-clawed crayfish has been recorded in the River Wye, but are widespread and abundant in the River Lugg. | • In the Wye catchment, the most significant sources of diffuse pollution are from agriculture, which includes fertiliser runoff, livestock manure, silage effluent and soil erosion from ploughed land. |

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| | • The current unfavourable status of Bullhead results from the presence of adverse factors, in particular localised water quality failures.<br>• The current unfavourable status of Atlantic salmon results from failure of the Management Target for adult run size, in particular the potential for flow depletion and localised water quality failures.<br>• Pollution of rivers with toxic chemicals, such as PCBs, was one of the major factors identified in the widespread decline of otters during the last century. There should be no increase in pollutants potentially toxic to otters.<br>• The present unfavourable status of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation results from reduced water quality in some tributaries of the Wye e.g. parts of the Ithon and Llynfi sub-catchments, due mainly to diffuse pollution from agriculture. | • Potential agricultural pollution from Rhayader, upper catchment, poultry and arable farming, sheep-dips, livestock encroachment. |
| NRW Phosphate compliance review for SAC rivers in Wales, 2021 (NRW, 2021). | • Comparison of phosphorus concentrations in the Wye against targets indicate widespread failures, some of them large in magnitude. Fourteen water bodies passed their targets, 28 failed and three were unknown.<br>• Water bodies achieving their phosphorus targets were located in the Upper Wye above Rhayader, about half of the Ithon, and two water bodies in the Irfon.<br>• All of the middle Wye tributaries, the remaining Irfon and Ithon and the Llynfi failed their targets.<br>• The largest failures were the Wye near Newbridge, the Cammarch, Clettwr Brook, Mithil Brook, lower Irfon, Garth Dulas and the three water bodies in the Llynfi catchment. Both consistent and episodic failures were identified. | Recent media interest has focussed strongly on poultry units as being the cause for concern in the Upper Wye, especially in the Ithon sub-catchment. However, the overall pattern of failures in the Wye does not support the hypothesis that poultry units are the main or even a particularly important reason for nutrient failures on the Wye. An investigation of nutrient sources in the Upper Wye is needed that takes into account all potential nutrient sources, including smaller local STW which may not have been included in previous work. |
| Phosphorus Source Apportionment Summary: Updating the SAGIS Upper Wye Model (DCWW, 2023). | • 67% of water bodies in the Upper Wye SAC fail to achieve targets, January 2021.<br>• On balance, a kilogram of phosphorus discharged from a treatment works will have a relatively greater impact on the in-river concentration than the equivalent input from diffuse sources. The concentration and load apportionment are different because inputs from different sources tend to occur under differing river flow conditions. | DCWW Source Apportionment Geographic Information Systems (SAGIS) model data for the Upper Wye showed that effluent from STW accounts for 23% of the average daily load with rural land use contributing 72%, storm overflows contributing 2% and a further 3% from other sources including ST and urban run-off. At the assessment location (quantified at water quality monitoring station 50021 which, although situated in England, is less than 2km from the border with |

| Source | Water quality issues | Sources and pathways of phosphorus pollution |
|---|---|---|
| | | Wales), the model shows that, under current conditions, approximately 67kg of phosphorus is discharged from the Welsh part of the upper River Wye catchment on a daily basis. |

In summary, previous research and findings indicate the River Wye SAC faces widespread phosphorus pollution, with 67% of water bodies failing to meet targets in the Upper Wye historically. This has impacted water quality, aquatic ecosystems, and housing development. While some areas meet phosphorus targets, many tributaries show failures. Key species, such as white-clawed crayfish, bullhead and Atlantic salmon, as well as notable vegetation, such as *Ranunculion fluitantis* and *Callitricho-Batrachion*, are in decline partly due to water quality issues.

## 4.2 ECOLOGICAL IMPACTS

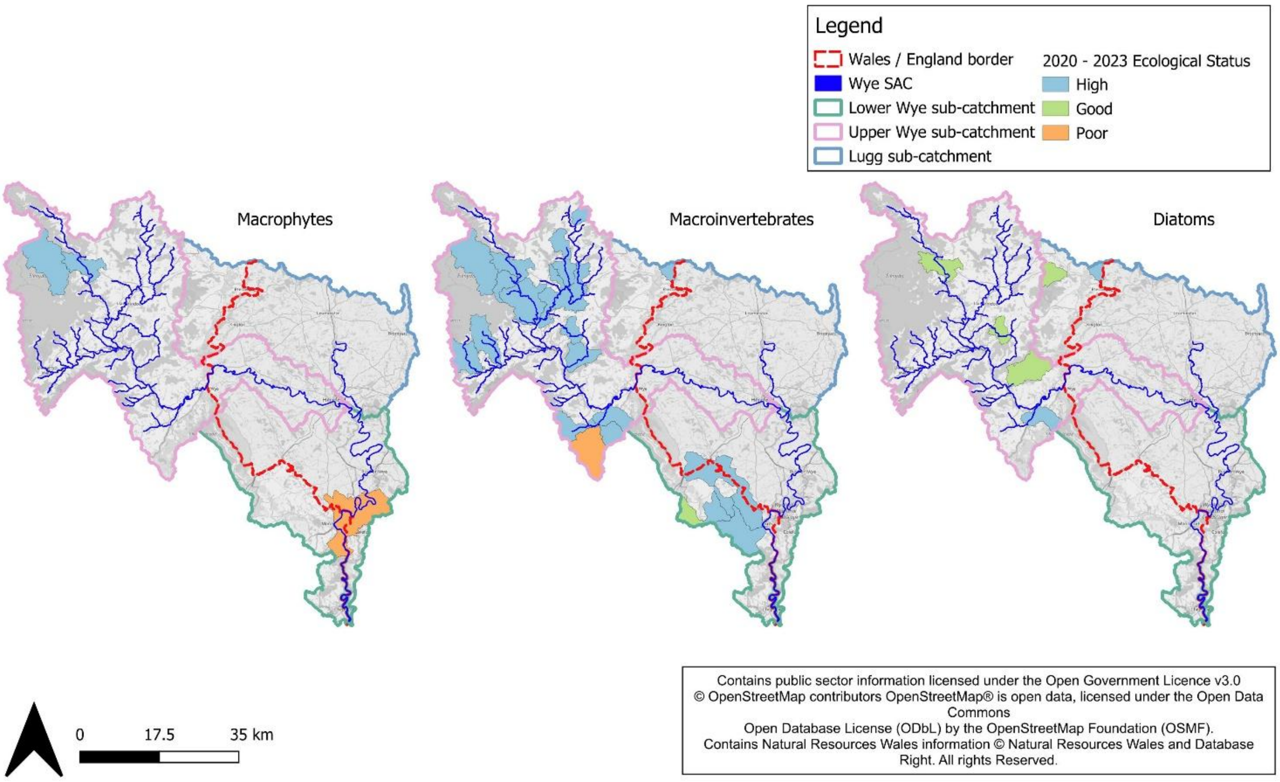
Excessive phosphorus loading in aquatic ecosystems can induce eutrophication, characterized by the proliferation of primary producers such as phytoplankton and macrophytes. This hyperproductive state often leads to harmful algal blooms (HABs), including toxin-producing cyanobacteria. The subsequent senescence and decomposition of these blooms result in increased biochemical oxygen demand (BOD), leading to hypoxic or anoxic conditions. These oxygen-depleted zones can cause significant mortality events in fish and benthic invertebrates, thereby disrupting trophic interactions and altering community structure. Additionally, the decline in water quality can impair ecosystem services, including potable water supply, recreational activities, and habitat provision for aquatic organisms. Effective management of phosphorus inputs is critical to mitigate these ecological impacts and maintain the integrity of aquatic ecosystems.

Due to the importance of the impact of phosphorus concentrations on aquatic organisms this section evaluates waterbody ecological classification based on UKTAG WFD guidelines and standard ecological assessment thresholds. The assessment uses the available 2020 to 2023 biological monitoring data collected from NRW data catalogue (NRW, 2025c). Data varies slightly from the routine WFD status classification from 2024 due to the addition of a larger open-source dataset and a slightly longer temporal dataset for phosphorus (2020 – 2024). These data have been included to provide a broader understanding of the influences on the status over time, and to include any data which may supplement the official WFD classification. WFD classification provides a standardised approach to assessing ecological status per water body utilising only predetermined monitoring data over a three year period and reported as an annual classification. NRW data was selected for classification and mapping over a series of years to provide a deeper understanding of the biological status over time. A detailed description of the methodology used to assess and classify monitoring data on diatoms, invertebrates and macrophytes in the Welsh Wye catchment, is provided in Appendix E.

Results from this assessment is presented in Figure 10 for macroinvertebrate, macrophyte and diatom data, respectively. Coverage of recent data over the catchment is limited and about half of the WFD waterbodies could not be assessed. However, a general assessment of the correspondence between ecology data and phosphorus concentration can be made from available data. Overall, WFD 2024 overall classifications match the ecological status classification performed in this study corresponding to invertebrates and macrophyte samples collected between 2020 and 2023. *Afon Llynfi - source to conf Dulas Bk* waterbody shows poor invertebrate ecological status, in line with its current Moderate WFD overall classification, while all other waterbodies covered align with good or high ecological status. The analysis showed that available macrophyte and diatom data is much reduced between 2020 and 2023. Diatom data do not show high correspondence with WFD 2024 water quality status. However, it should be noted that while both diatoms and green algae respond to nutrient loads, diatoms have a unique requirement for silica and can adapt to varying nutrient conditions, whereas green algae often respond more dramatically to nutrient enrichment. Abundance and growth of these two biological elements are closely related to P content in water and should be considered as key biological indicators of nutrient pollution.

Coherence between invertebrate, macrophyte and diatom SAC waterbody classification is low, with most ecological assessment results showing High or Good status, while the corresponding waterbodies have been reported as failing SAC P compliance.

Figure 10: Summary map of Welsh Wye waterbodies unofficial ecological status based on NRW invertebrate, macrophyte and diatom available monitoring data between 2020 and 2023




## 4.3 SOURCES AND PATHWAYS OF PHOSPHORUS POLLUTION

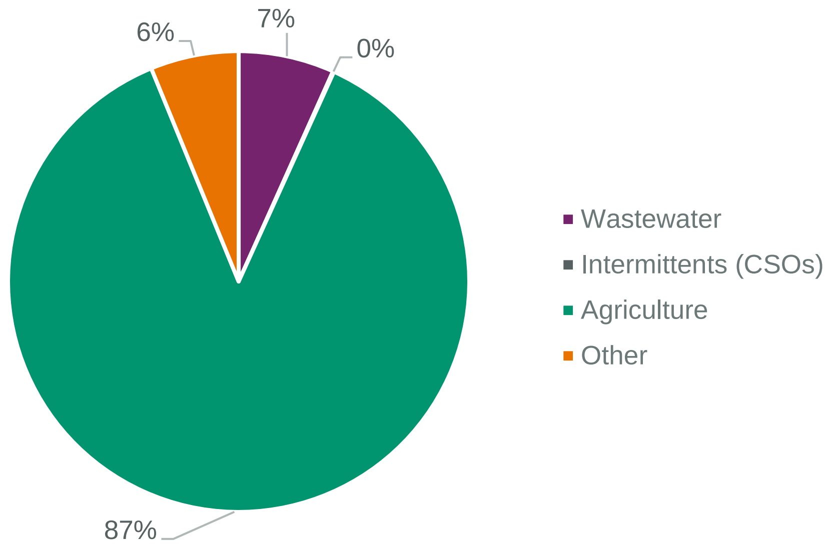
Source apportionment data has been produced for the catchment using SAGIS v3 modelling provided by NRW. DCWW produced SAGIS model outputs (based on 2016 to 2019 water quality monitoring) for the Welsh part of the Upper Wye, that was reviewed by NRW, and the EA produced SAGIS model outputs for the Welsh Lugg and Lower Wye. The data consists of modelled sector sources of phosphorus at the lowest boundary of each waterbody. The sector sources include STW, intermittent discharges (combined sewer overflows), rural land use (agriculture), and other (ST, urban and industrial discharges).

There are no sector contributions for highways.

The Upper Wye Welsh model showed that under current conditions effluent from sewage treatment works accounts for 23% of the average daily load (kg/day) with rural land use contributing 72%, storm overflows contributing 2% and a further 3% from other sources including ST, industry and urban runoff.

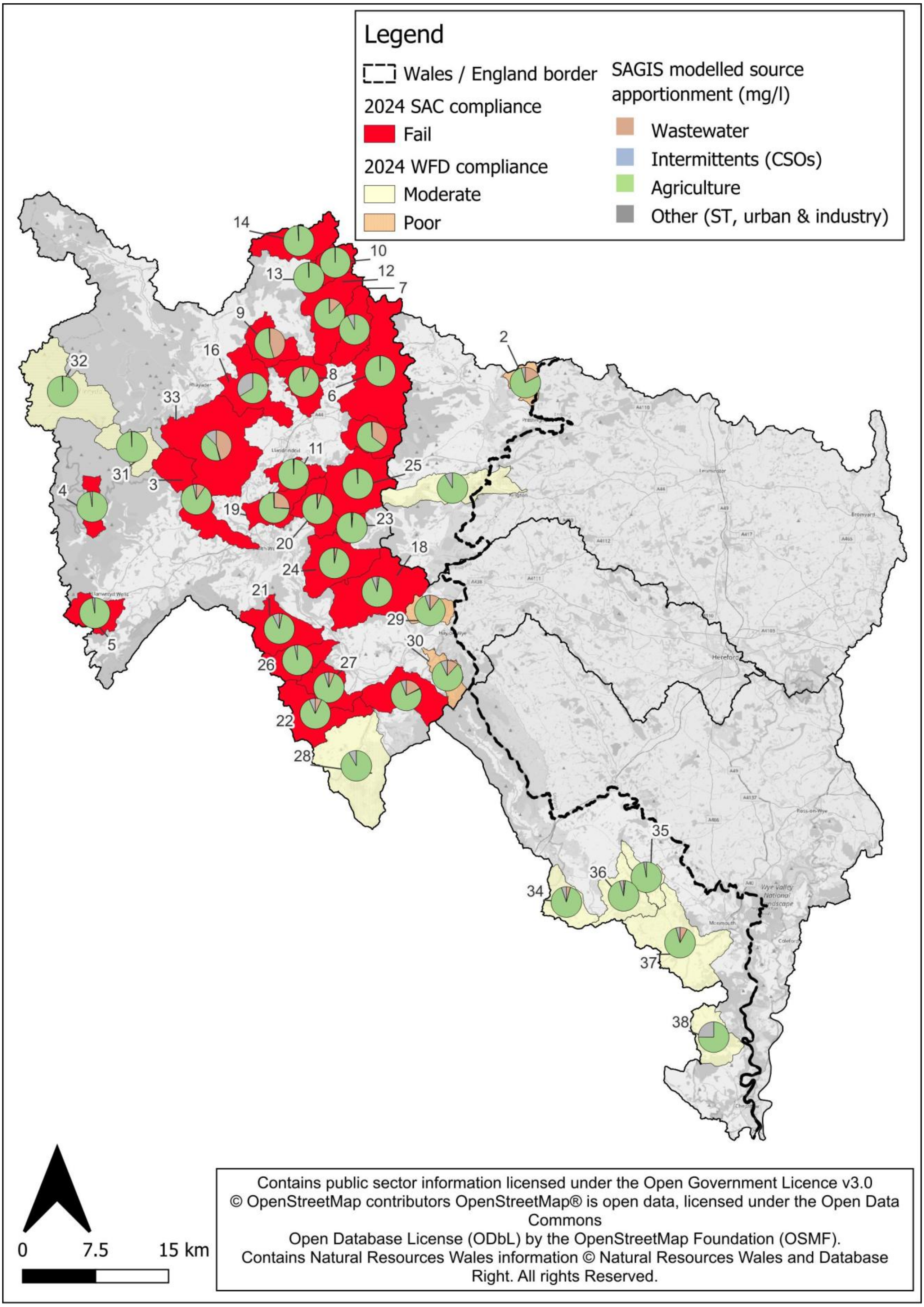
The model outputs were analysed looking only at those water bodies in the Welsh Wye failing phosphorus targets in 2024. The highest sector contribution is agriculture (87%), followed by sewage (7%), other (ST, urban and industry) (6%) and intermittent discharges (<1%) (Figure 11).

Figure 11: Total sector contributions of phosphorus concentration across all failing waterbodies in the Welsh Wye catchment (as derived from SAGIS).




Sector contributions of phosphorus concentration (as derived from SAGIS) in individual waterbody catchments is displayed in Figure 12 (see Appendix F for the full dataset and Appendix H for a detailed methodology of how percentage sector contributions have been calculated). Rural contributions are highest in all failing waterbody catchments, with wastewater having significant contributions in Clywedog Bk - source to conf Bachell Bk, Mithil Bk - source to conf R Ithon and Wye - conf Afon Elan to conf R Ithon of over 30%. Other contributions are limited to less than 10% of contributions in all failing waterbodies except *Nantmel Dulas - source to conf R Ithon*, *Wye - conf Afon Elan to conf R Ithon* and *Tintern Bk - source to conf R Wye*. CSOs have minimal contributions in all failing waterbodies.

Figure 12: Map of combined EA and DCWW SAGIS modelled source apportionment concentrations



### 4.3.1 Geological and soil influences

The variation in geology and soil types can influence how phosphorus is transported into the river. In the Upper Wye, the impermeability of the mudstone geology, combined with the erodibility of the peaty soils, steep topography of the Cambrian mountains and high rainfall in this area (2,320 – 2,418mm/yr) can lead to surface run-off and flash flooding in the Upper Wye catchment, driving nutrient inputs through mobilised sediment (Brandt *et al.,* 2004).

In the Lugg catchment the sandy soil types and underlaying sandstone are more permeable which reduces flash flooding, however, these soil types are more suspectable to erosion via overland flow if soils are bare and heavy rainfall occurs, which can carry phosphorus into the river via this pathway. Phosphorus inputs bound to sediment can be higher if heavy rainfall occurs during droughts or when high flows can cause bankside erosion (Petry *et al.,* 2002; Dupas *et al.,* 2024).

In the Lower Wye, the limestone geology is more resistant to erosion and as a result gorges and caves are formed, which can increase the occurrence of ground and surface water interaction at springs (BGS, 2025). Significant groundwater contributions to the Lower Wye can stabilise lower river flows (Jarvie *et al.,* 2003), however high river flow given the upstream contributions can increase bankside erosion.

### 4.3.2 Agriculture sources

The SAGIS model estimated that 87% of phosphorus loading originates from the agricultural sector across all waterbody catchments failing SAC or WFD targets (Environmental Information Data Centre, 2025). This has been attributed to an annual phosphorus surplus of 3,000t across the whole of the Wye Catchment (ranging from 1.9 to 17kgP/ha across the catchment); this is 55% higher than the national average and is primarily driven by livestock manure inputs to land (Withers *et al.,* 2022a). In the uplands of the Upper Wye and the furthest reaches of the Lugg catchment, sheep grazing and peatland degradation can exacerbate surface runoff and carry sediments and phosphorus into the river, however phosphorus concentrations in the soil are considered low (P index 1 or below) in this area due to low nutrient inputs from extensive grazing practices (Jarvie *et al.,* 2003; Wtihers *et al.,* 2022b). In the lowlands of the Wye catchment phosphorus loading is higher, with 55% of fields having above optimum phosphorus concentrations (Withers *et al.,* 2022b). Livestock manures have historically originated from cattle and sheep; however, poultry numbers have increased in the catchment in recent years. Poultry manure has a higher phosphorus concentration than cattle and sheep manure by around 60% on average, as derived from RB209 Nutrient Management Guide (AHDB, 2023) (see Table 4). Therefore, the increases in poultry production may have increased the concentration of phosphorus applied in livestock manures across the catchment, contributing to elevated phosphorus concentrations in the waterbodies.

Table 4 Phosphorus concentrations in fresh-weight livestock manures.

| Livestock | Dry matter (%) | Total phosphorus (kg / tonne) | Available phosphorus (kg / tonne) |
|---|---|---|---|
| Cattle and sheep | 25 | 3.2 | 1.9 |
| Poultry | 20 | 8.0 | 4.8 |

(Source: adapted from AHDB, 2023).

There is currently no regulatory limit on phosphorus applications to land in Wales, however there is existing guidance (Welsh Government, 2022c):

- Materials spread to land should benefit agriculture or ecological improvements - Environment Permitting Regulations (Defra, 2016),
- Phosphorus applications must be limited to crop offtake only and risks to the environment must be addressed when applied to P index 3 or above soils - Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (Welsh Assembly Government, 2011),
- Nutrient requirements to be considered when applying sludge - Sludge Use in Agriculture Regulations (Defra, 2018).

In the Welsh Wye, there is limited up-to-date data on phosphorus soil reserves (Welsh Government, 2022b). However, across the whole of the Wye catchment, the surplus phosphorus after crop uptake is 60% higher than the national average and has led to high legacy phosphorus reserves in the soil (Withers *et al.,* 2022a). The soils have limited phosphorus buffering capacity due to the high existing phosphorus reserves. Steep slopes and high rainfall can lead to soil erosion and sedimentation of watercourses, which can transport sediment-bound phosphorus into watercourses. During the springtime, soil erosion following livestock manure applications has been shown to be a major cause of phosphorus pollution in rivers from rural land (Bowes *et al.,* 2022). In addition, bankside erosion from high flows or livestock poaching (Scott *et al.,* 2023) can cause sediment and nutrient pollution. Therefore, the two major causes of phosphorus pollution from the agricultural sector can be attributed to excessive livestock manure inputs to land and soil erosion into watercourses.

To assess the contribution of diffuse phosphorus pollution from different farm types, Farmscoper Upscale V5 (ADAS, 2025) was used to model the estimated loads of phosphorus for the Wye catchment. See Appendix G for the full methodology.

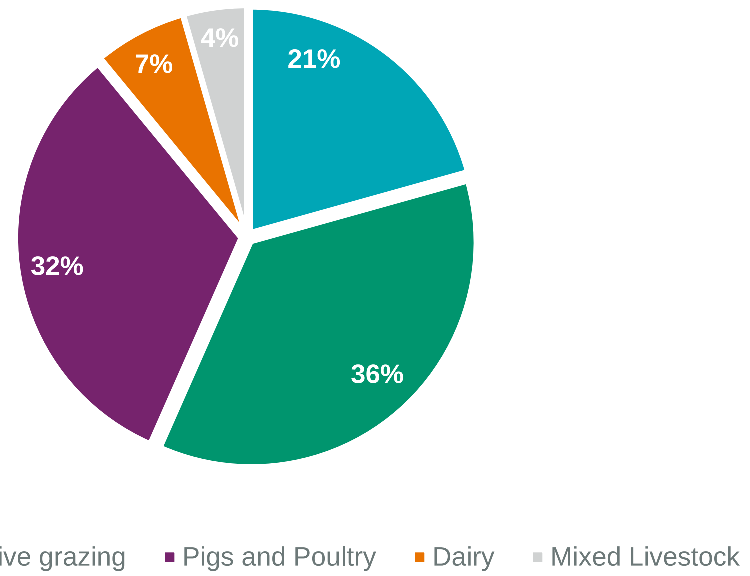
The farm type results (Table 5) show that extensive grazing farms are the most numerous, followed by arable, mixed livestock, dairy and pig and poultry. Pig and poultry farms have the highest stocking density in kg of nitrogen per hectare due to the high livestock numbers and higher phosphorus content in manure. The average area per farm for poultry has been increased based on the land area required to spread the livestock manure under the “170 kg N per ha” regulatory limit (which would include land on neighbouring farms). Therefore, this area does not represent the average area of individual poultry farms. The number of poultry in the catchment was increased to a total of 29.7 million poultry to represent the increase in poultry numbers since 2019 (Natural England, 2024).

Table 5 Farmscoper Create results modelled in Farmscoper Upscale V5 for farm types in the Wye catchment.

| | Arable | Extensive Grazing | Pigs and Poultry | Dairy | Mixed Livestock |
|---|---|---|---|---|---|
| Number of farms | 837 | 2,765 | 16 | 115 | 232 |
| Stocking density (kg N per ha) | 0 | 87 | 167 | 132 | 97 |
| Average area per farm (ha) | 105 | 72 | 974 | 169 | 106 |
| ***Land use per farm type (ha)*** | | | | | |
| Cropping | 67 | 4 | 566 | 31 | 41 |
| Grassland | 28 | 56 | 400 | 130 | 56 |
| Woodland | 10 | 4 | 6 | 6 | 7 |
| Rough grazing | 0 | 8 | 2 | 2 | 2 |
| ***Livestock numbers per farm type (head)*** | | | | | |
| Cattle | 0 | 46 | 0 | 244 | 65 |
| Sheep | 0 | 518 | 0 | 153 | 412 |
| Pigs | 0 | 0 | 548 | 0 | 21 |
| Poultry | 0 | 0 | 245,049 | 0 | 5,566 |

The total phosphorus loading per farm type across the Wye catchment is predominantly from extensive grazing and pigs and poultry farms (Figure 13).

Figure 13: Phosphorus loading per farm type



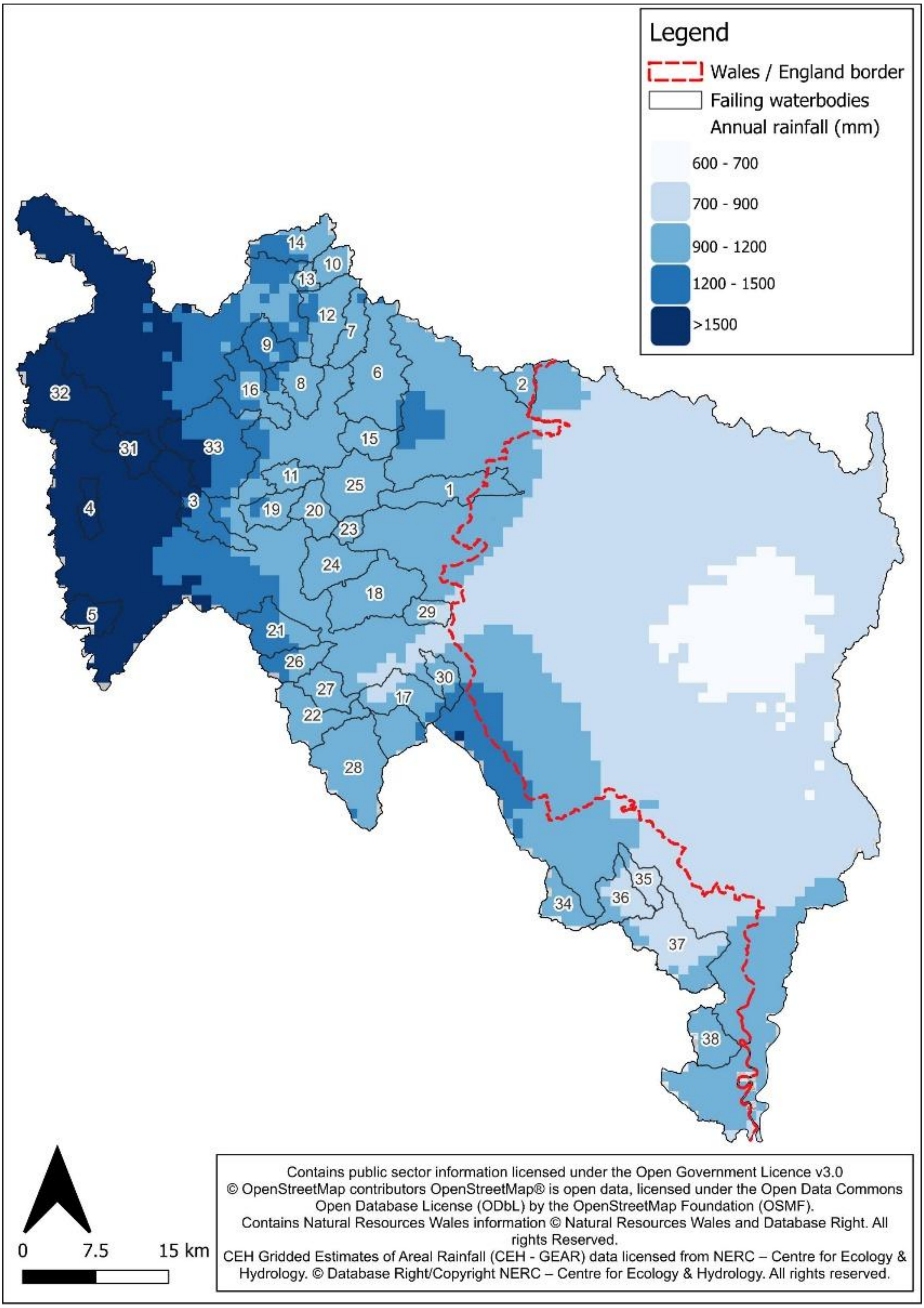

Extensive grazing farms are thought to be a large contributor of phosphorus loading from agriculture due to the large land area this farm type covers. Pig and poultry farms are few in the catchment, however the large livestock numbers on each farm, combined with a higher phosphorus content in manures contribute to the high phosphorus load from this farm type.

Table 6 shows the failing waterbody catchments categorised into rainfall bands and the baseline phosphorus load per ha on each of the farm types present within the individual waterbody catchments (refer to  for the locations of waterbody catchments categorised by annual rainfall). The results show that the highest phosphorus load per ha is from pig and poultry farms in waterbody catchments with an annual rainfall of 1200-1500mm (which are located in the Upper Wye and Lower Wye sub-catchments). Dairy farms in waterbody catchments with an annual rainfall of 900-1200mm have the second highest phosphorus load per ha (2.24kg).

Table 6 Estimated current baseline phosphorus load per hectare from the different farm types with different annual rainfall quantities within the Wye catchment, as modelled in Farmscoper Upscale V5.

| | **Annual rainfall** | | | |
|---|---|---|---|---|
| Rainfall | >1500mm | 1200-1500mm | 900-1200mm | 700-900mm |
| Waterbody catchment reference | 32, 31, 4, 5, upper 3, upper 33 | Lower 3, lower 33, 16, 9, upper 14, upper 21, upper 26, | Lower 14, 13, 10, 12, 7, 6, 8, lower 16, 11, 19, 15, 25, 20, 23, 24, 1, 18, 29, 2, lower 21, lower 26, 22, 27, 28, lower 17, 30, 38 | 34, 35, 37, |
| **Farm types** | **Phosphorus baseline load per hectare (kg)** | | | |
| Extensive grazing | 2.34 | 1.57 | 1.08 | 0.66 |
| Dairy | 3.48 | 2.24 | 2.24 | 0.99 |
| Pigs and Poultry | - | 2.45 | 1.69 | 1.02 |
| Mixed Livestock | - | - | 1.69 | 0.93 |
| Arable | - | - | - | 0.80 |

Figure 14: Annual rainfall across the failing waterbody catchments in the Wye catchment.



### 4.3.3 Wastewater Treatment Works sources

On the Welsh side of the Wye, the wastewater sector is inputting phosphorus mostly from final treated effluent, contributing to a total of 7% of concentrations in the failing waterbody catchments. Figure 15 highlights all STW from the Permitted Discharges to Controlled Waters with Conditions register (NRW, 2025d) on the Welsh side of the Wye. Table 7 shows all the failing waterbody catchments where the SAGIS outputs identified inputs from wastewater, and whether there are any STW located in the catchment (based on the Permitted Discharges to Controlled Waters with Conditions register (NRW, 2025d) and data provided by NRW and DCWW).

Figure 15: Map of all STW on the Welsh side of the Wye from the Permitted Discharges Register

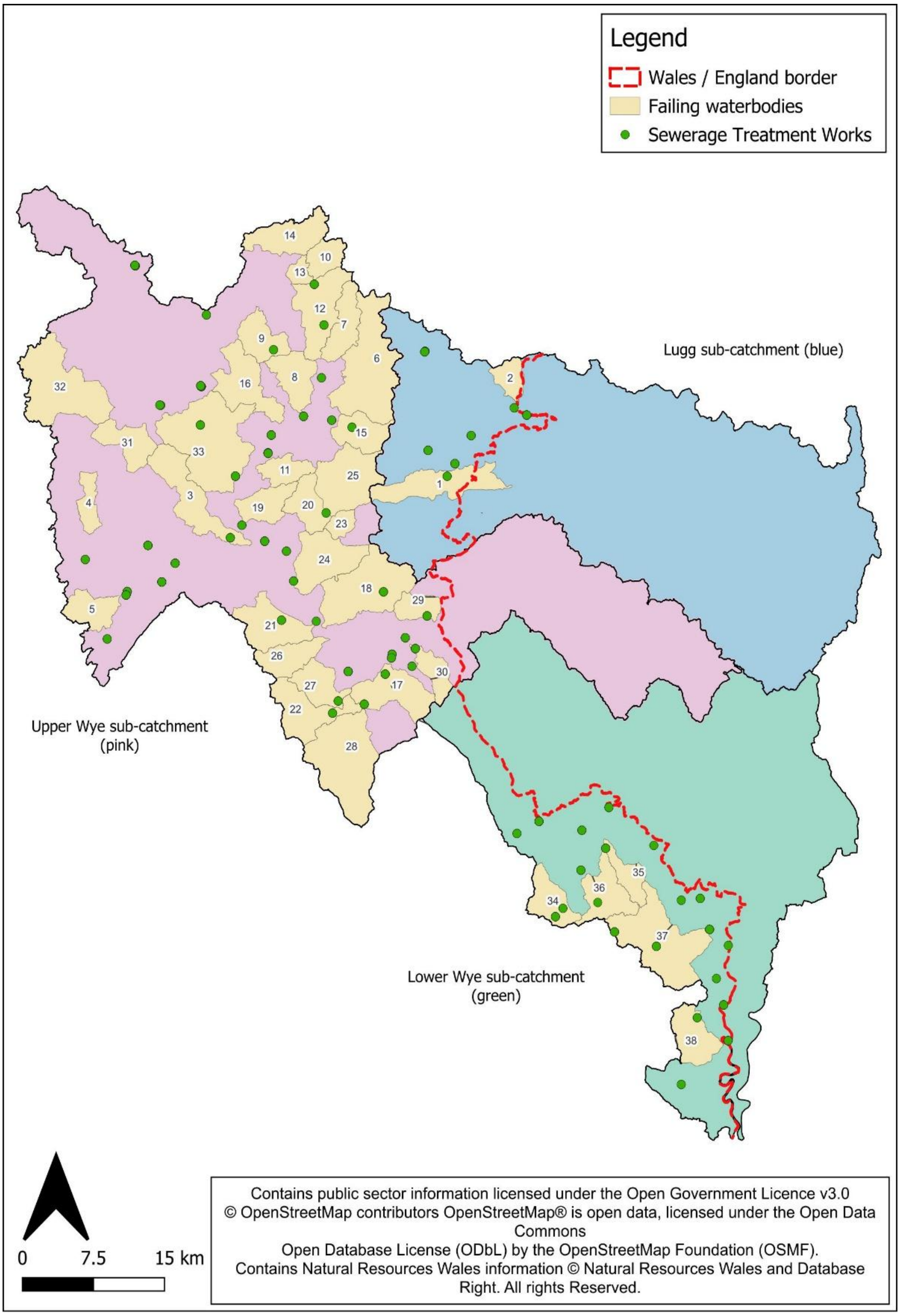


Table 7 Wastewater sources identified in the failing waterbody catchments where SAGIS outputs indicate a phosphorus load from the wastewater sector.

| Failing waterbody catchment | WwTWs identified in the catchment |
|---|---|
| 2 *Norton Bk - source to conf R Lugg* | None identified |
| 3 *Afon Chwefru - source to conf R Irfon* | Cilmery STW |
| 8 *Clywedog Bk - conf Bachell Bk to conf R Ithon* | None identified |
| 9 *Clywedog Bk - source to conf Bachell Bk* | Abbey Cwm Hir STW |
| 12 *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | Llanbister STW<br>Llanbadarn STW |
| 15 *Mithil Bk - source to conf R Ithon* | Llandegley STW |
| 17 *Afon Llynfi - conf Dulas Bk to conf R Wye* | Aberllynfi (Three Cocks) STW<br>Velindre STW<br>Talgarth STW |
| 18 *Bach Howey Bk - source to conf R Wye* | Painscastle STW |
| 19 *Builth Dulas Bk - source to conf R Wye* | Builth Road STW |
| 20 *Camnant Brook - source to confluence R Edw* | Hundred House STW |
| 21 Clettwr Bk - source to conf R Wye | Gwenddwr STW |
| 22 *Dulas Bk - source to conf Afon Llynfi* | Llanfilo STW |
| 23 *Edw - conf Camnant Bk to conf Clas Bk* | None identified |
| 24 *Edw - conf Clas Bk to conf R Wye* | None identified |
| 27 *Triffrwd - source to Dulas* | Llandefalle STW |
| 29 *Clyro Bk - source to conf R Wye* | Clyro STW |
| 30 *Digedi Bk - source to conf R Wye* | Llanigon STW |
| 33 *Wye - conf Afon Elan to conf R Ithon* | Newbridge-On-Wye STW<br>Llanwrthwl STW |
| 34 *Llanymynech Bk - source to conf R Trothy* | Llanddewi Rhydderch STW<br>Llanvapley STW |
| 36 *Trothy - conf Llanymynach Bk to conf Llymon Bk* | Llantilio Crosenny STW Abergavenny |
| 37 *Trothy - conf Llymon Bk to conf R Wye* | Dingestow STW<br>Penrhos STW |

### 4.3.4 Intermittent (CSO) sources

Within the failing waterbodies, CSO contributions of 1% are identified in waterbodies 11. *Howey Bk - source to conf R Ithon*, 17. *Afon Llynfi - conf Dulas Bk to conf R Wye* and 33. *Wye - conf Afon Elan to conf R Ithon.*

### 4.3.5 Other sources

*"Other"* sources of phosphorus inputs within the failing waterbodies includes private sewerage systems and industrial effluent. Other sources contribute a total of 6% of all phosphorus input into the Welsh side of the Wye according to SAGIS modelling outputs.

*Private sewerage systems*

Septic Tanks are private sewerage systems that serve small residential properties that cannot connect to a mains sewer network. ST with an Environmental Permit to Discharge, contribute a total of 23kg P/yr on the Welsh side of the Wye (see Figure 16). Package treatment plants (PTP) are larger private sewerage systems that serve larger residential properties or businesses that cannot connect to a mains sewer network. PTP with an Environmental Permit to Discharge (NRW, 2025d) or that are operating under the General Binding Rules, contribute a total of 1,565kg P/yr on the Welsh side of the Wye (see Figure 17). It should be noted that only private sewerage systems with a permit to discharge to controlled waters from the Permitted Discharges Register (NRW, 2025d) have been assessed, and additional private sewerage systems do operate within the catchment, however the details of these are unknown and unquantified within this report.

Figure 16: Map of all ST with a permit to discharge to controlled waters on the Welsh side of the Wye from the Permitted Discharges Register (NRW, 2025d)

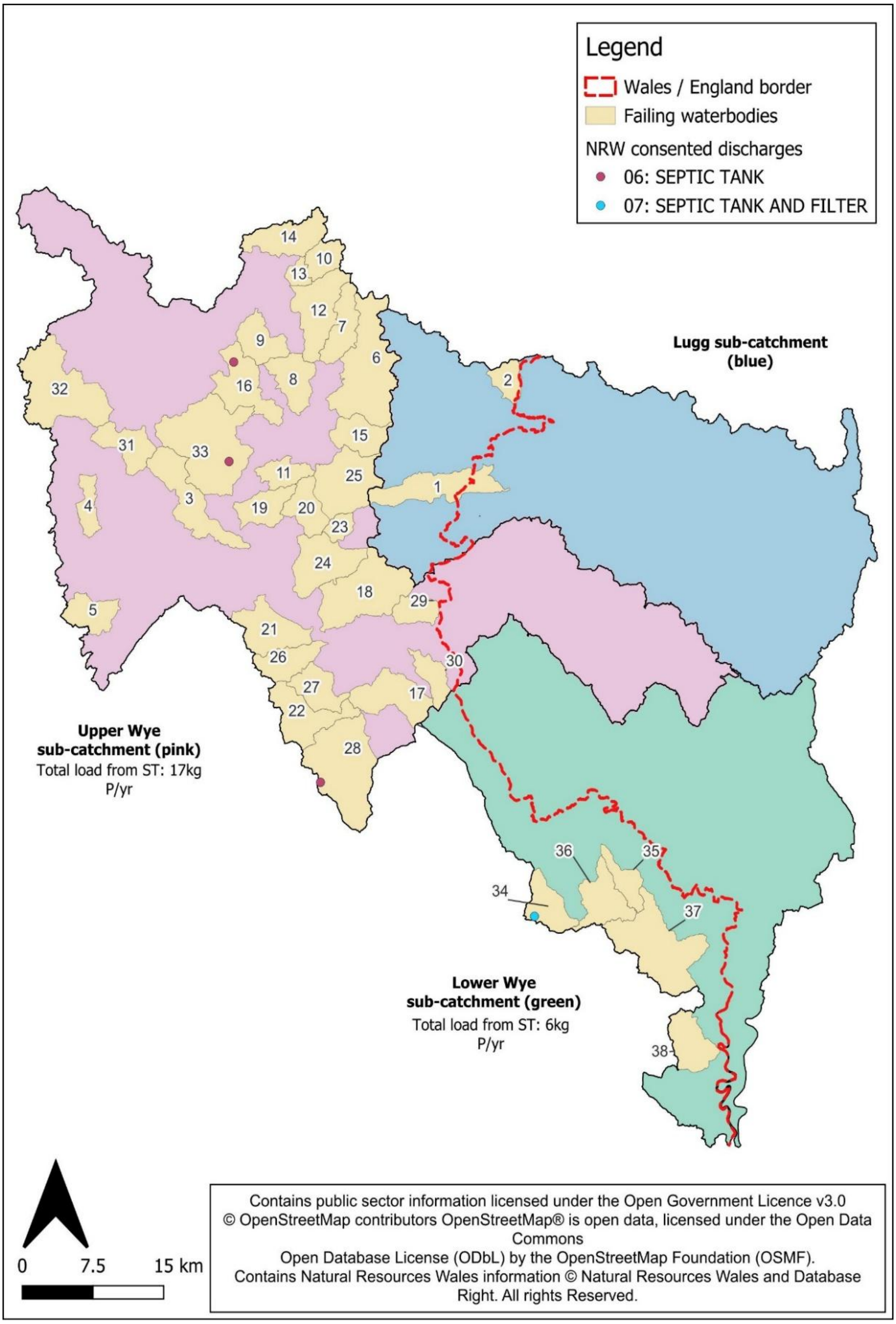
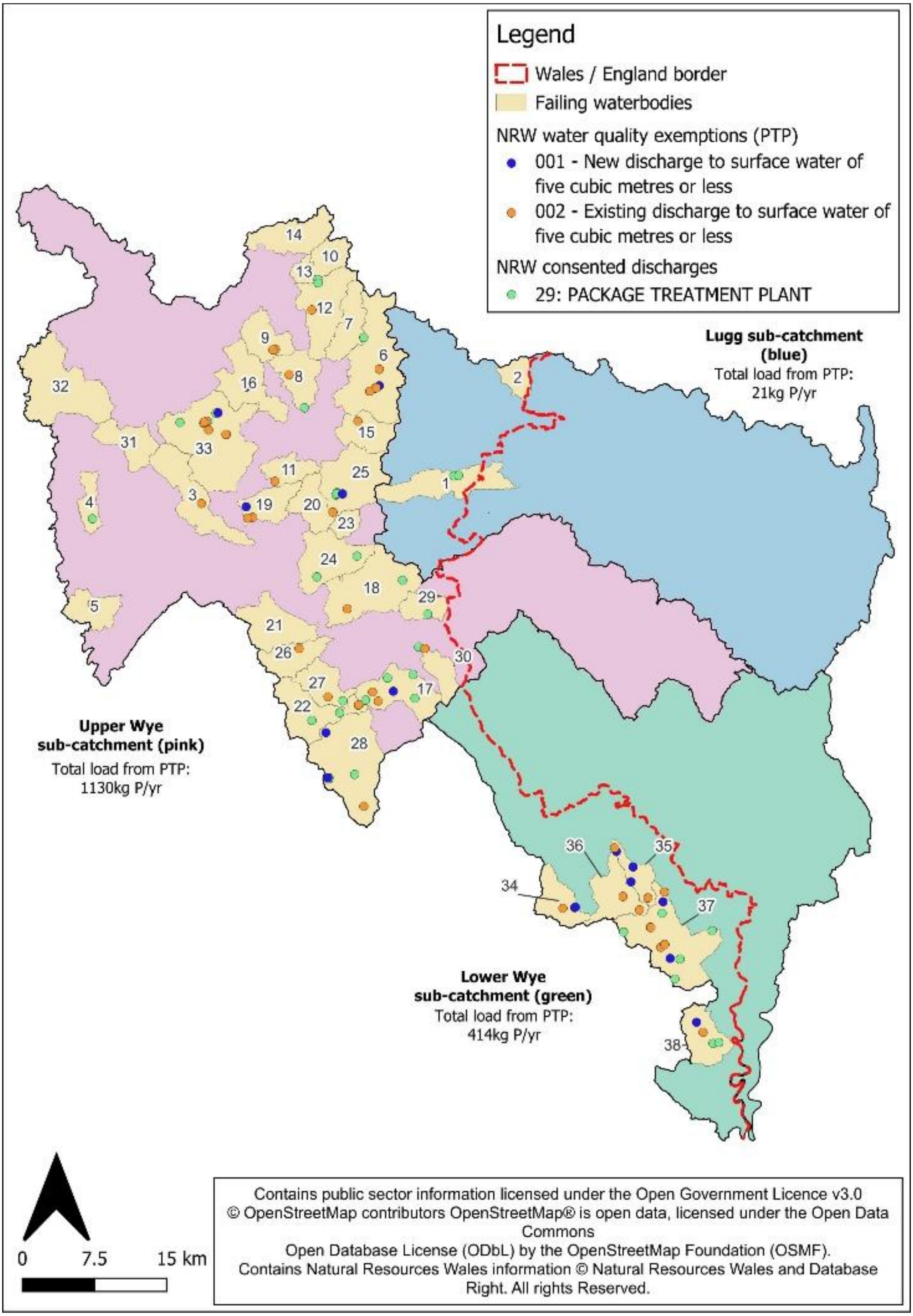


Figure 17: Map of all PTP on the Welsh side of the Wye from the Permitted Discharges Register (NRW, 2025b) and the Water Quality Exemptions Register (NRW, 2025c)



*Industrial sources*

SAGIS concentrations identify a total of 0.0079 mg/l of phosphorus in waterbody 16. *Nantmel Dulas - source to conf R Ithon and* in waterbody 33. *Wye - conf Afon Elan to conf R Ithon*. However, NRW advised that the discharge was a landfill and was modelled based on permitted flow and a generic phosphorus value. Therefore, industrial inputs modelled in SAGIS are highly unlikely to be realistic sources in the Wye catchment.

#### 4.3.6 Phosphorus concentration reductions required

Phosphorus concentration reductions required for agricultural and other (ST and urban) inputs to meet SAC or WFD compliance for each failing waterbody is proportional to the sectors total percentage contribution derived from the SAGIS data (see Appendix H for full detailed on the methods used).

Table 8 provides the percentage contribution of phosphorus per sector. The reductions in phosphorus concentrations are provided as an exceedance of the target phosphorus concentration. The sector contribution therefore relates to the percentage reduction of the difference in actual phosphorus vs the target phosphorus concentration (the exceedance). Sectors will be required to reduce their concentration of phosphorus by the sector contribution to the exceedance of the target value. The wastewater sector already has regulated *"fair share"* phosphorus reduction targets set by NRW to be met by 2030 based on the SAGIS outputs and water quality data measured between 2017 and 2019.

Note that *Camnant Brook - source to confluence R Edw* and *Afon Claerwen - conf Afon Arban to Caban-coch* require 100% and 108% reductions in sector concentrations to meet the target. This is because the SAGIS model outputs were based on a 2016 to 2019 river water quality dataset and the in-river concentration from recent monitored data has been assessed after the SAGIS model has been produced. Therefore, the total phosphorus concentrations from the sectors as modelled in SAGIS may be higher than the exceedance above target from recent water quality monitoring.

Table 8 Percentage contribution of phosphorus concentration from each sector (derived from SAGIS).

| Main catchment | Operational catchment | Water body name | Annual average P conc (mg/L) | Target P conc (mg/L) | P exceedance (mg/L) | Sector percentage contribution | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | CSO's | Rural | Other* |
| Lugg | Arrow Lugg and Frome | *1. Gilwern Bk - source to conf R Arrow* | - | 0.046 | - | 0% | 0% | 92% | 8% |
| | Lugg | *2. Norton Bk - source to conf R Lugg* | 0.113 | 0.035 | 0.078 | 17% | 0% | 78% | 4% |
| Upper Wye | Irfon | *3. Afon Chwefru - source to conf R Irfon* | 0.015 | 0.010 | 0.005 | 9% | 0% | 87% | 4% |
| | | *4. Afon Gwesyn - source to conf R Irfon* | 0.012 | 0.010 | 0.002 | 0% | 0% | 98% | 2% |
| | | *5. Cledan - source to conf R Irfon* | 0.016 | 0.010 | 0.006 | 0% | 0% | 97% | 3% |
| | Ithon | *6. Aran - source to conf R Ithon* | 0.020 | 0.015 | 0.005 | 0% | 0% | 100% | 0% |
| | | *7. Camddwr Bk - source to conf R Ithon* | 0.024 | 0.013 | 0.011 | 0% | 0% | 93% | 7% |
| | | *8. Clywedog Bk - conf Bachell Bk to conf R Ithon* | 0.011 | 0.010 | 0.001 | 7% | 0% | 92% | 1% |
| | | *9. Clywedog Bk - source to conf Bachell Bk* | 0.012 | 0.010 | 0.002 | 46% | 0% | 54% | 1% |
| | | *10. Gwenlas Bk - source to conf R Ithon* | 0.033 | 0.010 | 0.023 | 0% | 0% | 100% | 0% |
| | | *11. Howey Bk - source to conf R Ithon* | 0.044 | 0.015 | 0.029 | 0% | 1% | 99% | 0% |
| | | *12. Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 0.012 | 0.010 | 0.002 | 13% | 0% | 87% | 0% |
| | | *13. Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | 0.012 | 0.010 | 0.002 | 0% | 0% | 99% | 1% |
| | | *14. Ithon - source to conf Llaethdy Bk* | 0.011 | 0.010 | 0.001 | 0% | 0% | 99% | 1% |
| | | *15. Mithil Bk - source to conf R Ithon* | 0.042 | 0.015 | 0.027 | 35% | 0% | 64% | 1% |
| | | *16. Nantmel Dulas - source to conf R Ithon* | 0.019 | 0.010 | 0.009 | 0% | 0% | 66% | 34% |
| | Wye - Ithon to Hay | *17. Afon Llynfi - conf Dulas Bk to conf R Wye* | 0.059 | 0.025 | 0.034 | 17% | 1% | 76% | 6% |
| | | *18. Bach Howey Bk - source to conf R Wye* | 0.032 | 0.015 | 0.017 | 2% | 0% | 92% | 6% |
| | | *19. Builth Dulas Bk - source to conf R Wye* | 0.018 | 0.015 | 0.003 | 26% | 0% | 73% | 1% |
| | | *20. Camnant Brook - source to confluence R Edw* | 0.048 | 0.015 | 0.033 | 4% | 0% | 95% | 1% |
| | | *21. Clettwr Bk - source to conf R Wye* | 0.022 | 0.015 | 0.007 | 3% | 0% | 90% | 7% |

| Main catchment | Operational catchment | Water body name | Annual average P conc (mg/L) | Target P conc (mg/L) | P exceedance (mg/L) | Sector percentage contribution | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | CSO's | Rural | Other* |
| | | *22. Dulas Bk - source to conf Afon Llynfi* | 0.035 | 0.025 | 0.010 | 7% | 0% | 87% | 6% |
| | | *23. Edw - conf Camnant Bk to conf Clas Bk* | 0.037 | 0.015 | 0.022 | 1% | 0% | 98% | 1% |
| | | *24. Edw - conf Clas Bk to conf R Wye* | 0.016 | 0.015 | 0.001 | 3% | 0% | 96% | 1% |
| | | *25. Edw - source to conf Colwyn Bk* | 0.023 | 0.015 | 0.008 | 0% | 0% | 99% | 1% |
| | | *26. Scithwen Bk - source to conf R Wye* | 0.020 | 0.015 | 0.005 | 0% | 0% | 97% | 3% |
| | | *27. Triffrwd - source to Dulas* | 0.033 | 0.015 | 0.018 | 6% | 0% | 89% | 5% |
| | | *28. Afon Llynfi - source to conf Dulas Bk* | 0.076 | 0.052 | 0.024 | 0% | 0% | 92% | 8% |
| | | *29. Clyro Bk - source to conf R Wye* | 0.076 | 0.062 | 0.014 | 10% | 0% | 84% | 5% |
| | | *30. Digedi Bk - source to conf R Wye* | 0.083 | 0.064 | 0.019 | 12% | 0% | 81% | 7% |
| | Wye source to Ithon | *31. Afon Claerwen - conf Afon Arban to Caban-coch* | 0.040 | 0.028 | 0.012 | 0% | 0% | 99% | 1% |
| | | *32. Afon Claerwen - source to conf Afon Arban* | - | 0.028 | - | 0% | 0% | 100% | 0% |
| | | *33. Wye - conf Afon Elan to conf R Ithon* | 0.012 | 0.010 | 0.002 | 45% | 1% | 41% | 12% |
| Lower Wye | Trothy | *34. Llanymynech Bk - source to conf R Trothy* | 0.130 | 0.075 | 0.055 | 4% | 0% | 91% | 5% |
| | | *35. Llymon Bk - source to conf R Trothy* | 0.093 | 0.085 | 0.008 | 0% | 0% | 97% | 3% |
| | | *36. Trothy - conf Llanymynach Bk to conf Llymon Bk* | 0.089 | 0.079 | 0.010 | 2% | 0% | 94% | 4% |
| | | *37. Trothy - conf Llymon Bk to conf R Wye* | 0.099 | 0.084 | 0.015 | 8% | 0% | 88% | 4% |
| | Wye OC | *38. Tintern Bk - source to conf R Wye* | - | 0.083 | - | 0% | 0% | 75% | 25% |

***Other sources include ST, urban and industrial discharges**

# 5. OPTIONS APPRAISAL

## 5.1 AGRICULTURAL MEASURES

### 5.1.1 Existing mitigation measures

*Regulatory compliance, best practice and agri-environment schemes*

The agricultural sector currently already has in place existing mitigation measures that are delivered as part of regulatory requirements, best practices or funded through agri-environment grants. In Wales, farmers and land managers must comply with The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 (Welsh Government, 2023a). These include:

- Storage of silage must be compliant with The Water Resources (Control of Pollution) (Silage, Slurry and Agriculture Fuel Oil) (Wales) Regulations 2010;
- Notifying NRW of the construction of any new substantially enlarged or reconstructed silo or slurry storage system;
- Controlling the spreading of nitrogen fertiliser at high risk times and high risk areas;
- Incorporating organic manures into bare soil or stubble;
- Closed periods for spreading manufactured nitrogen fertiliser.
- Risk maps for spreading or storage of organic manures;
- Storage of organic manure 10m away from field drains and watercourses;
- The individual hectare limit (250kg/ha) for the spreading of organic manure;
- Import/export of manure to ensure farm limits (170kg/ha) from livestock manures are met;
- Nutrient Management Planning and recording;
- Nutrient applications restricted to crop limits.
- Holding nitrogen limit: ‘the 170kg of nitrogen per ha from all livestock manures limit’.
- Closed periods for spreading nitrogen fertiliser (includes slurry and other organic manures);
- Storage capacity for slurry must be enough to prevent spreading in the closed period;
- The storage period for pigs and poultry must be six months, and other livestock types must be five months.

At the time of writing[1], farm inspections were completed in 2023 as part of a new Service Level Agreement across 596 farms in Wales (Welsh government, 2025a). Of the farms surveyed, 243 (40.8%) were compliant with all the current required regulations while 353 (59.2%) were not compliant with the regulations. Compliance failures were commonly attributed to silage clamp construction, nutrient management planning, capacity and construction of slurry stores, risk mapping for manure spreading and nitrogen limits. This suggests that common sources of phosphorus pollution in the River Wye from agricultural practices can be attributed to point source pollution from inappropriate slurry or silage storage, and diffuse pollution from the overapplication or inappropriate application of manures or artificial fertilisers.

In addition, Welsh Government provide rural grants and payments to farmers and land managers to improve agricultural infrastructure or sustainable land management practices, with a total of £60 million set aside for capital funding for 2024 to 2025 (Welsh Government, 2023b). These grants aim to reduce the environmental impact and improve the sustainability of the agricultural sector in Wales. Grants encourage best practice and cover a broad range of measures that directly impact the water environment including nutrient management, habitat creation, fencing, guttering, and slurry and silage storage and management (Welsh Government, 2025b).

Farmscoper Upscale and Evaluate V5 (ADAS, 2025) were used to estimate the impact of existing mitigation measures delivered as part of regulatory compliance, best practice or agri-environment scheme measures on

[1] Note: NRW advise that there were 847 Control of Agricultural Pollution Regulations inspections (November 2023 - March 2025) across Wales, of which 448 (53%) farms were noncompliant with one or more CoAPR requirements.

phosphorus loading from agriculture (See Appendix I for full methodology). The existing level of compliance (41%) was input into Farmscoper Evaluate V5 against the following relevant mitigation measures:

- Fertiliser spreader calibration
- Use a fertiliser recommendation system
- Integrate fertiliser and manure nutrient supply
- Do not apply manufactured fertiliser to high-risk areas
- Avoid spreading manufactured fertiliser to fields at high-risk times
- Do not apply P fertilisers to high P index soils
- Increase the capacity of farm slurry stores to improve timing of slurry applications
- Minimise the volume of dirty water produced (sent to dirty water store)
- Minimise the volume of dirty water produced (sent to slurry store)
- Site solid manure heaps away from watercourses/field drains
- Manure Spreader Calibration
- Do not apply manure to high-risk areas
- Do not spread slurry or poultry manure at high-risk times
- Do not spread FYM to fields at high-risk times
- Incorporate manure into the soil
- Capture of dirty water in a dirty water store

All other mitigation measures remained at the standard implementation level (derived from Farmscoper Evaluate V5 prior implementation values, which represent national average rates of mitigation measure implementation on farms). The results showed that, compared to baseline phosphorus loads (with no mitigation in place), the existing estimated uptake of mitigation measures and the current level of regulatory compliance reduced phosphorus loading by a total of 24,650kg, which represents a load reduction of 13% compared to the baseline load (with no mitigation measures in place) (Table 9).

Table 9 Estimated phosphorus load reduction achieved from existing mitigation measures across the Wye catchment as modelled in Farmscoper V5.

| Mitigation scenario | Phosphorus load (kg/yr) | Phosphorus load reduction (kg/yr) | Phosphorus load reduction (%) |
|---|---|---|---|
| Baseline (no mitigation) | 187,014 | - | - |
| Existing mitigation measures | 162,364 | 24,650 | 13 |

Table 10 presents the percentage contribution of phosphorus from the agricultural sector, each failing waterbody will need to reduce their concentration of phosphorus by their percentage contribution to the exceedance of the target (See Table 8) to achieve SAC and WFD compliance. The existing mitigation measures in eight waterbody catchments (highlighted in green) achieve the load reduction target from agriculture to meet compliance.

Table 10 Estimated phosphorus reduction (proportion of the exceedance of the target), required beyond current regulatory compliance and existing mitigation measures implemented in each failing waterbody catchment.

| Main catchment | Operational Catchment | Water body name | Phosphorus concentration reduction of the exceedance of the target |
|---|---|---|---|
| Lugg | Arrow, Lugg and Frome | 1. *Gilwern Bk - source to conf R Arrow* | 92% |
| | | 2. *Norton Bk - source to conf R Lugg* | 78% |

| Main catchment | Operational Catchment | Water body name | Phosphorus concentration reduction of the exceedance of the target |
|---|---|---|---|
| Upper Wye | Irfon | 3. *Afon Chwefru - source to conf R Irfon* | 87% |
| | | 4. *Afon Gwesyn - source to conf R Irfon* | 98% |
| | | 5. *Cledan - source to conf R Irfon* | 97% |
| | Ithon | 6. *Aran - source to conf R Ithon* | 100% |
| | | 7. *Camddwr Bk - source to conf R Ithon* | 93% |
| | | 8. *Clywedog Bk - conf Bachell Bk to conf R Ithon* | 92% |
| | | 9. *Clywedog Bk - source to conf Bachell Bk* | 54% |
| | | 10. *Gwenlas Bk - source to conf R Ithon* | 100% |
| | | 11. *Howey Bk - source to conf R Ithon* | 99% |
| | | 12. *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 87% |
| | | 13. *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | 99% |
| | | 14. *Ithon - source to conf Llaethdy Bk* | 99% |
| | | 15. *Mithil Bk - source to conf R Ithon* | 64% |
| | | 16. *Nantmel Dulas - source to conf R Ithon* | 66% |
| | Wye – Ithon to Hay | 17. *Afon Llynfi - conf Dulas Bk to conf R Wye* | 76% |
| | | 18. *Bach Howey Bk - source to conf R Wye* | 92% |
| | | 19. *Builth Dulas Bk - source to conf R Wye* | 73% |
| | | 20. *Camnant Brook - source to confluence R Edw* | 95% |
| | | 21. *Clettwr Bk - source to conf R Wye* | 90% |
| | | 22. *Dulas Bk - source to conf Afon Llynfi* | 87% |
| | | 23. *Edw - conf Camnant Bk to conf Clas Bk* | 98% |
| | | 24. *Edw - conf Clas Bk to conf R Wye* | 96% |
| | | 25. *Edw - source to conf Colwyn Bk* | 99% |
| | | 26. *Scithwen Bk - source to conf R Wye* | 97% |
| | | 27. *Triffrwd - source to Dulas* | 89% |
| | | 28. *Afon Llynfi - source to conf Dulas Bk* | 92% |
| | | 29. *Clyro Bk - source to conf R Wye* | 84% |
| | | 30. *Digedi Bk - source to conf R Wye* | 81% |
| | Wye source to Ithon | 31. *Afon Claerwen - conf Afon Arban to Caban-coch* | 99% |
| | | 32. *Afon Claerwen - source to conf Afon Arban* | 100% |
| | | 33. *Wye - conf Afon Elan to conf R Ithon* | 41% |
| Lower Wye | Trothy | 34. *Llanymynech Bk - source to conf R Trothy* | 91% |
| | | 35. *Llymon Bk - source to conf R Trothy* | 97% |
| | | 36. *Trothy - conf Llanymynach Bk to conf Llymon Bk* | 94% |
| | | 37. *Trothy - conf Llymon Bk to conf R Wye* | 88% |
| | Wye OC | 38. *Tintern Bk - source to conf R Wye* | 75% |

In addition to the uptake of mitigation measures as part of regulatory compliance, best practice or agri-environment measures on farms and other river restoration projects aiming at reducing phosphorus loading in the River Wye catchment have been delivered, which are detailed below.

*Upper Wye Catchment Restoration Project*

Launched in 2024, the £900,000 project aims to restore and enhance habitats in the Upper Wye catchment. The project will run until 2029, and activities will aim to reduce sediment, and pollutant loads to surface water and strengthen the river's resilience to extreme weather and rising temperatures caused by climate change (NRW, 2024a).

The project is being carried out as a collective effort involving farmers and landowners, and the support of local communities. Key partners include the Freshwater Habitats Trust (demonstration sites and funding for water troughs), Radnorshire Wildlife Trust's Wye Adapt to Climate Change project (completing farm visits), the Wye and Usk Foundation, the Floodplain Meadows Partnership, Swansea University and NRW.

Activities which are completed or in progress include:

- **Local farm and demonstration sites visit:** Visited local organisations and demonstration sites, engaging with farmers along the Ithon, Irfon, and Marteg rivers to explore collaborative efforts in improving river health (NRW, 2024a).

- **Surveys of river condition and migratory fish:** Conducted specialist surveys, including river condition assessments and acoustic monitoring for migratory shad, to guide targeted restoration efforts and enhance understanding of key species in the Wye catchment. Spring surveys confirmed significant shad spawning in the upper Wye near Newbridge and the first official record on the Ithon, helping guide future habitat improvements for this rare migratory species (NRW, 2024a; NRW, 2024c).

- **Surveys for Invasive Non-Native Species:** Surveyed Upper Wye tributaries for Himalayan Balsam, Japanese Knotweed and American Skunk Cabbage and identified areas for treatment, encouraging local involvement to help stop their spread. Planned work consisted of efforts focused on early action to halt their spread and protect river ecosystems (NRW, 2025f).

- **'Slow the Flow' project**: The restoration project visited the Stroud Valleys Natural Flood Management Project to learn natural flood management techniques and is now developing similar 'Slow the Flow' projects in the upper Wye forests to reduce runoff, improve water quality, and enhance habitats. A Slow the Flow project was completed on the Afon Bidno, adding deadwood and pleached willows to improve river habitats, slow water flow, and create a demonstration site for wider catchment benefits (NRW, 2024c).

- **Work with farming community:** Working closely with farmers in the Upper Wye catchment to co-design voluntary, tailored schemes that benefit both farm businesses and river health through nature-based solutions (NRW, 2024c) including:

  - Installation of fences along river corridors to create buffer zones.

  - Provide alternative drinking options to remove the need for livestock to enter watercourses.

  - Plant trees to increase shading of rivers and bank stability.

  - Install measures to reduce overland flow, increase infiltration, and reduce soil and nutrient run off.

  - Improve riparian and floodplain habitats.

  - Make improvements on or around farmyards to reduce diffuse pollution.

- **Introduced drone assistance:** Enhanced environmental monitoring, enabling capture of high-resolution imagery and tracking the impact of restoration efforts across the Upper Wye (NRW, 2024c). The drone was used to undertake surveys to monitor and measure landscape changes in the Slow the Flow work on the Afon Bidno and Tarenig Forest, using high-resolution optical and multispectral images for detailed analysis (NRW, 2025f).

- **Conducted stakeholder events**: The first stakeholder event was held in Llandrindod Wells and brought together over 50 participants to share project progress, strengthen partnerships, and explore collaborative ways to restore the Upper Wye catchment (NRW, 2024c).
- **Completed first farm scheme**: The scheme was completed on the River Irfon and succeeded in creating 1.6km of fenced buffer zones and wetland habitat to protect endangered species and support sustainable farming (NRW, 2025f).

Of the actions that impact water quality improvements on agricultural land, the estimated phosphorus load reductions achieved from each project is detailed in Table 11 (see Appendix I.2 for methodology).

Table 11 Upper Wye Restoration project actions and estimated phosphorus load reductions achieved.

| Project | Project location | Action | Land area covered | Estimated phosphorous load reduction achieved (kg/yr) |
|---|---|---|---|---|
| **Upper Wye Restoration Project: Work with the farming community** | Focus areas around Afon Marteg *(outside of failing waterbody catchments)* | Watercourse fencing | 2.7km<br>(27ha of land influenced assuming a minimum of 100m adjacent to the fenced river is grazed by livestock) | 2.7 |
| | | Riparian buffers | 2.7km x 3m<br>(0.81ha) | 0.8 |
| **First farm scheme** | 1.6km of the River Irfon, south-west of Builth Wells ((*outside of failing waterbody catchments)* | Watercourse fencing | 1.6km<br>(16ha of land influenced assuming a minimum of 100m adjacent to the fenced river is grazed by livestock) | 1.6 |
| | | Riparian buffers | 0.96ha | 0.10 |
| | | Floodplain wetland creation | 16.00ha | 1.55 |

*The Wilder Lugg Project*

The Wilder Lugg Project is a two-year initiative running from January 2024 to January 2026, focused on implementing natural flood management and habitat creation within the River Lugg (SSSI) catchment in Wales. Covering an area of 9,257 hectares in north-east Radnorshire, Powys, the project aims to empower the local rural community to collaboratively develop a long-term, sustainable vision for the river's health. By uniting farmers, conservationists, and other stakeholders, the project seeks to restore a clean and thriving River Lugg for future generations. It is funded by Radnorshire Wildlife Trust with a total grant of £180,000 (Radnorshire Wildlife Trust, n.d.).

Activities which are completed or in progress include (Westbury, 2025):

- Promoted regenerative and sustainable land management to improve soil and river health.
- Encouraging the following practices:
    - *In permanent pasture systems:*
        - Greater rest periods.

- Increased grazing exclusion.
- Increased herbage variety.
- Diverse livestock stocking.

  - *In arable systems:*

    - Use of cover crops.
    - Companion planting.
    - Reduction of chemical inputs.
    - Creation of wildflower margins.

  - *Landscape-scale interventions:*

    - Restoration of woodland on steep upland hills to slow rainwater runoff.
    - Development of lowland wetlands to store and purify water, protecting farmland and towns.

- Raised awareness about the complexity of river pollution and the need for multi-stakeholder collaboration.

*SAC Nutrients Project*

Focuses on improving water quality through collaboration with various stakeholders.

Since its initiation in 2021, the SAC Rivers Water Quality Project in NRW (now the SAC Nutrients Project) has been addressing the water quality issues identified in nine SAC rivers, as listed under the EU Habitats Directive. This work is essential for enabling NRW to meet its statutory obligations regarding the sustainable management of natural resources, as well as its well-being duties under the Environment (Wales) Act.

The project has focused on identifying sources of pollution, developing targeted interventions, and working with stakeholders across sectors to improve ecological conditions in the affected catchments. It also aligns closely with the Welsh Government's priority to improve water quality across Wales.

This ongoing programme represents a critical step in securing the long-term health and biodiversity of some of Wales's most important riverine habitats (NRW, 2023a)

To address excess nutrients in the soil and SAC rivers of Wales, collaborative efforts between the housing development and the agriculture sector are essential. Key actions include:

1. **Support and training programmes**: Farming Connect provides advice, support, training, and on-farm events to improve water quality in failing SAC catchments.
2. **Rural Investment Schemes**: Offering 40% grants for infrastructure improvements in nutrient management and pollution prevention, continuing the support previously provided by the Rural Development Plan.
3. **Agricultural Representation**: Ensuring agricultural representation at all NMBs/Catchment Partnerships in Wales.
4. **Innovation**: Working with groups like the WLMF sub-group on agricultural pollution to encourage innovation and achieve measurable outcomes by September 2023.
5. **Farming Unions and Organizations**: Promoting good nutrient management practices, continuing collaboration with the WLMF sub-group, advocating for the Water Standard, and providing guidance on the Control of Agricultural Pollution Regulation.

Further mitigation activities and recommendations provided by various stakeholders have been included in Appendix I.

### 5.1.2 Future mitigation measures

*Improvements to agricultural practices and infrastructure*

Improving agricultural practices and farm infrastructure can reduce the phosphorus loads in the River Wye from the agricultural sector. Farmscoper mitigation measures were categorised into five mitigation scenarios to assess the impact of improving agricultural practices or infrastructure on phosphorus loading from agriculture, if all applicable measures were implemented on 100% of applicable land or farm types in the Wye catchment.

In addition, two further scenarios (all possible measures + P index 2 or below soils and all possible measures + 5% land use change) were assessed. Reducing the P index to optimal or below soils was modelled due to the high amount of legacy phosphorus in the soils, which is believed to be a major source of phosphorus pollution to the River Wye when soils erode in surface waters (Withers *et al.,* 2022b). Across Wales, a total of 43,000ha of trees needs to be planted to tackle the climate emergency (Welsh Government, 2024). The conversion of agricultural land to woodland could reduce the phosphorus load from the agricultural sector.

The mitigation scenario descriptions are outlined in Table 12 and the individual mitigation measures that have been modelled at the maximum implementation rate (100%) within each mitigation scenario are present in Table 13. The mitigation scenarios were modelled in Farmscoper Upscale and Evaluate V5 to assess the potential phosphorus load reduction that could be achieved. Appendix I.3 presents the full methodology.

Table 12 Mitigation measure scenarios.

| Mitigation scenario | Description |
|---|---|
| Regulatory compliance | Measures that allow maximum regulatory compliance with The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021. |
| Best practice | Regulation + measures that can be implemented to ensure best practice. |
| Welsh agri-environment measures | Regulation + best practice + measures that can be implemented under current agri-environment schemes or grants in Wales. |
| All possible agri-environment measures | Regulation + best practices + Welsh agri-environment measures + all possible measures that can be implemented as part of an agri-environment schemes or grants. |
| All possible measures | All possible measures that can be implemented on farms to improve practices or infrastructure. |
| All possible measures + P index 2 or below soils | All possible measures that can be implemented on farms to improve practices or infrastructure with soils at P index 2 and below. |
| All possible measures + 5% land use change | Converting 5% of the existing agricultural land to woodland and all possible measures that can be implemented on farms to improve practices or infrastructure on the remaining farmland. |

Table 13 Individual mitigation measures included within the mitigation measure scenarios above. “Yes” indicates that the mitigation measure is included in the mitigation scenario and has been modelled at the maximum level of implementation on all applicable land (100%). “No” indicates that this mitigation measure is not included in the mitigation scenario and has been modelled at the current level of implementation.

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Establish cover crops in the autumn | No | Yes | Yes | Yes | Yes |
| Early harvesting and establishment of crops in the autumn | No | Yes | Yes | Yes | Yes |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | No | Yes | Yes | Yes | Yes |
| Adopt reduced cultivation systems | No | No | No | Yes | Yes |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Cultivate compacted tillage soils | No | Yes | Yes | Yes | Yes |
| Cultivate and drill across the slope | No | No | No | Yes | Yes |
| Leave autumn seedbeds rough | No | Yes | Yes | Yes | Yes |
| Manage over-winter tramlines | No | Yes | Yes | Yes | Yes |
| Establish in-field grass buffer strips | No | No | No | Yes | Yes |
| Establish riparian buffer strips | No | Yes | Yes | Yes | Yes |
| Loosen compacted soil layers in grassland fields | No | Yes | Yes | Yes | Yes |
| Allow grassland field drainage systems to deteriorate | No | No | No | Yes | Yes |
| Ditch management on arable land | No | No | Yes | Yes | Yes |
| Ditch management on grassland | No | No | Yes | Yes | Yes |
| Improved livestock through breeding | No | No | No | No | Yes |
| Use plants with improved nitrogen use efficiency | No | No | Yes | Yes | Yes |
| Fertiliser spreader calibration | Yes | Yes | Yes | Yes | Yes |
| Use a fertiliser recommendation system | Yes | Yes | Yes | Yes | Yes |
| Integrate fertiliser and manure nutrient supply | Yes | Yes | Yes | Yes | Yes |
| Do not apply manufactured fertiliser to high-risk areas | Yes | Yes | Yes | Yes | Yes |
| Avoid spreading manufactured fertiliser to fields at high-risk times | Yes | Yes | Yes | Yes | Yes |
| Use manufactured fertiliser placement technologies | No | No | No | Yes | Yes |
| Use nitrification inhibitors | No | No | No | Yes | Yes |
| Replace urea fertiliser to grassland with another form | No | No | No | Yes | Yes |
| Replace urea fertiliser to arable land with another form | No | No | No | Yes | Yes |
| Incorporate a urease inhibitor into urea fertilisers for grassland | No | No | No | Yes | Yes |
| Incorporate a urease inhibitor into urea fertilisers for arable land | No | No | No | Yes | Yes |
| Use clover in place of fertiliser nitrogen | No | No | Yes | Yes | Yes |
| Do not apply P fertilisers to high P index soils | Yes | Yes | Yes | Yes | Yes |
| Reduce dietary N and P intakes: Dairy | No | No | No | Yes | Yes |
| Reduce dietary N and P intakes: Pigs | No | No | No | Yes | Yes |
| Reduce dietary N and P intakes: Poultry | No | No | No | Yes | Yes |
| Adopt phase feeding of livestock: Dairy | No | No | No | Yes | Yes |
| Adopt phase feeding of livestock: Pigs | No | No | No | Yes | Yes |
| Reduce the length of the grazing day/grazing season | No | No | No | Yes | Yes |
| Extend the grazing season for cattle | No | No | No | Yes | Yes |
| Reduce field stocking rates when soils are wet | No | Yes | Yes | Yes | Yes |
| Move feeders at regular intervals | No | Yes | Yes | Yes | Yes |
| Construct troughs with concrete base | No | No | No | Yes | Yes |
| Increase scraping frequency in dairy cow cubicle housing | No | No | Yes | Yes | Yes |
| Additional targeted bedding for straw-bedded cattle housing | No | No | No | Yes | Yes |
| Washing down of dairy cow collecting yards | No | No | No | Yes | Yes |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Frequent removal of slurry from beneath-slat storage in pig housing | No | No | No | Yes | Yes |
| Install air-scrubbers: mechanically ventilated pig housing | No | No | No | No | Yes |
| Install air-scrubbers: mechanically ventilated poultry housing | No | No | No | No | Yes |
| More frequent manure removal from laying hen housing with manure belt systems | No | No | No | No | Yes |
| In-house poultry manure drying | No | No | No | No | Yes |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | Yes | Yes | Yes | Yes | Yes |
| Adopt batch storage of slurry | No | No | No | Yes | Yes |
| Install covers to slurry stores | No | No | Yes | Yes | Yes |
| Allow cattle slurry stores to develop a natural crust | No | No | No | Yes | Yes |
| Anaerobic digestion of livestock manures | No | No | No | Yes | Yes |
| Minimise the volume of dirty water produced (sent to dirty water store) | Yes | Yes | Yes | Yes | Yes |
| Minimise the volume of dirty water produced (sent to slurry store) | Yes | Yes | Yes | Yes | Yes |
| Compost solid manure | No | No | No | Yes | Yes |
| Site solid manure heaps away from watercourses/field drains | Yes | Yes | Yes | Yes | Yes |
| Store solid manure heaps on an impermeable base and collect effluent | No | No | No | Yes | Yes |
| Cover solid manure stores with sheeting | No | No | Yes | Yes | Yes |
| Use liquid/solid manure separation techniques | No | No | Yes | Yes | Yes |
| Use poultry litter additives | No | No | No | No | Yes |
| Manure Spreader Calibration | Yes | Yes | Yes | Yes | Yes |
| Do not apply manure to high-risk areas | Yes | Yes | Yes | Yes | Yes |
| Do not spread slurry or poultry manure at high-risk times | Yes | Yes | Yes | Yes | Yes |
| Use slurry band spreading application techniques | No | No | Yes | Yes | Yes |
| Use slurry injection application techniques | No | No | Yes | Yes | Yes |
| Do not spread FYM to fields at high-risk times | Yes | Yes | Yes | Yes | Yes |
| Incorporate manure into the soil | Yes | Yes | Yes | Yes | Yes |
| Fence off rivers and streams from livestock | No | Yes | Yes | Yes | Yes |
| Construct bridges for livestock crossing rivers/streams | No | No | No | Yes | Yes |
| Re-site gateways away from high-risk areas | No | No | No | Yes | Yes |
| Farm track management | No | No | No | Yes | Yes |
| Establish new hedges | No | No | Yes | Yes | Yes |
| Establish and maintain artificial wetlands - steading runoff | No | No | No | Yes | Yes |
| Irrigate crops to achieve maximum yield | No | No | No | Yes | Yes |
| Establish tree shelter belts around livestock housing | No | No | Yes | Yes | Yes |
| Calibration of sprayer | No | No | No | Yes | Yes |
| Fill/Mix/Clean sprayer in field | No | No | No | Yes | Yes |
| Avoid PPP application at high risk timings | No | No | No | Yes | Yes |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Drift reduction methods | No | No | No | Yes | Yes |
| PPP substitution | No | No | No | Yes | Yes |
| Construct bunded impermeable PPP filling/mixing/cleaning area | No | No | No | Yes | Yes |
| Treatment of PPP washings through disposal, activated carbon or biobeds | No | No | No | Yes | Yes |
| Protection of in-field trees | No | No | No | No | Yes |
| Management of woodland edges | No | No | Yes | Yes | Yes |
| Management of in-field ponds | No | No | Yes | Yes | Yes |
| Management of arable field corners | No | No | No | No | Yes |
| Plant areas of farm with wild bird seed / nectar flower mixtures | No | No | Yes | Yes | Yes |
| Beetle banks | No | No | No | No | Yes |
| Uncropped cultivated margins | No | No | No | No | Yes |
| Skylark plots | No | No | No | No | Yes |
| Uncropped cultivated areas | No | No | Yes | Yes | Yes |
| Unfertilised cereal headlands | No | No | Yes | Yes | Yes |
| Unharvested cereal headlands | No | No | Yes | Yes | Yes |
| Undersown spring cereals | No | Yes | Yes | Yes | Yes |
| Management of grassland field corners | No | No | No | No | Yes |
| Leave residual levels of non-aggressive weeds in crops | No | No | Yes | Yes | Yes |
| Use correctly-inflated low ground pressure tyres on machinery | No | Yes | Yes | Yes | Yes |
| Locate out-wintered stock away from watercourses | No | Yes | Yes | Yes | Yes |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | No | No | No | No | Yes |
| Capture of dirty water in a dirty water store | Yes | Yes | Yes | Yes | Yes |
| Irrigation/water supply equipment is maintained and leaks repaired | No | No | No | No | Yes |
| Avoid irrigating at high risk times | No | No | No | No | Yes |
| Use efficient irrigation techniques (boom trickle, self closing nozzles) | No | No | No | No | Yes |
| Use high sugar grasses | No | No | No | No | Yes |
| Monitor and amend soil pH status for grassland | No | No | No | No | Yes |
| Increased use of maize silage | No | No | No | No | Yes |
| Improved crop health | No | No | No | No | Yes |
| Better health planning: dairy | No | No | No | No | Yes |
| Better health planning: beef | No | No | No | No | Yes |
| Better health planning: sheep | No | No | No | No | Yes |
| Improve livestock through genetic modification | No | No | No | No | Yes |
| Slurry acidification during storage | No | No | No | No | Yes |
| Slurry acidification at spreading | No | No | No | No | Yes |
| Install covers to slurry stores and burn off methane | No | No | Yes | Yes | Yes |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Use feed additives to reduce enteric methane emissions | No | No | No | No | Yes |

The results show that the mitigation scenarios could achieve a phosphorus load reduction of between 18% and 50% compared to the estimated baseline load modelled in Farmscoper for the whole of the Wye catchment (Table 14). These load reductions are the theoretical maximum that can be achieved if the mitigation measures in each scenario are implemented on 100% of all applicable land or farm types.

The load reduction percentages that could be achieved from each mitigation scenario from Table 14 were applied to the current estimated agricultural load (calculated from SAGIS) for each failing waterbody catchment. The results are displayed in Appendix I. A cost benefit analysis was completed for each failing waterbody catchment for the mitigation measure scenario that is required to meet the load reduction target (or the maximum that can be achieved from *all possible measures + 5% land use change* if the target cannot be met). See Appendix I for a detailed methodology. Table 15 shows that the agricultural sector can achieve the load reductions required to contribute to achieving SAC/WFD compliance in 25 out of the 38 failing waterbody catchments. Three waterbody catchments could not be assessed as water quality monitoring is not undertaken in these catchments. The load reduction required from agriculture in 10 catchments cannot be met.

The results show that regulatory compliance has the highest cost benefit of 2.78, which means that £1 of investment in mitigation measures for the agricultural sector would equate to £2.78 worth of benefits from reduced fertiliser costs to agriculture and reduced pollution to the environment. Best practice and Welsh agri-environment schemes can achieve higher benefits than the cost, however the other mitigation scenarios would have higher costs than benefits.

The total cost of implementing the mitigation measures as part of the Regulatory compliance, Best practice and Welsh agri-environment measures scenarios can partly be offset by current rural grants and payments offered by Welsh Government. The new Sustainable Farming Scheme set to be launched in 2026 (Welsh Government, 2025c) can partly offset the cost associated with the *“All possible agri-environment”* measures *and “All possible measures”* scenarios. However, the extent of this offset cost will be determined by the eligibility and uptake of grants on individual farms, as well as the additional grants available to farmers in 2026, which at the time of writing are still being developed. In Wales, farmers and landowners may be eligible to apply for a Woodland Creation Grant which could contribute towards the implementation costs (Welsh Government, 2024).

Table 14 Estimated costs per year and cost benefits for each mitigation scenario for the whole of the Wye catchment.

| Mitigation scenario | Phosphorus load (kg/yr) | Phosphorus load reduction* (kg/yr) | Phosphorus load reduction relative to baseline (%) | Total cost (£/yr) | Agricultural benefit[1] (£/yr) | Environmental benefit[2] (water quality[3]) (£/yr) | Total benefits[4] (£/yr) | Benefit cost ratio[5] | Total benefits per kg load reduction[6] (£/yr) |
|---|---|---|---|---|---|---|---|---|---|
| Baseline (no mitigation) | 187,014 | - | - | - | - | - | - | - | - |
| Regulation | 153,426 | 33,587 | 18 | £17,631,582 | £33,587 | £49,023,932 (£1,695,492) | £49,057,520 | 2.78 | £1,461 |
| Best practice | 126,478 | 60,536 | 32 | £39,025,896 | £60,536 | £66,293,254 (£3,055,855) | £66,353,790 | 1.70 | £1,096 |
| Welsh agri-environment measures | 114,910 | 72,104 | 39 | £92,577,042 | £72,104 | £103,432,014 (£3,639,786) | £103,504,117 | 1.12 | £1,435 |
| All possible agri-environment measures | 105,100 | 81,914 | 44 | £134,350,454 | £81,914 | £122,175,435 (£4,135,019) | £122,257,349 | 0.91 | £1,493 |
| All possible measures | 101,949 | 85,065 | 45 | £174,578,993 | £85,065 | £154,342,113 (£4,294,060) | £154,427,178 | 0.88 | £1,815 |
| All possible measures + P index 2 or below soils | 99,854 | 87,160 | 47 | £175,610,359 | £87,160 | £154,342,113 (£4,399,840) | £154,429,273 | 0.88 | £1,772 |
| All possible measures + 5% land use change | 93,815 | 93,199 | 50 | £209,762,813 | £93,199 | £186,008,785 (£4,704,694) | £186,101,984 | 0.89 | £1,997 |

*Phosphorus load reduction that can be achieved from measures, modelled in Farmscoper.

[1]Agricultural benefit: value of phosphorus fertiliser saved from reduced losses to environment based on 2025 fertiliser price of triple super phosphate at £460 per tonne containing 46% phosphorus (Redman, 2025).

[2]Environmental benefit:

[3]Water quality benefit: Monetary value of economic damage from phosphorus on drinking water quality, fishing, bathing water quality and eutrophication based on £50.48 / kg (2025 value) (ADAS, 2025).

[4]$Total\ benefit\ (£) = agricultural\ benefit\ (£) + environmental\ benefit\ (£)$

[5]$Benefit\ cost\ ratio\ = total\ benefits\ (£) \div total\ cost\ (£)$

[6]$Total\ benefits\ per\ kg\ load\ reduction\ (£)\ = total\ benefits\ (£)\ \div\ load\ reduction\ achieved\ \ (kg)$

Table 15 Agricultural contribution of phosphorus concentration (%) as derived from SAGIS, the recommended mitigation measure to achieve water quality targets (or the maximum that can be achieved from mitigation scenarios assessed) and the cost benefit of each mitigation scenario in each failing waterbody catchment. Green indicates that sector concentration reductions to meet water quality targets can be achieved from mitigation scenarios assessed.

| Sub-catchment | Operational catchment | Water body name | Target | Agricultural contribution of phosphorus concentration | Mitigation recommended | Phosphorus load reduction achieved from mitigation (kg P/yr)* | Cost (£/yr) | Benefit (£/yr) | Benefit / Cost Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Lugg | Arrow, Lugg and Frome | 1. *Gilwern Bk - source to conf R Arrow* | WFD | 92% | - | - | - | - | - |
| | | 2. *Norton Bk - source to conf R Lugg* | WFD | 78% | All possible measures + 5% land use change | 283 | £637,341 | £565,733 | 0.89 |
| Upper Wye | Irfon | 3. *Afon Chwefru - source to conf R Irfon* | SAC | 87% | Welsh agri-environment measures | 159 | £204,127 | £228,379 | 1.12 |
| | | 4. *Afon Gwesyn - source to conf R Irfon* | SAC | 98% | Welsh agri-environment measures | 64 | £81,680 | £91,384 | 1.12 |
| | | 5. *Cledan - source to conf R Irfon* | SAC | 97% | All possible measures + P index 2 or below soils | 160 | £321,962 | £283,289 | 0.88 |
| | Ithon | 6. *Aran - source to conf R Ithon* | SAC | 100% | Best practice | 192 | £123,647 | £210,422 | 1.70 |
| | | 7. *Camddwr Bk - source to conf R Ithon* | SAC | 93% | All possible measures + 5% land use change | 156 | £351,123 | £311,673 | 0.89 |
| | | 8. *Clywedog Bk - conf Bachell Bk to conf R Ithon* | SAC | 92% | Existing regulation and measures | 55 | £30,526 | £79,521 | 2.61 |
| | | 9. *Clywedog Bk - source to conf Bachell Bk* | SAC | 54% | Best practice | 17 | £10,643 | £18,112 | 1.70 |
| | | 10. *Gwenlas Bk - source to conf R Ithon* | SAC | 100% | All possible measures + 5% land use change | 144 | £323,913 | £287,520 | 0.89 |
| | | 11. *Howey Bk - source to conf R Ithon* | SAC | 99% | All possible measures + 5% land use change | 196 | £440,907 | £391,370 | 0.89 |
| | | 12. *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | SAC | 87% | Best practice | 83 | £53,489 | £91,028 | 1.70 |
| | | 13. *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | SAC | 99% | Best practice | 128 | £82,344 | £140,133 | 1.70 |
| | | 14. *Ithon - source to conf Llaethdy Bk* | SAC | 99% | Existing regulation and measures | 26 | £14,107 | £36,749 | 2.61 |

| Sub-catchment | Operational catchment | Water body name | Target | Agricultural contribution of phosphorus concentration | Mitigation recommended | Phosphorus load reduction achieved from mitigation (kg P/yr)* | Cost (£/yr) | Benefit (£/yr) | Benefit / Cost Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | *15. Mithil Bk - source to conf R Ithon* | SAC | 64% | All possible measures + 5% land use change | 204 | £458,413 | £406,909 | 0.89 |
| | | *16. Nantmel Dulas - source to conf R Ithon* | SAC | 66% | All possible measures + 5% land use change | 155 | £348,009 | £308,909 | 0.89 |
| | Wye – Ithon to Hay | *17. Afon Llynfi - conf Dulas Bk to conf R Wye* | SAC | 76% | All possible measures + 5% land use change | 1,664 | £3,745,583 | £3,324,753 | 0.89 |
| | | *18. Bach Howey Bk - source to conf R Wye* | SAC | 92% | All possible measures + 5% land use change | 664 | £1,493,769 | £1,325,938 | 0.89 |
| | | *19. Builth Dulas Bk - source to conf R Wye* | SAC | 73% | Regulation | 36 | £18,748 | £52,200 | 2.78 |
| | | *20. Camnant Brook - source to confluence R Edw* | SAC | 95% | All possible measures + 5% land use change | 352 | £791,320 | £702,412 | 0.89 |
| | | *21. Clettwr Bk - source to conf R Wye* | SAC | 90% | Welsh agri-environment measures | 202 | £259,372 | £290,189 | 1.12 |
| | | *22. Dulas Bk - source to conf Afon Llynfi* | SAC | 87% | Best practice | 152 | £98,165 | £167,058 | 1.70 |
| | | *23. Edw - conf Camnant Bk to conf Clas Bk* | SAC | 98% | All possible measures + 5% land use change | 965 | £2,170,925 | £1,927,013 | 0.89 |
| | | *24. Edw - conf Clas Bk to conf R Wye* | SAC | 96% | Existing regulation and measures | 163 | £89,949 | £234,319 | 2.61 |
| | | *25. Edw - source to conf Colwyn Bk* | SAC | 99% | Welsh agri-environment measures | 285 | £366,512 | £410,057 | 1.12 |
| | | *26. Scithwen Bk - source to conf R Wye* | SAC | 97% | Best practice | 104 | £66,951 | £113,938 | 1.70 |
| | | *27. Triffrwd - source to Dulas* | SAC | 89% | All possible measures + 5% land use change | 132 | £297,292 | £263,890 | 0.89 |
| | | *28. Afon Llynfi - source to conf Dulas Bk* | WFD | 92% | Best practice | 695 | £448,064 | £762,517 | 1.70 |
| | | *29. Clyro Bk - source to conf R Wye* | WFD | 84% | Best practice | 185 | £119,434 | £203,253 | 1.70 |
| | | *30. Digedi Bk - source to conf R Wye* | WFD | 81% | Best practice | 218 | £140,512 | £239,123 | 1.70 |

| Sub-catchment | Operational catchment | Water body name | Target | Agricultural contribution of phosphorus concentration | Mitigation recommended | Phosphorus load reduction achieved from mitigation (kg P/yr)* | Cost (£/yr) | Benefit (£/yr) | Benefit / Cost Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | Wye source to Ithon | 31. *Afon Claerwen - conf Afon Arban to Caban-coch* | WFD | 99% | Best practice | 1,115 | £719,041 | £1,223,664 | 1.70 |
| | | 32. *Afon Claerwen - source to conf Afon Arban* | WFD | 100% | - | - | - | - | - |
| | | 33. *Wye - conf Afon Elan to conf R Ithon* | SAC | 41% | Best practice | 785 | £411,869 | £1,146,755 | 2.78 |
| Lower Wye | Trothy | 34. *Llanymynech Bk - source to conf R Trothy* | WFD | 91% | Regulation | 559 | £916,278 | £1,269,862 | 0.89 |
| | | 35. *Llymon Bk - source to conf R Trothy* | WFD | 97% | All possible agri-environment measures | 84 | £46,701 | £121,656 | 2.61 |
| | | 36. *Trothy - conf Llanymynech Bk to conf Llymon Bk* | WFD | 94% | Existing regulation and measures | 268 | £147,913 | £385,315 | 2.61 |
| | | 37. *Trothy - conf Llymon Bk to conf R Wye* | WFD | 88% | Existing regulation and measures | 972 | £510,116 | £1,420,301 | 2.78 |
| | Wye OC | 38. *Tintern Bk - source to conf R Wye* | WFD | 75% | - | - | - | - | - |

* Phosphorus load reduction that can be achieved from measures, modelled in Farmscoper.

Phosphorus concentration reductions required from the agricultural sector to achieve water quality targets can be achieved in 25 out of 38 waterbody catchments assessed, with three not assessed due to limited water quality monitoring data. The remaining 10 waterbody catchments would require all possible mitigation measures plus land use change to meet their *"fair share"* target.

*"Regulation", "best practice"* and *"welsh agri-environment measures"* mitigation scenarios are existing delivery mechanisms that can theoretically achieve a maximum phosphorus load reduction of up to 39% from the agricultural sector if all measures within each mitigation scenario are implemented on all applicable land. These mitigation scenarios deliver more environmental and agricultural benefits than the costs. However, *"all possible measures"*, *"all possible measures plus low P index"* and *"all possible measures plus 5% land use change"* all deliver less environmental and agricultural benefits than the cost. It may not be economically feasible to implement mitigation scenarios that cost more than the benefits gained, and land use change may impact food production and agricultural productivity. Improving compliance with regulation, implementing best practices where possible, and increasing the uptake of Welsh agri-environment scheme measures will deliver more benefits than the cost, as well as improving water quality in the failing waterbody catchments.

*Evaluation of individual measures*

The impact of implementing individual mitigation measures across the whole of the Wye catchment on each farm type was modelled in Farmscoper Upscale and Evaluate V5 and categorised into rainfall bands to understand which specific mitigation measures would be most effective to reduce phosphorus loading in individual waterbody catchments (see Appendix I for full methodology). Table 16 shows the annual rainfall across the waterbody catchments. The following sections outline the most effective individual mitigation measures to reduce agricultural phosphorus loading for each waterbody catchment, categorised by rainfall.

Table 16 Waterbody catchments categorised by annual rainfall.

| | Waterbody catchments categorised by annual rainfall | | | |
|---|---|---|---|---|
| Rainfall | >1500mm | 1200-1500mm | 900-1200mm | 700-900mm |
| Waterbody catchment reference | 32, 31, 4, 5, upper 3, upper 33 | Lower 3, lower 33, 16, 9, upper 14, upper 21, upper 26, | Lower 14, 13, 10, 12, 7, 6, 8, lower 16, 11, 19, 15, 25, 20, 23, 24, 1, 18, 29, 2, lower 21, lower 26, 22, 27, 28, lower 17, 30, 38 | 34, 35, 37, lower 29, upper 17 |

***<u>Most effective measures for farms in >1500mm rainfall areas</u>***

Land use is predominantly upland or lowland grassland (as assessed from CORINE and ESRI satellite datasets), and Farmscoper Upscale V5 create results show that there are 37 extensive grazing and two dairy farms in the Upper Wye catchment in the areas with more than 1500mm annual rainfall.

The following failing waterbody catchments are within the >1500mm annual rainfall area within the Wye catchment (refer to Figure 14 for location of water body catchments that corresponds to the reference numbers below):

- 32. *Afon Claerwen - source to conf Afon Arban.*
- 31. *Afon Claerwen - conf Afon Arban to Caban-coch.*
- 4. *Afon Gwesyn - source to conf R Irfon.*
- 5. *Cledan - source to conf R Irfon.*
- Upper catchment of 3. *Afon Chwefru - source to conf R Irfon.*
- Upper catchment of 33. *Wye - conf Afon Elan to conf R Ithon.*

Within the above waterbodies the top ten most effective individual mitigation measures to implement on each farm type depending on their fertiliser practices and land use is provided in Table 17.

Table 17 Top ten mitigation measures that can be implemented on the different farm types within the failing waterbodies in the Upper Wye catchment in areas with >1500mm rainfall per year, and the respective load reduction that can be achieved relative to the baseline.

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| **Extensive Grazing (no fertiliser applied)** | | |
| Reduce the length of the grazing day/grazing season | 7.86 | 0.18 |
| Loosen compacted soil layers in grassland fields | 7.15 | 0.17 |
| Management of grassland field corners | 6.92 | 0.16 |
| Establish riparian buffer strips | 6.44 | 0.15 |
| Do not spread Farmyard Manure (FYM) to fields at high-risk times | 6.30 | 0.15 |
| Establish new hedges | 6.04 | 0.14 |
| Construct troughs with concrete base | 6.04 | 0.14 |
| Fence off rivers and streams from livestock | 6.04 | 0.14 |

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 6.00 | 0.14 |
| Establish and maintain artificial wetlands - steading runoff | 5.96 | 0.14 |
| **Extensive Grazing (fertiliser applied)** | | |
| Reduce the length of the grazing day/grazing season | 7.86 | 0.18 |
| Allow grassland field drainage systems to deteriorate | 7.17 | 0.17 |
| Loosen compacted soil layers in grassland fields | 7.15 | 0.17 |
| Do not apply P fertilisers to high P index soils | 7.06 | 0.17 |
| Management of grassland field corners | 6.92 | 0.16 |
| Integrate fertiliser and manure nutrient supply | 6.46 | 0.15 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 6.46 | 0.15 |
| Establish riparian buffer strips | 6.44 | 0.15 |
| Do not spread FYM to fields at high-risk times | 6.30 | 0.15 |
| Establish new hedges | 6.04 | 0.14 |
| **Dairy (on grassland, fertiliser applied)** | | |
| Use slurry injection application techniques | 17.10 | 0.60 |
| Establish riparian buffer strips | 13.92 | 0.48 |
| Do not apply P fertilisers to high P index soils | 12.24 | 0.43 |
| Loosen compacted soil layers in grassland fields | 12.22 | 0.43 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 12.04 | 0.42 |
| Minimise the volume of dirty water produced (sent to slurry store) | 12.04 | 0.42 |
| Management of grassland field corners | 11.95 | 0.42 |
| Reduce the length of the grazing day/grazing season | 11.86 | 0.41 |
| Fence off rivers and streams from livestock | 11.73 | 0.41 |
| Integrate fertiliser and manure nutrient supply | 11.72 | 0.41 |

***Most effective measures for farms in 1200-1500mm rainfall areas***

Land use is predominantly upland or lowland grassland and Farmscoper Upscale V5 create results show that there are 127 extensive grazing, 6 dairy farms and 1 pig and poultry farm in the Wye catchment in the areas with 1200 to 1500mm annual rainfall.

The following failing waterbody catchments are within the 1200-1500mm annual rainfall area within the Upper Wye catchment (refer to Figure 14 for location of water body catchments that corresponds to the reference numbers below)

- Lower catchment of 3. *Afon Chwefru - source to conf R Irfon.*
- Lower catchment of 33. *Wye - conf Afon Elan to conf R Ithon.*
- Upper catchment of 16. *Nantmel Dulas - source to conf R Ithon.*
- 9. *Clywedog Bk - source to conf Bachell Bk.*
- Upper catchment of 14. *Ithon - source to conf Llaethdy Bk*.
- Upper catchment of 21. *Clettwr Bk - source to conf R Wye.*
- Upper catchment of 26. *Scithwen Bk - source to conf R Wye.*

Within the above waterbodies the top  most effective individual mitigation measures to implement on each farm type depending on their fertiliser practices and land use is provided in Table 18.

Table 18 Top ten mitigation measures that can be implemented on the different farm types within the failing waterbodies in the Upper Wye catchment in areas with 1200-1500mm rainfall per year, and the respective load reduction that can be achieved relative to the baseline.

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| **Extensive Grazing (no fertilisers)** | | |
| Reduce the length of the grazing day/grazing season | 7.98 | 0.13 |
| Loosen compacted soil layers in grassland fields | 7.35 | 0.12 |
| Management of grassland field corners | 7.05 | 0.11 |
| Do not spread FYM to fields at high-risk times | 6.64 | 0.10 |
| Fence off rivers and streams from livestock | 6.38 | 0.10 |
| Establish riparian buffer strips | 6.32 | 0.10 |
| Construct troughs with concrete base | 6.28 | 0.10 |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 6.22 | 0.10 |
| Establish new hedges | 6.18 | 0.10 |
| Establish and maintain artificial wetlands - steading runoff | 6.18 | 0.10 |
| **Extensive Grazing (fertilisers applied)** | | |
| Reduce the length of the grazing day/grazing season | 7.98 | 0.13 |
| Allow grassland field drainage systems to deteriorate | 7.39 | 0.12 |
| Loosen compacted soil layers in grassland fields | 7.35 | 0.12 |
| Do not apply P fertilisers to high P index soils | 7.15 | 0.11 |
| Management of grassland field corners | 7.05 | 0.11 |
| Integrate fertiliser and manure nutrient supply | 6.73 | 0.11 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 6.73 | 0.11 |
| Do not spread FYM to fields at high-risk times | 6.64 | 0.10 |
| Fence off rivers and streams from livestock | 6.38 | 0.10 |
| Establish riparian buffer strips | 6.32 | 0.10 |
| **Dairy (grassland, fertilisers applied)** | | |
| Use slurry injection application techniques | 18.83 | 0.42 |
| Establish riparian buffer strips | 12.94 | 0.29 |
| Loosen compacted soil layers in grassland fields | 12.38 | 0.28 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 12.35 | 0.28 |
| Minimise the volume of dirty water produced (sent to slurry store) | 12.35 | 0.28 |
| Do not apply P fertilisers to high P index soils | 12.25 | 0.27 |
| Fence off rivers and streams from livestock | 12.09 | 0.27 |
| Management of grassland field corners | 12.02 | 0.27 |
| Do not spread FYM to fields at high-risk times | 11.89 | 0.27 |
| Integrate fertiliser and manure nutrient supply | 11.88 | 0.27 |
| **Dairy (maize and cereals, fertilisers applied)** | | |
| Establish cover crops in the autumn | 21.2 | 0.48 |
| Use slurry injection application techniques | 18.8 | 0.42 |
| Early harvesting and establishment of crops in the autumn | 14.4 | 0.32 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 14.4 | 0.32 |
| Uncropped cultivated areas | 13.3 | 0.30 |
| Establish riparian buffer strips | 12.9 | 0.29 |

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Adopt reduced cultivation systems | 12.5 | 0.28 |
| Allow grassland field drainage systems to deteriorate | 12.5 | 0.28 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 12.4 | 0.28 |
| Loosen compacted soil layers in grassland fields | 12.4 | 0.28 |
| **Pigs and Poultry (grassland, fertilisers applied)** | | |
| Establish riparian buffer strips | 11.75 | 0.29 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 10.14 | 0.25 |
| Do not apply P fertilisers to high P index soils | 8.83 | 0.22 |
| Incorporate manure into the soil | 8.82 | 0.22 |
| Do not spread slurry or poultry manure at high-risk times | 8.72 | 0.21 |
| Integrate fertiliser and manure nutrient supply | 8.57 | 0.21 |
| Store solid manure heaps on an impermeable base and collect effluent | 8.06 | 0.20 |
| Use correctly-inflated low ground pressure tyres on machinery | 7.87 | 0.19 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 7.76 | 0.19 |
| Loosen compacted soil layers in grassland fields | 7.66 | 0.19 |
| **Pigs and Poultry (arable land)** | | |
| Uncropped cultivated areas | 13.49 | 0.33 |
| Establish cover crops in the autumn | 12.32 | 0.30 |
| Undersown spring cereals | 11.94 | 0.29 |
| Establish riparian buffer strips | 11.75 | 0.29 |
| Adopt reduced cultivation systems | 10.27 | 0.25 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 10.14 | 0.25 |
| Cultivate compacted tillage soils | 8.99 | 0.22 |
| Establish in-field grass buffer strips | 8.94 | 0.22 |
| Do not apply P fertilisers to high P index soils | 8.83 | 0.22 |
| Incorporate manure into the soil | 8.82 | 0.22 |

***<u>Most effective measures for farms in 900-1200mm rainfall areas</u>***

Land use is predominantly upland or lowland grassland, with some arable land. Farmscoper Upscale V5 create results show that there are 47 extensive grazing, two dairy, one pig and poultry and one mixed livestock farm in the Wye catchment in the areas with 900-1200mm annual rainfall.

The following failing waterbody catchments are within the 900-1200mm annual rainfall area within the Upper Wye catchment (refer to Figure 14 for location of water body catchments that corresponds to the reference numbers below):

- Lower catchment of 16. *Nantmel Dulas - source to conf R Ithon.*
- Lower catchment of 14*. Ithon - source to conf Llaethdy Bk.*
- 13. *Ithon - conf Llaethdy Bk to conf Gwenlas Bk.*
- 10. *Gwenlas Bk - source to conf R Ithon.*
- 12. *Ithon – conf Gwenlas Bk to conf Camddwr Bk.*
- 7. *Camddwr Bk - source to conf R Ithon.*
- 6. *Aran - source to conf R Ithon.*
- 15. *Mithil Bk - source to conf R Ithon.*
- 25. *Edw - source to conf Colwyn Bk.*

- 20. *Camnant Brook - source to confluence R Edw.*
- 11. *Howey Bk - source to conf R Ithon.*
- 19. *Builth Dulas Bk - source to conf R Wye.*
- 23. *Edw - conf Camnant Bk to conf Clas Bk.*
- 24. *Edw - conf Clas Bk to conf R Wye.*
- 18. *Bach Howey Bk - source to conf R Wye.*
- 1. *Gilwern Bk - source to conf R Arrow.*
- 2. *Norton Bk - source to conf R Lugg.*
- Upper catchment of 29. *Clyro Bk - source to conf R Wye.*
- 22. *Dulas Bk - source to conf Afon Llynfi.*
- Lower catchment of 21. *Clettwr Bk - source to conf R Wye.*
- Lower catchment of 26. *Scithwen Bk - source to conf R Wye.*
- 27. *Triffrwd - source to Dulas.*
- 28. *Afon Llynfi - source to conf Dulas Bk.*
- Lower catchment of 17. *Afon Llynfi - conf Dulas Bk to conf R Wye.*
- 30. *Digedi Bk - source to conf R Wye.*
- 34. *Llanymynech Bk - source to conf R Trothy.*
- 38. *Tintern Bk - source to conf R Wye.*

Within the above waterbodies the top ten most effective individual mitigation measures to implement on each farm type depending on their fertiliser practices and land use is provided in Table 19.

Table 19 Top ten mitigation measures that can be implemented on the different farm types within the failing waterbodies in the Upper Wye catchment in areas with 900-1200mm rainfall per year, and the respective load reduction that can be achieved relative to the baseline.

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| **Extensive Grazing (no fertilisers)** | | |
| Reduce the length of the grazing day/grazing season | 8.12 | 0.09 |
| Allow grassland field drainage systems to deteriorate | 7.68 | 0.08 |
| Loosen compacted soil layers in grassland fields | 7.65 | 0.08 |
| Management of grassland field corners | 7.26 | 0.08 |
| Do not spread FYM to fields at high-risk times | 7.10 | 0.08 |
| Fence off rivers and streams from livestock | 6.91 | 0.07 |
| Construct troughs with concrete base | 6.66 | 0.07 |
| Establish riparian buffer strips | 6.64 | 0.07 |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 6.57 | 0.07 |
| Establish and maintain artificial wetlands - steading runoff | 6.52 | 0.07 |
| **Extensive Grazing (fertilisers applied)** | | |
| Reduce the length of the grazing day/grazing season | 8.12 | 0.09 |
| Allow grassland field drainage systems to deteriorate | 7.68 | 0.08 |
| Loosen compacted soil layers in grassland fields | 7.65 | 0.08 |
| Do not apply P fertilisers to high P index soils | 7.36 | 0.08 |
| Management of grassland field corners | 7.26 | 0.08 |
| Integrate fertiliser and manure nutrient supply | 7.11 | 0.08 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 7.11 | 0.08 |

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Do not spread FYM to fields at high-risk times | 7.10 | 0.08 |
| Fence off rivers and streams from livestock | 6.91 | 0.07 |
| Construct troughs with concrete base | 6.66 | 0.07 |
| **Dairy (grassland, fertilisers applied)** | | |
| Use slurry injection application techniques | 21.02 | 0.47 |
| Establish riparian buffer strips | 13.81 | 0.31 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 13.41 | 0.30 |
| Minimise the volume of dirty water produced (sent to slurry store) | 13.41 | 0.30 |
| Allow grassland field drainage systems to deteriorate | 13.32 | 0.30 |
| Fence off rivers and streams from livestock | 13.30 | 0.30 |
| Loosen compacted soil layers in grassland fields | 13.26 | 0.30 |
| Do not apply P fertilisers to high P index soils | 13.04 | 0.29 |
| Do not spread FYM to fields at high-risk times | 12.87 | 0.29 |
| Management of grassland field corners | 12.82 | 0.29 |
| **Dairy (maize and cereals, fertilisers applied)** | | |
| Establish cover crops in the autumn | 21.81 | 0.49 |
| Use slurry injection application techniques | 21.02 | 0.47 |
| Early harvesting and establishment of crops in the autumn | 15.19 | 0.34 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 15.18 | 0.34 |
| Uncropped cultivated areas | 14.15 | 0.32 |
| Establish riparian buffer strips | 13.81 | 0.31 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 13.41 | 0.30 |
| Minimise the volume of dirty water produced (sent to slurry store) | 13.41 | 0.30 |
| Adopt reduced cultivation systems | 13.38 | 0.30 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 13.32 | 0.30 |
| **Pigs and Poultry (grassland, fertilisers applied)** | | |
| Establish riparian buffer strips | 12.48 | 0.21 |
| Do not apply P fertilisers to high P index soils | 9.14 | 0.15 |
| Do not spread slurry or poultry manure at high-risk times | 9.11 | 0.15 |
| Integrate fertiliser and manure nutrient supply | 9.05 | 0.15 |
| Incorporate manure into the soil | 9.01 | 0.15 |
| Store solid manure heaps on an impermeable base and collect effluent | 8.71 | 0.15 |
| Use correctly-inflated low ground pressure tyres on machinery | 8.29 | 0.14 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 8.17 | 0.14 |
| Loosen compacted soil layers in grassland fields | 8.00 | 0.14 |
| Allow grassland field drainage systems to deteriorate | 7.97 | 0.14 |
| **Pigs and Poultry (arable land)** | | |
| Uncropped cultivated areas | 13.87 | 0.23 |
| Establish cover crops in the autumn | 12.61 | 0.21 |
| Establish riparian buffer strips | 12.48 | 0.21 |
| Undersown spring cereals | 12.24 | 0.21 |
| Adopt reduced cultivation systems | 10.90 | 0.18 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 10.67 | 0.18 |

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Cultivate compacted tillage soils | 9.56 | 0.16 |
| Establish in-field grass buffer strips | 9.48 | 0.16 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 9.15 | 0.15 |
| Do not apply P fertilisers to high P index soils | 9.14 | 0.15 |
| **Mixed Livestock (arable, fertilisers applied)** | | |
| Establish cover crops in the autumn | 10.94 | 0.19 |
| Uncropped cultivated areas | 9.77 | 0.17 |
| Establish riparian buffer strips | 8.82 | 0.15 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 8.46 | 0.14 |
| Adopt reduced cultivation systems | 8.28 | 0.14 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 8.28 | 0.14 |
| Early harvesting and establishment of crops in the autumn | 8.20 | 0.14 |
| Cultivate compacted tillage soils | 8.20 | 0.14 |
| Do not apply P fertilisers to high P index soils | 8.14 | 0.14 |
| Establish in-field grass buffer strips | 8.03 | 0.14 |
| **Mixed Livestock (grassland, fertilisers applied)** | | |
| Establish riparian buffer strips | 10.94 | 0.19 |
| Do not apply P fertilisers to high P index soils | 8.82 | 0.15 |
| Reduce the length of the grazing day/grazing season | 8.46 | 0.14 |
| Integrate fertiliser and manure nutrient supply | 8.28 | 0.14 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 8.28 | 0.14 |
| Allow grassland field drainage systems to deteriorate | 8.26 | 0.14 |
| Do not spread slurry or poultry manure at high-risk times | 8.20 | 0.14 |
| Loosen compacted soil layers in grassland fields | 8.20 | 0.14 |
| Use slurry injection application techniques | 8.14 | 0.14 |
| Do not spread FYM to fields at high-risk times | 8.03 | 0.14 |

***Most effective measures for farms in 700-900mm rainfall areas***

Land use is predominantly upland or lowland grassland, with some arable land. Farmscoper Upscale V5 create results show that there are 47 extensive grazing, 2 dairy, 1 pig and poultry and 1 mixed livestock farm in the Wye catchment in the areas with 700-900mm annual rainfall.

The following failing waterbody catchments are within the 700-900mm annual rainfall area within the Lower Wye catchment (refer to Figure 14 for location of water body catchments that corresponds to the reference numbers below):

- Lower catchment of 29. *Clyro Bk - source to conf R Wye.*
- Upper catchment of 17. *Afon Llynfi - conf Dulas Bk to conf R Wye.*
- 35. *Llymon Bk - source to conf R Trothy.*
- 36. *Trothy - conf Llanymynach Bk to conf Llymon Bk.*
- 37. *Trothy - conf Llymon Bk to conf R Wye.*

Within the above waterbodies the top ten most effective individual mitigation measures to implement on each farm type depending on their fertiliser practices and land use is provided in Table 20.

Table 20 Top ten mitigation measures that can be implemented on the different farm types within the failing waterbodies in the Lower Wye catchment in areas with 700-900mm rainfall per year, and the respective load reduction that can be achieved relative to the baseline.

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| **Extensive Grazing (no fertilisers)** | | |
| Reduce the length of the grazing day/grazing season | 8.74 | 0.06 |
| Loosen compacted soil layers in grassland fields | 8.50 | 0.06 |
| Allow grassland field drainage systems to deteriorate | 8.34 | 0.05 |
| Fence off rivers and streams from livestock | 8.07 | 0.05 |
| Do not spread FYM to fields at high-risk times | 8.05 | 0.05 |
| Management of grassland field corners | 7.84 | 0.05 |
| Construct troughs with concrete base | 7.53 | 0.05 |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 7.37 | 0.05 |
| Move feeders at regular intervals | 7.30 | 0.05 |
| Establish and maintain artificial wetlands - steading runoff | 7.30 | 0.05 |
| **Extensive Grazing (fertilisers applied)** | | |
| Reduce the length of the grazing day/grazing season | 8.74 | 0.06 |
| Loosen compacted soil layers in grassland fields | 8.50 | 0.06 |
| Allow grassland field drainage systems to deteriorate | 8.34 | 0.05 |
| Fence off rivers and streams from livestock | 8.07 | 0.05 |
| Do not spread FYM to fields at high-risk times | 8.05 | 0.05 |
| Do not apply P fertilisers to high P index soils | 7.92 | 0.05 |
| Integrate fertiliser and manure nutrient supply | 7.91 | 0.05 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 7.91 | 0.05 |
| Management of grassland field corners | 7.84 | 0.05 |
| Construct troughs with concrete base | 7.53 | 0.05 |
| **Dairy (grassland, fertilisers applied)** | | |
| Establish riparian buffer strips | 29.27 | 0.29 |
| Fence off rivers and streams from livestock | 27.26 | 0.27 |
| Reduce the length of the grazing day/grazing season | 24.77 | 0.25 |
| Loosen compacted soil layers in grassland fields | 24.64 | 0.25 |
| Use slurry injection application techniques | 24.38 | 0.24 |
| Construct bridges for livestock crossing rivers/streams | 23.21 | 0.23 |
| Construct troughs with concrete base | 23.11 | 0.23 |
| Do not spread slurry or poultry manure at high-risk times | 22.93 | 0.23 |
| Establish new hedges | 22.81 | 0.23 |
| Move feeders at regular intervals | 22.74 | 0.23 |
| **Dairy (maize and cereals, fertilisers applied)** | | |
| Establish cover crops in the autumn | 43.39 | 0.43 |
| Establish riparian buffer strips | 29.27 | 0.29 |
| Early harvesting and establishment of crops in the autumn | 28.89 | 0.29 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 28.69 | 0.29 |
| Adopt reduced cultivation systems | 28.15 | 0.28 |
| Fence off rivers and streams from livestock | 27.26 | 0.27 |

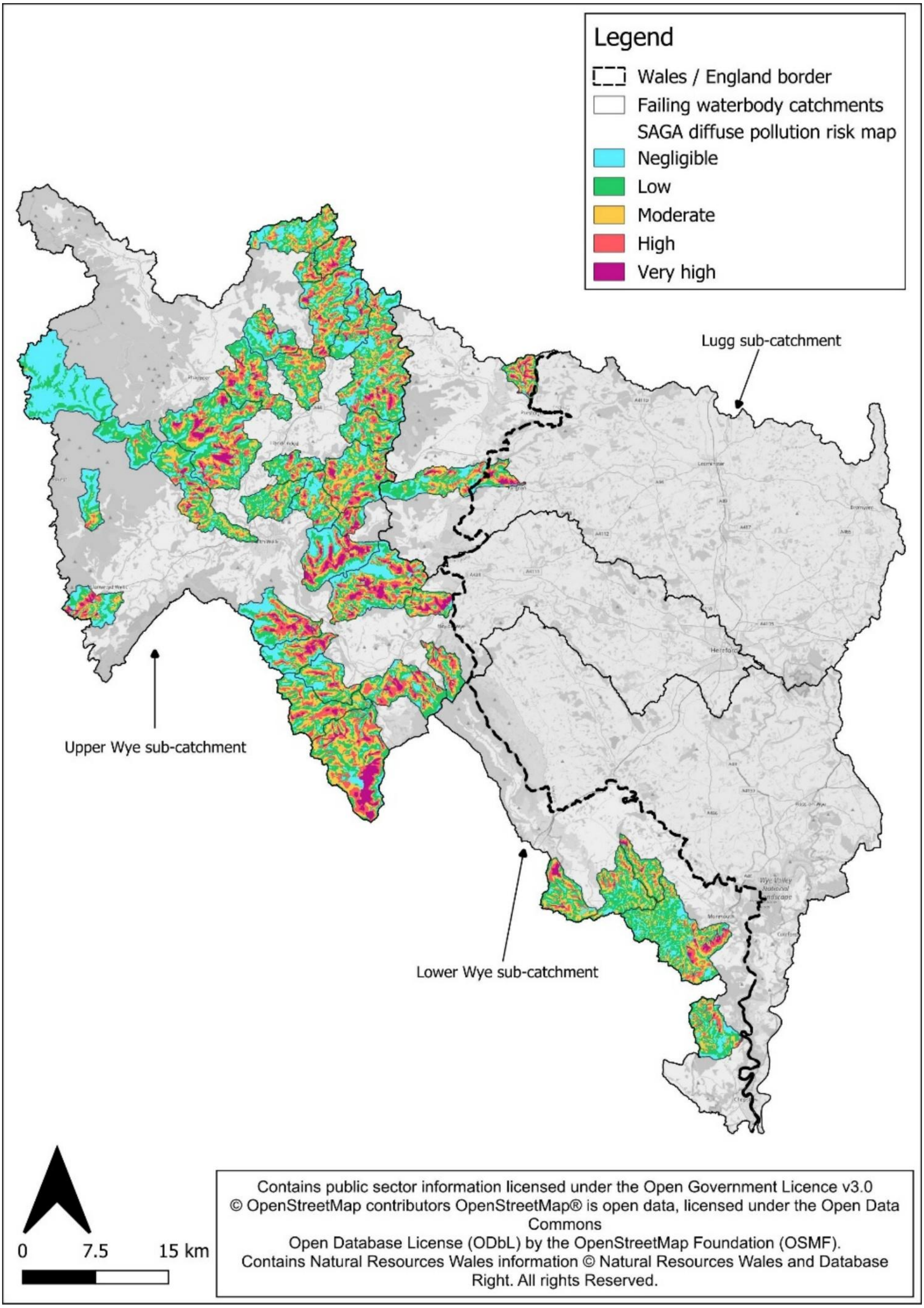
| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Uncropped cultivated areas | 26.56 | 0.26 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 25.97 | 0.26 |
| Cultivate compacted tillage soils | 25.39 | 0.25 |
| Establish in-field grass buffer strips | 25.30 | 0.25 |
| **Pigs and Poultry (grassland, fertilisers applied)** | | |
| Establish riparian buffer strips | 12.24 | 0.13 |
| Do not spread slurry or poultry manure at high-risk times | 9.71 | 0.10 |
| Integrate fertiliser and manure nutrient supply | 9.69 | 0.10 |
| Do not apply P fertilisers to high P index soils | 9.48 | 0.10 |
| Incorporate manure into the soil | 9.43 | 0.10 |
| Store solid manure heaps on an impermeable base and collect effluent | 9.31 | 0.10 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 8.65 | 0.09 |
| Use correctly-inflated low ground pressure tyres on machinery | 8.53 | 0.09 |
| Loosen compacted soil layers in grassland fields | 8.40 | 0.09 |
| Allow grassland field drainage systems to deteriorate | 8.33 | 0.09 |
| **Pigs and Poultry (arable land)** | | |
| Uncropped cultivated areas | 14.22 | 0.15 |
| Establish cover crops in the autumn | 12.95 | 0.13 |
| Undersown spring cereals | 12.58 | 0.13 |
| Establish riparian buffer strips | 12.24 | 0.13 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 10.75 | 0.11 |
| Adopt reduced cultivation systems | 10.60 | 0.11 |
| Do not spread slurry or poultry manure at high-risk times | 9.71 | 0.10 |
| Cultivate compacted tillage soils | 9.69 | 0.10 |
| Integrate fertiliser and manure nutrient supply | 9.69 | 0.10 |
| Establish in-field grass buffer strips | 9.53 | 0.10 |
| **Mixed Livestock (arable, fertilisers applied)** | | |
| Establish cover crops in the autumn | 17.21 | 0.16 |
| Uncropped cultivated areas | 12.30 | 0.11 |
| Establish riparian buffer strips | 10.81 | 0.10 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 10.80 | 0.10 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 9.94 | 0.09 |
| Adopt reduced cultivation systems | 9.72 | 0.09 |
| Early harvesting and establishment of crops in the autumn | 9.35 | 0.09 |
| Do not apply P fertilisers to high P index soils | 9.19 | 0.09 |
| Cultivate compacted tillage soils | 9.02 | 0.08 |
| Establish in-field grass buffer strips | 8.95 | 0.08 |
| | | |
| Establish riparian buffer strips | 10.81 | 0.10 |
| Do not apply P fertilisers to high P index soils | 9.19 | 0.09 |
| Reduce the length of the grazing day/grazing season | 8.83 | 0.08 |
| Integrate fertiliser and manure nutrient supply | 8.81 | 0.08 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 8.81 | 0.08 |

| Top ten measures per farm type | Load reduction (%) | Load reduction per ha (kg) |
|---|---|---|
| Do not spread slurry or poultry manure at high-risk times | 8.80 | 0.08 |
| Use slurry injection application techniques | 8.76 | 0.08 |
| Loosen compacted soil layers in grassland fields | 8.71 | 0.08 |
| Allow grassland field drainage systems to deteriorate | 8.66 | 0.08 |
| Fence off rivers and streams from livestock | 8.62 | 0.08 |
| **Arable (fertilisers applied)** | | |
| Establish cover crops in the autumn | 18.77 | 0.15 |
| Uncropped cultivated areas | 13.16 | 0.10 |
| Establish riparian buffer strips | 10.25 | 0.08 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 9.27 | 0.07 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 8.42 | 0.07 |
| Adopt reduced cultivation systems | 8.33 | 0.07 |
| Cultivate compacted tillage soils | 6.96 | 0.06 |
| Do not apply P fertilisers to high P index soils | 6.87 | 0.05 |
| Establish in-field grass buffer strips | 6.87 | 0.05 |
| Early harvesting and establishment of crops in the autumn | 6.87 | 0.05 |

*Locations of mitigation measures*

Mitigation measures should first be targeted at the highest risk areas of soil and nutrient run-off, to maximise the impact of measures to reduce diffuse pollution from agriculture to the water environment. Using the SAGA GIS diffuse risk map model, a diffuse pollution risk map was created for the whole Wye catchment and then clipped to the failing waterbodies to highlight high priorities areas within the Welsh Wye catchment (see Figure 18). The model calculates the highest risk areas for soil erosion and surface water connectivity based on soil type, slope and land cover. The dark purple areas on the map indicate the areas of highest risk for sediment and soil-bound run-off, therefore these are the areas that should be prioritised for implementing mitigation measures that aim to intercept sediment and nutrient run-off or reduce nutrients applied to land.

Figure 18: SAGA diffuse pollution risk map for failing waterbody catchments



## 5.2 WASTEWATER MEASURES

Phosphorus removal schemes have been identified under plans that were based on relevant environmental needs using the best available data at the time of the price review (PR24) in readiness from AMP8 (2020 – 2025). DCWW works with their environmental regulators, NRW and the EA, to develop an investment programme to protect and restore environmental failures which could be as a result of operations. Most of the schemes listed below were agreed for investment to meet the requirements of the WFD and SAC compliance.

The Upper and Lower Wye had the highest number of scheme commitments of all SAC catchments in DCWW's operating area between 2020-2025. These also included additional drivers such as monitoring, storm overflow investigation and schemes to prepare for growth. DCWW introduced accelerated funding of £60 million that was committed at the First Minister's Phosphorus Summit in 2022; this meant these schemes (i.e. Monmouth STW) that would have been due for 2030 was brought forward for completion in 2025.

In February 2023, NRW published details of a proposed review of existing environmental permits against the revised water quality targets for SAC rivers. This work was done as an appropriate measure under Article 6(2) of the Habitats Directive in Wales and was completed in June 2024. It resulted in tighter phosphorus limits being placed on STW Environmental Permits for 31 assets that discharge to a SAC river with over $20m^3$ per day dry weather flow (NRW, 2024d).

DCWW produced a Phosphorus Reduction programme for all SAC rivers with the aim of reducing their '*fair share'* by 2032. This consisted of 17 STW that will receive new tighter phosphorus limits. In addition, 14 backstop limits of 5mg/l phosphorus were introduced to prevent deterioration of the River Wye.

There is currently no proposal to review the environmental permits for the majority of smaller STW (those with flows less than $20m^3$ per day that did not require a phosphorus limit in order to achieve 'fair share'). Therefore, the discharges from these STW will remain without phosphorus limits on their permits and development proposals connecting to such a works will need to demonstrate nutrient neutrality. If future development results in $20m^3$ DWF being met, a backstop condition in the permit would also be needed.

### 5.2.1 Mitigation measures undertaken to date

*AMP7 STW upgrades*

AMP7 upgrades consisted of 11 STW, six of which are located in England and have therefore not been considered. There is one STW located in the Lower Wye, one in the Lugg and three in the Upper Wye sub-catchments (see Figure 19 ). No AMP7 upgrades were located within the failing waterbodies. The total load reduction achieved from AMP7 STW upgrades in the Welsh Wye was 8,975kg P/yr (see Table 21 for more detail).

Figure 19: AMP7 STW upgrades in Wales

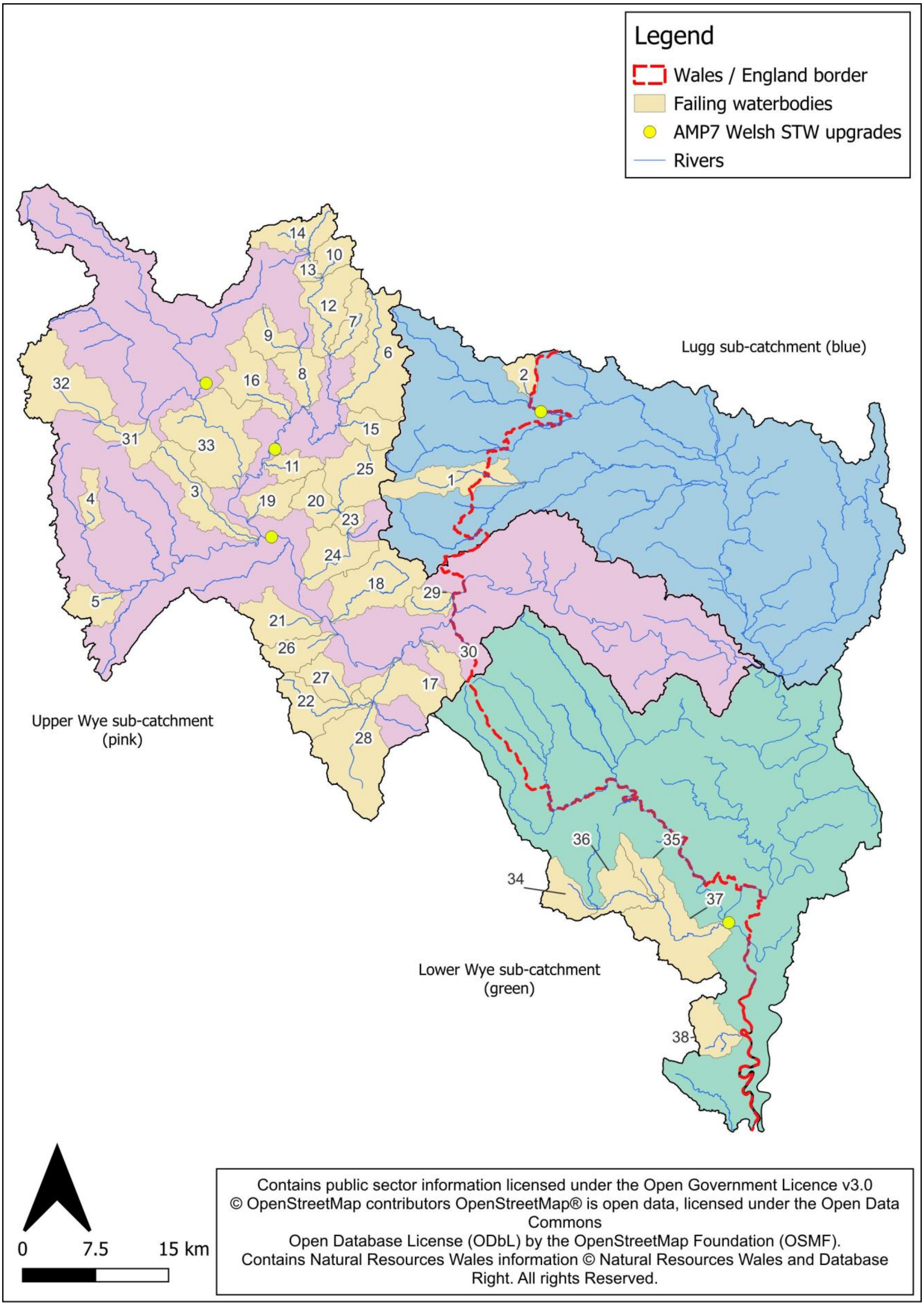


Table 21 Load reductions achieved from AMP7 sewerage treatment works upgrades

| Sub-Catchment | Water body catchment | Sewage treatment works | Current load (kg P/yr) | New load (kg P/yr) | Load reduction achieved (kg P/yr) |
|---|---|---|---|---|---|
| Lower Wye | *Wye - conf Walford Bk to Bigsweir Br* | Monmouth Redbrook Road | 6,495 | 2,598 | 3,894 |
| Lugg | *Lugg - conf Norton Bk to conf R Arrow* | Presteigne | 2,602 | 520 | 2,081 |
| Upper Wye | *Wye - conf R Irfon to Scithwen Bk* | Builth Wells | 3,703 | 1,851 | 1,850 |
| | *Ithon - conf Camddwr Bk to conf R Wye* | Llandrindod Wells STW Park Lane | 1,022 | 654 | 368 |
| | *Wye - conf to conf Afon Marteg to conf Afon Elan* | Rhayader | 1,956 | 1,174 | 782 |

### 5.2.2 Future mitigation measures

*Planned AMP8 STW upgrades*

In DCWW's current investment cycle (AMP8: 2025-30), they are investing more than £120 million on sites to improve the Wye. This includes more than £55m on further projects to remove phosphorous, more than £55 million targeted on storm overflows and a further £10m on improving final treated effluent before it is returned to the river. This includes the following improvements:

- **Storm overflows –** sites that were identified from DCWW's Storm Overflow Assessment Framework investigation 2020 – 2025, 12 sites will receive schemes in the Wye catchment for 2025 - 2030.
- **Phosphorous –** there will be a larger number of sites in the Wye catchment that will receive investment over the coming five years. However, the overall cost of the work will be lower. After prioritising the larger sites in AMP7, DCWW now see a variation of schemes to meet new tighter P limits along with work to maintain backstop limits etc. The work will also support reductions in ammonia, BOD and suspended solids.

To calculate the load reduction that can be achieved from planned AMP8 STW upgrades in the Upper Wye catchment, data was shared on NRW and DCWW's asset management programme investment. Using the 2030 proposed permit limit, and the current permitted limit and dry weather flow from the Permitted Discharges Register (NRW, 2025d), the current and proposed loads were calculated and compared to indicate the potential load reduction achieved from the STW upgrades. To calculate the current and proposed loads, the Dry Weather Flow of the works was multiplied by 1.25 to convert it to a permitted average and then the following equation was used:

$$Phosphorus\ load\ (kg) = flow\ (m3)\ \times\ 1{,}000\ \times\ concentration\ (mg/l)\ /\ 1{,}000{,}000\ \times\ 365$$

Further detail on the current and 2030 permit limits are highlighted in Appendix J.

In the Upper Wye catchment, there are 12 STW upgrades planned for completion in 2030 and two STW upgrades planned for completion in 2032, ten of which are located within the failing waterbody catchments (See Figure 20). Four of the upgrades achieve a 20% reduction in phosphorus load, two achieve a 30%

reduction, two achieve a 40% reduction, two achieve a 60% reduction, one achieves an 80% reduction, one achieves an 84% reduction, one achieves an 88% reduction, and one achieves a 90% reduction. All AMP8 upgrades contribute to a total reduction of 1,790kg P/yr in the Upper Wye sub-catchment and a load reduction of 877kg P/yr in the failing waterbody catchments (calculated based on current and future maximum permitted loads, this approach is relatively conservative and reflects the maximum possible load, under normal operation loads ae likely to be lower).

The planned permit reduction limits for all ten STW within the failing waterbody catchments will achieve their fair share targets based on SAGIS modelling and fair share methodologies agreed between DCWW and NRW to inform AMP8 investments. Table 22 details the reduction achieved from AMP8 upgrades in the Upper Wye catchment.

Figure 20: AMP8 STW upgrades

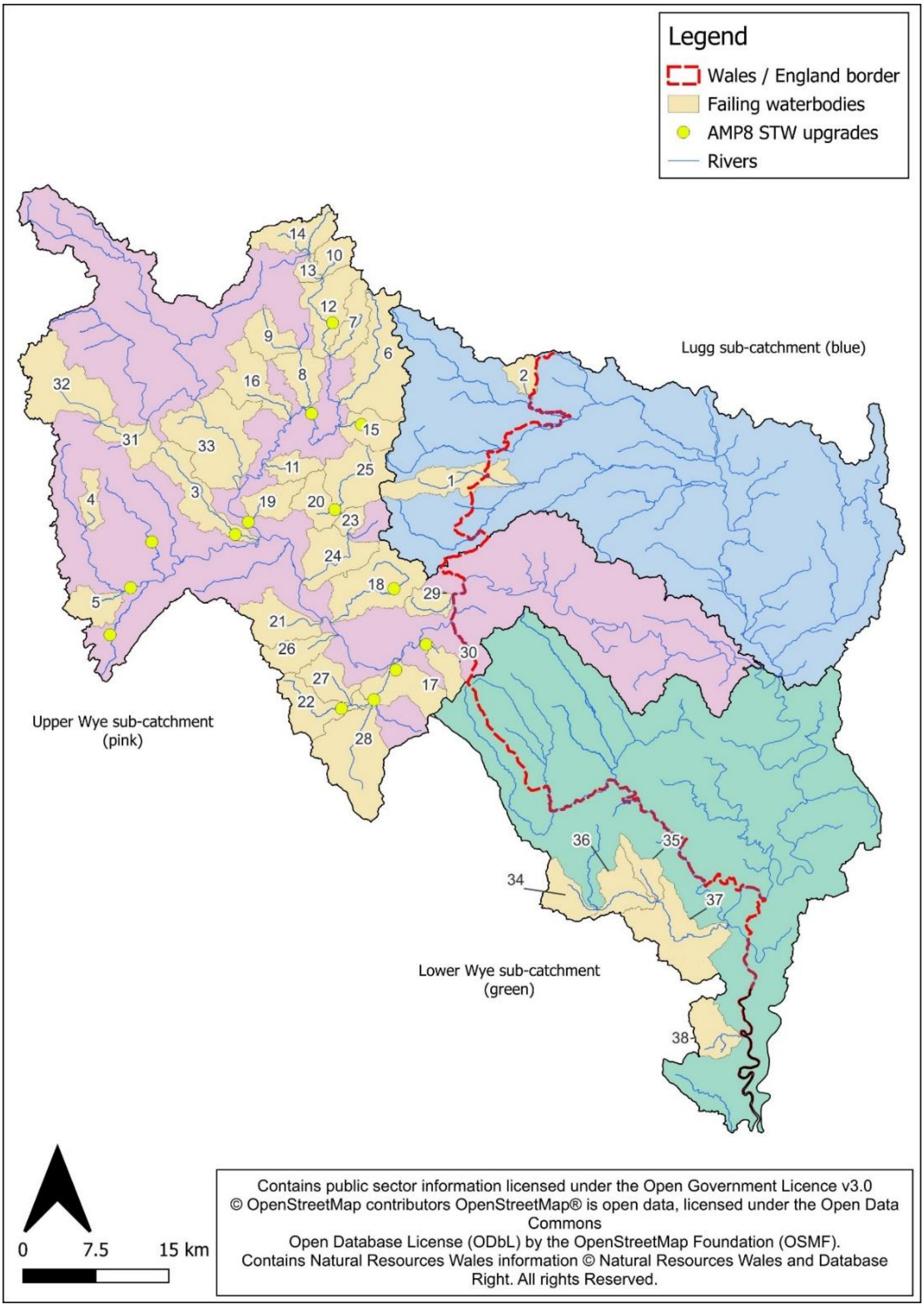



Table 22

Estimated load reduction achieved from AMP8 sewerage treatment work upgrades in the Upper Wye sub-catchment for failing waterbodies compared to sector load reduction targets.

| Water body catchment | Sewerage treatment works | Load reduction achieved (kg P/yr) | Percentage load reduction achieved |
|---|---|---|---|
| 17. *Afon Llynfi - conf Dulas Bk to conf R Wye* | Aberllynfi (Three Cocks) STW | 45 | 30% |

| Water body catchment | Sewerage treatment works | Load reduction achieved (kg P/yr) | Percentage load reduction achieved |
|---|---|---|---|
| | Talgarth STW | 671 | 87% |
| 12. *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | Llanbister STW | 7 | 20% |
| 19. *Builth Dulas Bk - source to conf R Wye* | Builth Road STW | 24 | 40% |
| 20. *Camnant Brook - source to confluence R Edw* | Hundred House STW | 2 | 20% |
| 3. *Afon Chwefru - source to conf R Irfon* | Cilmery STW | 10 | 20% |
| 30. *Digedi Bk - source to conf R Wye* | Llanigon STW | 66 | 90% |
| 18. *Bach Howey Bk - source to conf R Wye* | Painscastle STW | 10 | 30% |
| 15. *Mithil Bk - source to conf R Ithon* | Llandegley STW | 24 | 80% |
| 22. *Dulas Bk - source to conf Afon Llynfi* | Llanfilo STW | 18 | 60% |

In addition to the above measures planned for AMP8, DCWW are also implementing P permit limits through introducing a 5mg/l backstop limit on seven sites in the Wye catchment, without a current phosphorus condition contained within the permit to prevent deterioration (see Figure 21). Two of these sites are located within failing waterbodies (see Table 23). Additionally, storm overflow improvements have been undertaken at 12 sites (see Figure 22). The impact of these upgrades cannot be quantified as no baseline monitoring of phosphorus concentrations in final treated effluent has been undertaken and these sites do not currently have phosphorus permits. Note the sites and number of sites are subject to change

Table 23 P backstop limits (5mg/l) for STWs in failing waterbodies, to reduce phosphorus concentration in final treated effluent.

| Sub-catchment | Operational catchment | STW | Permit number |
|---|---|---|---|
| Upper Wye | Wye source to Ithon | Newbridge-on-Wye | AW1004401 |
| | Wye Ithon to Hay | Clyro | AW1000901 |

Figure 21: DCWW AMP8 backstop limits

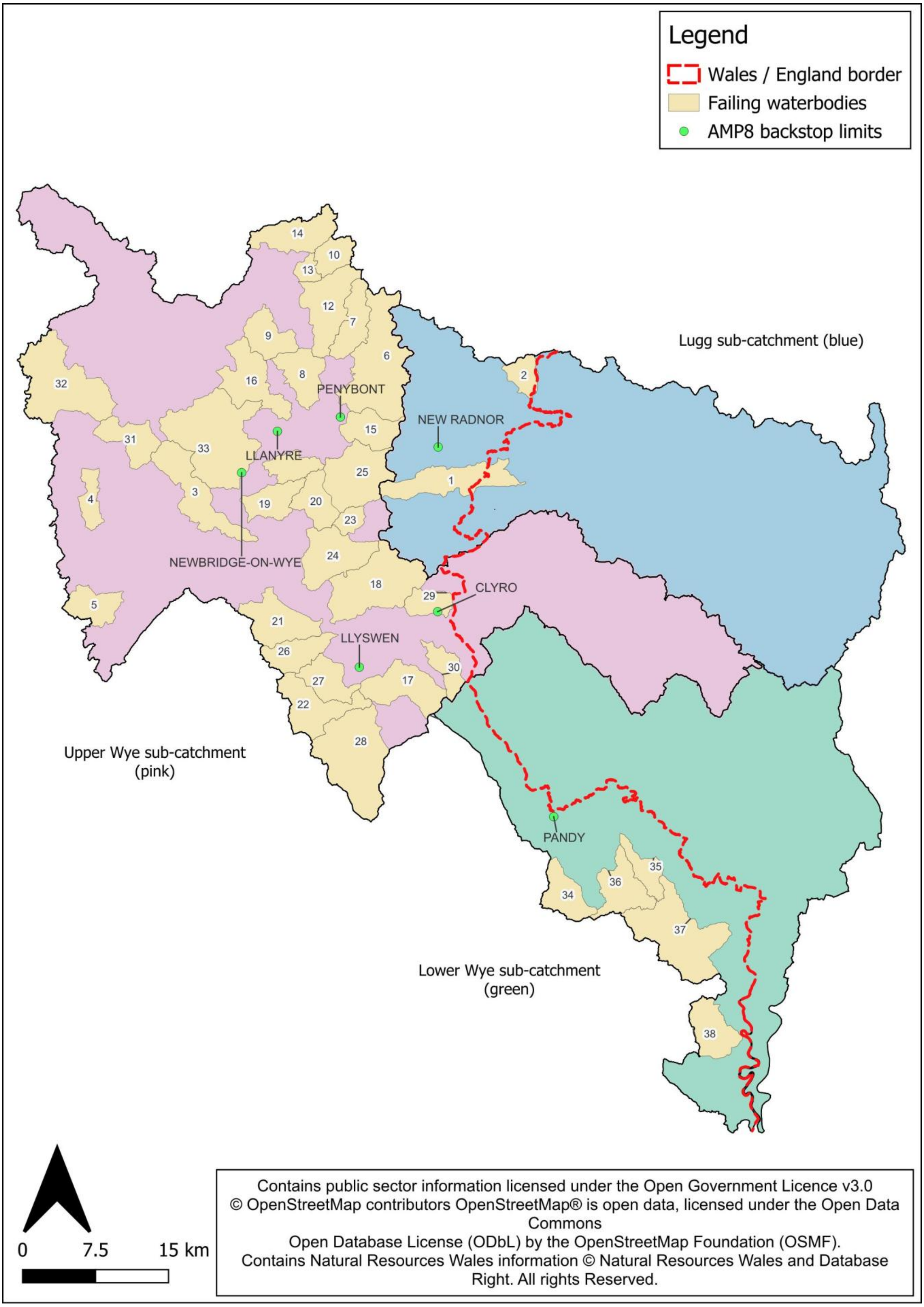



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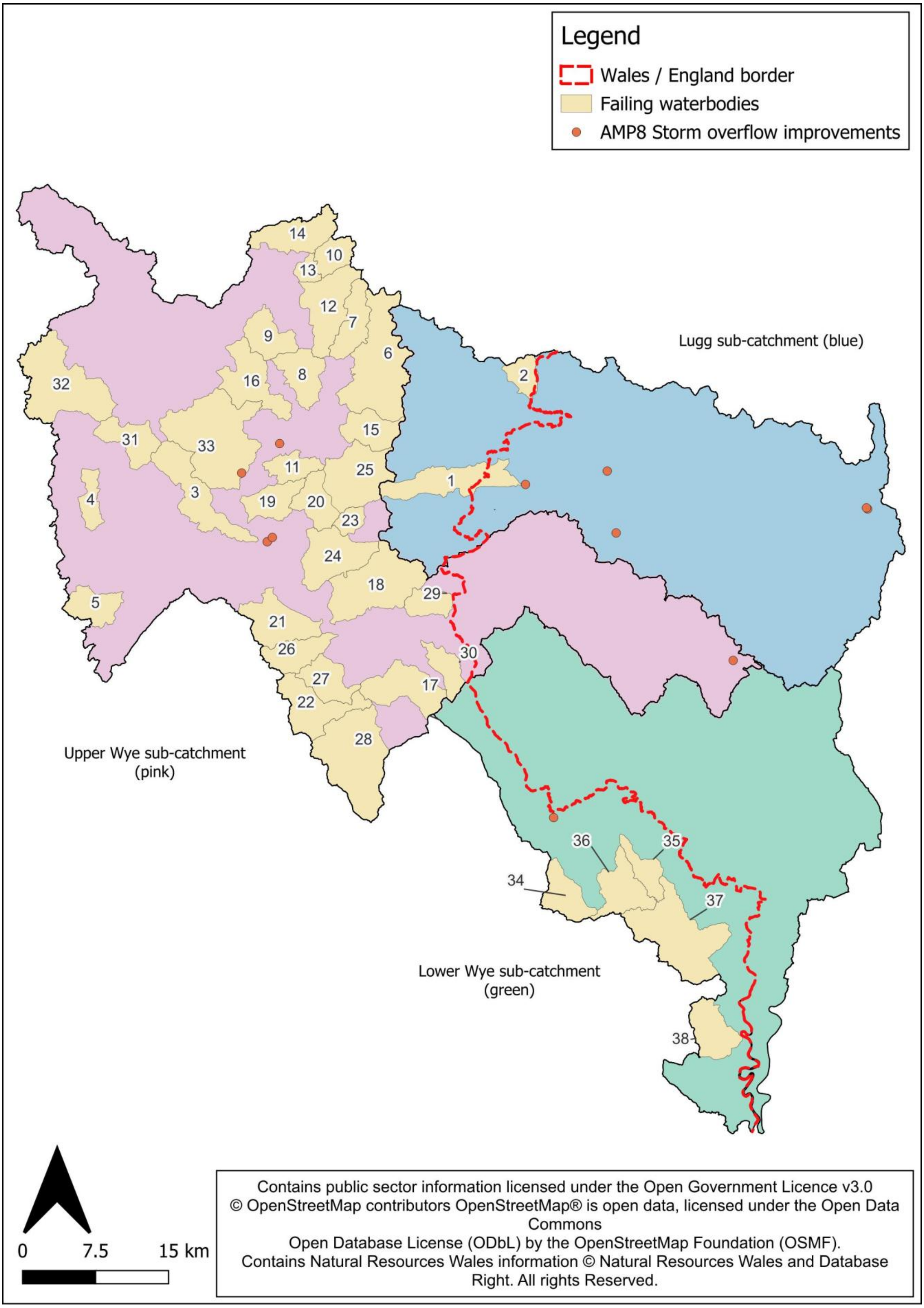
Figure 22: DCWW AMP8 storm overflow improvements



## 5.3 OTHER MEASURES

### 5.3.1 Mitigation measures undertaken to date

There is no current record of ST or package treatment plan upgrades that will reduce the phosphorus load from *"Other"* sources.

### 5.3.2 Potential mitigation measures

*Private sewerage system upgrades*

Older private sewerage systems (PSS) are likely to leak and discharge phosphorus into surface waters and heavily rely on regular maintenance to ensure no additional nutrients are entering the catchment. However, newer systems provide manufacturer guarantees of nutrients in the effluent, some as low as 0.4mg total phosphorus per litre (GRAF, 2023). To assess the potential load reduction that can be achieved from PSS upgrades, open-source data was collated from the Permitted Discharges Register (NRW, 2025d) and the Water Quality Exemptions register (NRW, 2025b), then plotted on QGIS 3.38.3 (QGIS Development Team, 2025). This helped to identify all PSS (ST and PTP) with an Environmental Permit to Discharge or operating under the General Binding Rules within the Wye catchment. ST that discharge into groundwater were excluded due to minimal connectivity to groundwater within the Upper Wye catchment (see Section 4.3.1).

Three ST were identified in the Upper Wye sub-catchment and one ST was identified in the Lower Wye sub-catchment, contributing a total of 23kg P/yr (See Figure 16). A total of 103 PTP were identified, 73 of which are located in the Upper Wye sub-catchment contributing 1,112 kg P/yr. Two are located in the Lugg sub-catchment, contributing a total of 21kg P/yr and, 28 are located in the Lower Wye sub-catchment contributing a total of 414kg P/yr. In total PTP contribute 1,565kg P/yr in the Wye catchment (see Figure 17)

The total phosphorus load from PSS was calculated using default PTP and ST concentrations obtained from the Wales Nutrient Budget Calculator (Herefordshire Council, 2019), and flow rates were obtained from the Permitted Discharges Register (NRW, 2025d) and the Water Quality Exemptions Register (NRW, 2025b). The load reduction that can be achieved from upgrades in each failing waterbody where registered PSS are located in, is provided in Table 24 and is calculated based on assumptions detailed in Appendix K (see Appendix K for further detail on load calculations of individual PSS). The results show that upgrading PSS within the catchment can reduce phosphorus inputs by 96 to 97%.

Upgrading PSS at individual properties has been estimated to cost around £4,500 per unit for a 3 to 4 bedroom house (Neilberg, 2025). The monetary benefit of reducing phosphorus loads to watercourses from agricultural sources has been estimated to be £50.48 per kilogram of phosphorus (calculated to 2025 values using Bank of England, 2025) (Defra, 2025). Although this value has been attributed to agricultural sources of phosphorus, the value represents the economic benefit from reducing phosphorus pollution per kilogram for drinking water quality, fishing, bathing water quality and eutrophication reduction (Defra, 2025). Using this value, a cost benefit analysis of PSS upgrades compared to the monetary benefits of phosphorus reduction has been completed to assess economic feasibility. The results displayed in Table 24 show that is it not cost beneficial to upgrade PSS when the cost is compared to the potential monetary benefit from phosphorus reductions.

It is important to note, that although PSS systems contribute less than 10% of nutrient loads in the failing waterbodies, temporal variations in nutrient loading may significantly increase in-stream nutrient concentrations particularly in low flow periods. In addition, although only PSS with a permit to discharge to controlled waters is assessed here, there is an uncertain number of additional systems operating within the catchment that do not require registration due to their size. Underestimating the number of ST can lead to an overestimation of contribution from diffuse sources, such as agriculture (Withers *et al.,* 2012).

Table 24 Estimated load reduction using modelled SAGIS contributions and cost-benefit analysis of upgrading PSS systems

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Number of PSS | SAGIS percentage contribution from ST | Total current load (kg) | Total upgraded load (kg) | Total load reduction (kg P/yr) | Total estimated cost | Total water quality benefit | Cost benefit ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lugg | Arrow Lugg Frome | 1 | *Gilwern Bk - source to conf R Arrow* | 2 | 6.3% | 21 | 1 | 20 | £9,000 | £1,022 | 0.11 |
| Upper Wye | Irfon | 3 | *Afon Chwefru - source to conf R Irfon* | 1 | 1.4% | 18 | 1 | 17 | £4,500 | £857 | 0.19 |
| | | 4 | *Afon Gwesyn - source to conf R Irfon* | 1 | 2.3% | 10 | 0 | 10 | £4,500 | £496 | 0.11 |
| | | 5 | *Cledan - source to conf R Irfon* | 2 | 2.6% | 35 | 1 | 34 | £9,000 | £1,715 | 0.19 |
| | | 6 | *Aran - source to conf R Ithon* | 8 | 0.4% | 134 | 5 | 128 | £36,000 | £6,486 | 0.18 |
| | | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | 2 | 1.4% | 45 | 2 | 43 | £9,000 | £2,179 | 0.24 |
| | | 9 | *Clywedog Bk - source to conf Bachell Bk* | 2 | 0.6% | 35 | 1 | 34 | £9,000 | £1,715 | 0.19 |
| | | 11 | *Howey Bk - source to conf R Ithon* | 1 | 0.3% | 18 | 1 | 17 | £4,500 | £857 | 0.19 |
| | | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 4 | 0.3% | 54 | 2 | 52 | £18,000 | £2,613 | 0.15 |
| | | 15 | *Mithil Bk - source to conf R Ithon* | 1 | 0.6% | 18 | 1 | 17 | £4,500 | £857 | 0.19 |
| | | 16 | *Nantmel Dulas - source to conf R Ithon* | 2 | 1.6% | 22 | 1 | 21 | £9,000 | £1,064 | 0.12 |
| | Wye Ithon to Hay | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | 7 | 4.8% | 143 | 5 | 138 | £31,500 | £6,960 | 0.22 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Number of PSS | SAGIS percentage contribution from ST | Total current load (kg) | Total upgraded load (kg) | Total load reduction (kg P/yr) | Total estimated cost | Total water quality benefit | Cost benefit ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 18 | *Bach Howey Bk - source to conf R Wye* | 2 | 5.7% | 21 | 1 | 20 | £9,000 | £1,002 | 0.11 |
| | | 19 | *Builth Dulas Bk - source to conf R Wye* | 4 | 0.8% | 71 | 3 | 68 | £18,000 | £3,429 | 0.19 |
| | | 22 | *Dulas Bk - source to conf Afon Llynfi* | 5 | 6.3% | 93 | 3 | 89 | £22,500 | £4,503 | 0.20 |
| | | 24 | *Edw - conf Clas Bk to conf R Wye* | 2 | 0.5% | 8 | 0 | 8 | £9,000 | £413 | 0.05 |
| | | 25 | *Edw - source to conf Colwyn Bk* | 7 | 1.1% | 74 | 3 | 71 | £31,500 | £3,605 | 0.11 |
| | | 26 | *Scithwen Bk - source to conf R Wye* | 1 | 3.1% | 18 | 1 | 17 | £4,500 | £857 | 0.19 |
| | | 27 | *Triffrwd - source to Dulas* | 2 | 4.7% | 48 | 2 | 46 | £9,000 | £2,344 | 0.26 |
| | | 28 | *Afon Llynfi - source to conf Dulas Bk* | 7 | 7.2% | 96 | 4 | 92 | £31,500 | £4,662 | 0.15 |
| | | 29 | *Clyro Bk - source to conf R Wye* | 2 | 5.3% | 24 | 1 | 23 | £9,000 | £1,167 | 0.13 |
| | | 30 | *Digedi Bk - source to conf R Wye* | 2 | 7.2% | 26 | 1 | 25 | £9,000 | £1,270 | 0.14 |
| | Wye Source to Ithon | 33 | *Wye - conf Afon Elan to conf R Ithon* | 11 | 0.9% | 136 | 5 | 130 | £49,500 | £6,569 | 0.13 |
| Lower Wye | Trothy | 34 | *Llanymynech Bk - source to conf R Trothy* | 4 | 5.1% | 59 | 2 | 57 | £18,000 | £2,882 | 0.16 |
| | | 35 | *Llymon Bk - source to conf R Trothy* | 5 | 2.8% | 89 | 4 | 85 | £22,500 | £4,287 | 0.19 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Number of PSS | SAGIS percentage contribution from ST | Total current load (kg) | Total upgraded load (kg) | Total load reduction (kg P/yr) | Total estimated cost | Total water quality benefit | Cost benefit ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | 2 | 4.3% | 35 | 1 | 34 | £9,000 | £1,715 | 0.19 |
| | | 37 | *Trothy - conf Llymon Bk to conf R Wye* | 14 | 3.7% | 190 | 8 | 183 | £63,000 | £9,225 | 0.15 |
| | Wye OP Catchment | 38 | *Tintern Bk - source to conf R Wye* | 4 | 24.9% | 47 | 2 | 45 | £18,000 | £2,262 | 0.13 |

## 5.4 LEGISLATIVE MEASURES: WATER PROTECTION ZONES

A Water Protection Zone (WPZ) is a statutory designation under Section 93 of the Water Resources Act 1991 which can be applied to a river or it’s catchment area to prohibit or regulate polluting activities that could cause harm to water quality and the water environment (Gov, 2025a). A WPZ can be created if it is necessary to stop polluting substances causing environmental harm. Although significant progress has been and will be made to reduce phosphorus pollution in the Wye, the mitigation measures appraised here are not enough to achieve SAC and WFD compliance for all failing waterbodies in the Wye catchment. Therefore, a WPZ may need to be considered by the Welsh Ministers if NRW apply for one in the Welsh part of the Wye catchment.

A WPZ can set rules to ban or restrict activities that may damage the water environment, require sectors to implement actions that aim to protect the water environment, and make it a criminal offence to breach the rules imposed (Gov, 2025a). The following sections outline controls which could be imposed on the sectors

The River Dee WPZ is currently the only one of its kind in the UK, whereby consents are required to carry out controlled activities at industrial or research and development sites, storage or distribution centres and for sites which store or treat water, surface water, effluent or sewage. Inorganic fertilisers are included in the list of controlled substances (which could contain phosphorus) alongside dangerous, medicinal, cosmetic, toxic, corrosive, harmful and irritant substances. Retail, construction and agricultural sites are exempt, and orders do not apply for activities permitted under the Environmental Permitting Regulations 2010. The following sections describe potential controls that could be applied to each sector to reduce diffuse and point source pollution in the River Wye.

### 5.4.1 Agricultural controls

The following mitigation measures assessed in this report that currently apply to the agricultural sector under The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021, Silage, Slurry and Agricultural Fuel Oil (SSAFO) Regulations 2010 and The Environmental Permitting (England and Wales) Regulations 2016 are:

- Fertiliser spreader calibration,
- Use a fertiliser recommendation system,
- Integrate fertiliser and manure nutrient supply,
- Do not apply manufactured fertiliser to high-risk areas,
- Avoid spreading manufactured fertiliser to fields at high-risk times,
- Do not apply P fertilisers to high P index soils,
- Increase the capacity of farm slurry stores to improve timing of slurry applications,
- Minimise the volume of dirty water produced (sent to dirty water store),
- Minimise the volume of dirty water produced (sent to slurry store),
- Site solid manure heaps away from watercourses/field drains,
- Manure Spreader Calibration,
- Do not apply manure to high-risk areas,
- Do not spread slurry or poultry manure at high-risk times,
- Do not spread FYM to fields at high-risk times,
- Incorporate manure into the soil,
- Capture of dirty water in a dirty water store.

The above measures ensure that farmers:

- Maintain up to date risk maps for inorganic and organic fertiliser applications (slope, locations of watercourses, land drains, boreholes, wells, springs, manure heaps),
- Observe buffer zones for watercourses, boreholes, wells or springs,
- Apply manures using techniques that reduce risks of nutrient run-off or leaching (low trajectory slurry spreading, incorporation of manures, closed periods, nitrogen limits, nutrient records),
- Store manures in a way that reduces risks of nutrient run-off or leaching (field heap site, slurry, manure and silage store construction,
- Observe permits for intensive poultry or pig units to prevent pollution.

The existing level of compliance with the current legislation is 40.8% (Welsh government, 2025a). Improving the level of compliance was estimated to reduce phosphorus loading from agriculture by 13% across the Wye catchment). It is recommended that compliance with existing regulation is improved before NRW introduce increased controls as part of a WPZ.

### 5.4.2 Wastewater controls

Further legislative controls have already been introduced to reduce phosphorus concentrations from the wastewater sector. The Water (Special Measures) Act 2025 has been introduced to support the Environment Act 2021 to reduce sewage pollution by 50% by 2030 and reduce phosphorus concentrations in final treated effluent by 50% by 2028 and 80% by 2038 (Gov, 2025b). Significant investment has been planned for AMP8 in the Wye catchment to meet wastewater's fair share target. Therefore, further legislative controls in the Wye catchment are not required.

### 5.4.3 Urban controls

Septic tanks and package treatment plants at residential properties that cannot connect to a main sewer, are not within 500m of an protect site (including SAC), and with discharge less than or equal to 5m$^3$/day to a watercourse or 2m$^3$/day to groundwaters are eligible for free registration which means they will be exempt from the Environmental Permitting Regulations 2016 (NRW, 2025g). However, these exemptions do not apply for any properties discharging near or to SAC sites. NRW have provided ST or PTP owners with maintenance guidance, which includes ensuring annual maintenance and emptying (NRW, 2025b). For larger ST and PTP the Environmental Permitting Regulations 2016 apply, which states they must have environmental permits and not cause pollution to surface or groundwater (Gov, 2025c). Therefore, further legislative controls in the Wye catchment are not required.

# 6. KNOWLEDGE GAPS

The following knowledge gaps, identified from the analysis, are outlined below.

There is a lack of water quality monitoring data collected by NRW in the following waterbodies, therefore WFD compliance cannot be assessed:

- 32. Afon Claerwen - source to conf Afon Arban.
- 38. *Tintern Bk - source to conf R Wye.*

There is a lack of monitored data on the sources and pathways of phosphorus pollution to the River Wye from agricultural sources. Phosphorus loading from agricultural sources and the percentage load reductions achieved from mitigation measures has been quantified using Farmscoper modelling (V5). Farmscoper is an environmental decision support tool used to assess diffuse agricultural pollution and quantify the impacts of mitigation measures, using data derived from Defra's June Agricultural Survey (ADAS, 2025). The model is based on a wide range of peer reviewed research, field trials and national datasets, and standard practices and implementation rates for the Wye catchment have been used at the Wye catchment scale (ADAS, 2025). However, the percentage load reductions have been modelled at the Wye catchment scale and applied to the waterbody catchment scale, as there is a lack of open-source data available on farming practices at the waterbody scale. This provides an estimated load reduction percentage from the mitigation measures; however, this will be not entirely reflective of real-world impacts for each waterbody catchment.

# 7. ACTION PLAN

The following sections outline:

- The progress on the Phosphate Action Plan 2021 to date,
- A Catchment Wide Action Plan, which outlines the main findings from the options appraisal that should be considered in the Wye Nutrient Management Plan and the Wye Catchment Plan.
- A monitoring framework that can be used if the actions are taken forward as part of the Wye Nutrient Management Plan and the Wye Catchment Plan.

## 7.1 PHOSPHATE ACTION PLAN 2021 PROGRESS TO DATE

The River Wye SAC Nutrient Management Plan Phosphate Action Plan was outlined by NRW, NE and EA as part of the previous Wye Nutrient Management Plan completed in 2021 (Herefordshire Council, 2021). Table 25 outlines the main actions identified, the progress completed to date and the estimated load reduction achieved from on-the-ground measures.

Table 25 Actions outlined in the Phosphate Action Plan 2021, including the progress to date and estimated phosphorus reductions achieved from actions.

| Action | Detail | Progress | Phosphorus reduction achieved | End date |
|---|---|---|---|---|
| ***Investigations*** | | | | |
| Investigate inputs from septic tanks | | 23kg P/yr input from septic tanks, 1,565kg P/yr from package treatment plants identified in this report (Section 0). | None | No end date |
| Investigate inputs from industry | | Eight industrial sites identified in Welsh Wye in this report, none present in 2024 failing waterbodies (Section 0). | None | No end date |
| Investigations based on geography (hot spots) | | Sediment risk mapping completed in this report (Section 0). | None | No end date |
| Certainty from voluntary actions (agri-environment measures) | TAG to consider how much certainty can be attributed to voluntary actions. | Farmscoper modelling completed for this report suggests voluntary actions (agri-environment measures) can reduce phosphorus loading from agriculture by up to 44%. | None | No end date |
| Legacy phosphorus | Consider outcomes of RePhokUS project. | Project outcomes used to inform Farmscoper modelling and mitigation actions in this report. | None | No end date |
| Water protection zone | EA to lead thinking on whether a water protection zone is required. | Water protection zone considered in this report for failing waterbodies where load reduction targets cannot be met from agriculture. | None | No end date |
| Desk study into Phosphate treatment of Farm wastes | Project to establish innovative approaches to reducing phosphate losses from agriculture. | Outcomes paper produced. | None | 2025 |
| Evidence review | Review existing evidence and define further work. | Completed in this report (Section 3). | None | No end date |
| Farmscoper runs | Consider if Farmscoper re-runs add value. | Completed in this report (Section 5.1.2). | None | No end date |
| Review and map all know data | Review and map all known data (WQ, ecological, agriculture data, permitted discharges, biosolid notifications). | WQ, ecological, permitted discharges, land cover and sediment risk mapping completed in this report (Section 4). | None | No end date |

| Action | Detail | Progress | Phosphorus reduction achieved | End date |
|---|---|---|---|---|
| Catchment Sensitive Farming review | Project to increase understanding of the successes, shortcomings of CSF, and future opportunities. Quantify reductions from CSF, list measures that reduce P, rank certainty, forecast future reductions from CSF. | Current Welsh agri-environment schemes, all potential agri-environment measures that could be included in new agri-environment schemes and all possible measures assessed in this report. | None | No end date |
| Groundwater / surface water abstractions | Assess potential to effect base flow and dilution of discharges. | | None | No end date |
| Citizen science | Six citizen science projects in the Wye catchment. | Citizen science data included in the evidence base of this report. | None | No end date |
| Identify highways as diffuse pollution pathways | Consider potential interventions. | Local authorities to update. | None | No end date |
| ***Monitoring*** | | | | |
| RBMP working group to agree target across Wales and England | Being discussed as part of River Basin Management Plan review. | NRW/ EA/ NE to report to TAG. | None | 2021 |
| Agree monitoring requirements across England and Wales | | SAC and WFD compliance monitoring completed. | None | No end date |
| ***Wastewater actions*** | | | | |
| STW improvements | Upgrade 12 STW in Wales to reduce phosphorus concentration in final treated effluent. | Four upgrades in AMP7.<br>Five upgrades in AMP8 (see Section 5.2). | AMP7: 5,080kg<br>AMP8: 1,834kg<br>**Total: 6,914kg**[1] | 2027 |
| DCWW Storm Overflow Assessment Framework (SOAF) | CSO spill monitoring at Event Duration Monitor Sites to target CSO upgrades. | Monitoring undertaken at 42 CSOs in South East Wales by DCWW (see Section 0). | None | 2025 |
| ***Agriculture actions*** | | | | |
| Farming Connect: review of catchments and priorities | Targeted pollution prevention. | Four farming connect farms in the Welsh Wye catchment, Farming Connect to report outcomes to TAG. | None | 2021 |
| NRW targeted farm inspection programme | Dairy project, poultry/pig farm visits. Ithon opportunity catchment partnership programme. | NRW to report to TAG. | None | 2022 |

| Action | Detail | Progress | Phosphorus reduction achieved | End date |
|---|---|---|---|---|
| ***Sub-catchment actions*** | | | | |
| River restoration work along all main rivers and tributaries | River restoration to reduce pollution risks and improve ecological resilience. | River restoration completed through Upper Wye Restoration Project (2.7km Afon Marteg, 1.6km River Irfon, Wye and Usk Foundation (WUF) Habitat Restoration project aims to improve riparian zones) (see Section 0). | 6.74kg | No end date |
| Identify point sources of all main rivers | Identify point sources from DCWW, private works, septic tanks, CSO, agricultural units, anerobic digestion plants. | DCWW, septic tanks, package treatment plants and industrial sites identified in this report (see Section 5.3.3 and 5.3.4). | None | No end date |
| Natural flood management | Encourage natural flood management in all main rivers. | Integrated Wetlands and Woodlands for Water projects by WUF completed. | None | No end date |
| Groundwater pollution sources | Identify sources discharging into ground. | | None | No end date |
| Target sub-catchment work based on phosphate evidence report | Target sub-catchment work based on phosphate evidence report taking into account wider evidence. | Sub-catchment projects identified and being undertaken. | None | No end date |
| Influence farming practices | Use catchment officers to influence farming practices. | | None | No end date |
| Ditch blocking and wetland restoration | | Integrated Wetlands and Woodlands for Water projects by WUF completed. | None | No end date |

[1]See Appendix J for full list of STWs included in Phosphate Action Plan actions.

The NMP actions mainly focus on investigative actions, most of which have been completed through the production of this report. There has also been significant progress on actions for the Wastewater sector through AMP7 and planned AMP8 upgrades (Section 4.2), and river restoration projects at the sub-catchment scale on agricultural land (Section 4.1.1).

## 7.2 WELSH WYE CATCHMENT RECOMMENDATIONS

Catchment wide recommendations that could be considered in the updated Wye NMP have been outlined in Table 26. Monitoring metrics and measures of success for each of these recommendations have been outlined in Section 6.3.1.

Table 26 Welsh Wye Catchment recommendations 2024.

| Sector / source | Recommendation | Effectiveness |
|---|---|---|
| Agriculture | Increase level of regulatory compliance. | Achieving 100% regulatory compliance will reduce phosphorus loads from agriculture by 18% across the Welsh Wye. |
| | Encourage uptake of best practice measures and existing agri-environment schemes in Wales. | Sector phosphorus concentration reductions can be achieved to meet SAC compliance in 22 out of 38 failing waterbodies. |
| | Collaborate with NRW, DCWW, Wye and Usk to track mitigation measures delivered through regulation, best practices, agri-environment schemes and other catchment projects. | Enables mitigation measures to be monitored and quantified. |
| Wastewater | Reduce phosphorus concentrations in final treated effluent in-line with AMP8 investment programme. | Fair share targets can be achieved. |
| Other | Engage with PSS owners to raise awareness about nutrient pollution, identify funding opportunities to support PSS upgrades. | A phosphorus concentration reduction of 97% can be achieved from the PSS. |

## 7.3 PROPOSED MONITORING FRAMEWORK

The below sections detail a proposed monitoring framework which Herefordshire Council can use to provide regular progress updates for the delivery of the updated Wye NMP.

### 7.3.1 Scope

This monitoring framework outlines how Herefordshire Council will track and evaluate the implementation of the actions taken forward in the updated NMP.

### 7.3.2 Objectives

The objective of a monitoring framework are:

1. To track the implementation of the mitigation actions recommended in the updated Wye NMP,
2. To track progress to achieving SAC and WFD compliance in failing waterbody catchments,
3. To identify any risks or gaps to achieving SAC and WFD compliance.

### 7.3.3 Monitoring

Table 27 outlines the key monitoring components and potential metrics and measures of success that could be used in the updated Wye NMP.

Table 27 Monitoring components required to track and assess progress of mitigation measures taken forward into the updated NMP.

| Monitoring component | Owner | Methods | Potential metrics / measures of success |
|---|---|---|---|
| Water quality sampling | NRW | Compliance monitoring for orthophosphate.<br>Citizen science water quality sampling. | Phosphorus concentration (mg/l). |
| Agricultural regulatory compliance | NRW | Compliance inspections on farms. | Percentage or number of farms compliant with regulations. |
| Agricultural mitigation measures uptake | NRW, Herefordshire Council | Compliance inspections<br>Agri-environment scheme uptake.<br>NRW funded interventions (e.g., Upper Wye Restoration Project). | Type and area (hectares) of mitigation measures implemented.<br>Percentage or number of farms implementing mitigation measures. |
| Delivery of AMP8 wastewater upgrades | DCWW | Upgrades to treatment process at STWs. | Number of STW upgrades.<br>Upgrade type.<br>Phosphorus concentration (mg/l) |
| PSS regulatory compliance | NRW | Compliance inspections at residential properties. | Percentage or number of PSS inspected.<br>Percentage or number of PSS owners compliant with regulations. |

#### 7.3.4 Reporting and evaluation

If the recommendations are bought forward into the updated Wye NMP, the progress of delivering the recommendations should be reported to the NMB annually, including phosphorus concentration reductions from sources where it is possible to quantify. Annual reviews and evaluation will allow the progress of the implementation of any recommendations to be tracked.

#### 7.3.5 Risks and mitigation

Risks that could impact the delivering of a monitoring framework and potential mitigation strategies to address the risks have been identified in Table 28.

Table 28 Potential risks and mitigation opportunities that could impact the monitoring framework.

| Risk | Potential mitigation |
|---|---|
| Insufficient data on mitigation measure implementation for agriculture | Collaborate with NRW, DCWW, NGOs (including Wye and Usk Foundation), Citizen Science, catchment partnerships, farm cluster groups and local landowners to collect and collate mitigation measures on farms. |
| Limited capacity to complete farm inspections | Target high risks areas outlined in Section 4.1.2.3 to have the largest impact. |
| Limited funding to implement mitigation measures for agriculture | Encourage uptake of agri-environment schemes. |
| Limited funding to implement PSS upgrades. | PSS found to be non-compliant and causing pollution should be upgraded at the expense of the polluter. |

# 8. AMMONIA AND NITRATE MANAGEMENT: CURRENT STRATEGIES AND FUTURE NEEDS

Ammonia concentrations across the Welsh Wye catchment have achieved WFD good status (Figure 24), however one waterbody catchment has failed for ammonia in the most recent SAC compliance assessment (Figure 23) (NRW, 2024d). The failing waterbody was 11. *Howey Bk - source to conf R Ithon*. Analysis of NRW's water quality sampling data did not show a statistically significant increasing trend over time at sampling site Howey Brook At Confl River Ithon (slope -0.00004 mg/L per day, $R^2$ = 0.01, p value = 0.47).

Nitrate (N) is not assessed as part of SAC or WFD compliance, however it is monitored. Statistical analysis of NRW's nitrate-as-N sampling data shows only one monitoring site to have a statistically significant trend at Llangorse Lake (slope = -0.0002 per day, p value = 0.04) in waterbody 28. *Afon Llynfi - source to conf Dulas Bk*. This equates to a decrease of 0.073 mg/L per year at the site.

Citizen science data shows that in the Wye catchment nitrate concentrations are higher on the English side and in a few limited source waterbody catchments (Figure 25).

Figure 23: Ammonia SAC compliance assessment, 2021 and 2024 comparison

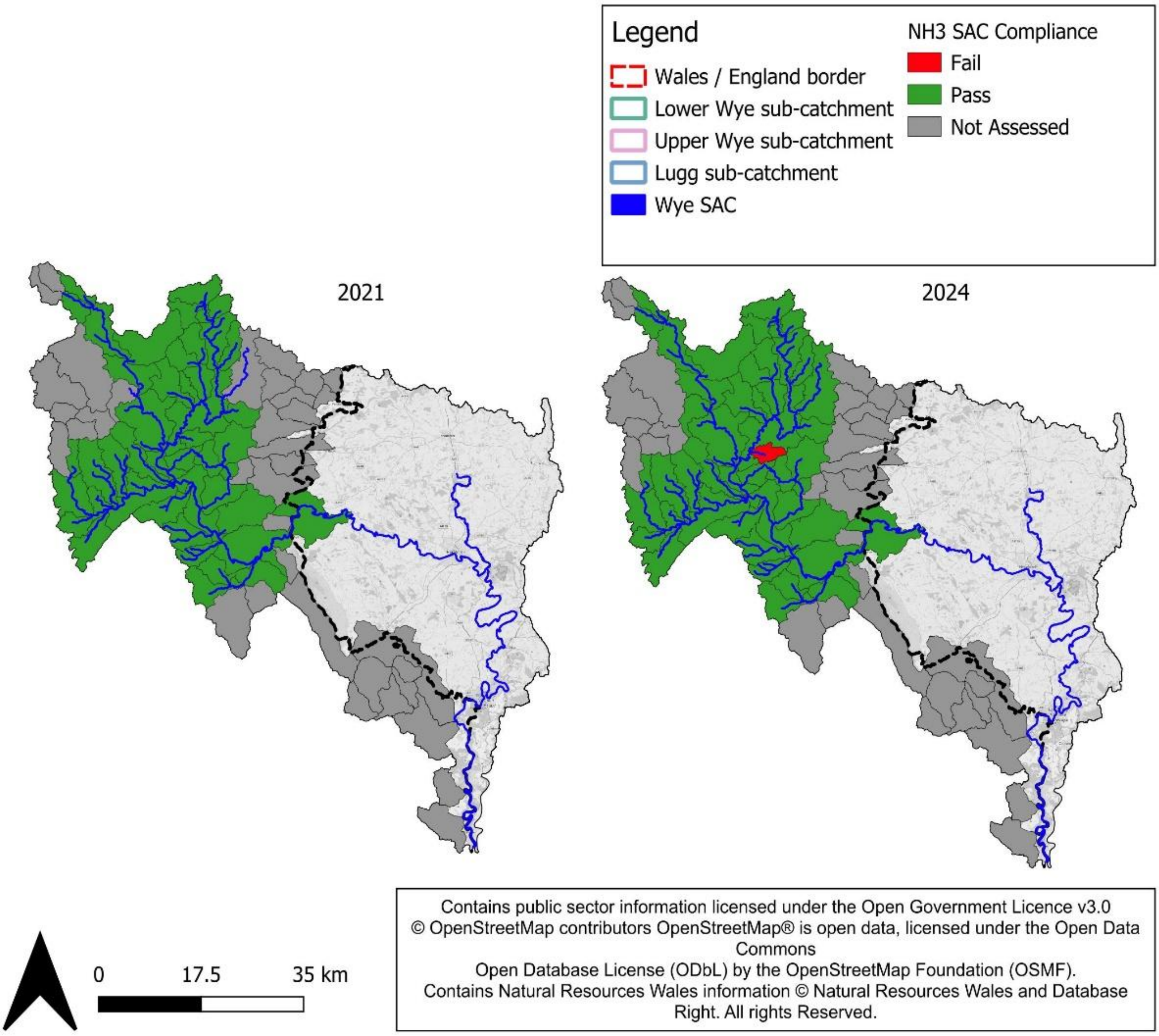


Figure 24: Ammonia WFD compliance assessment, 2021 and 2024 comparison

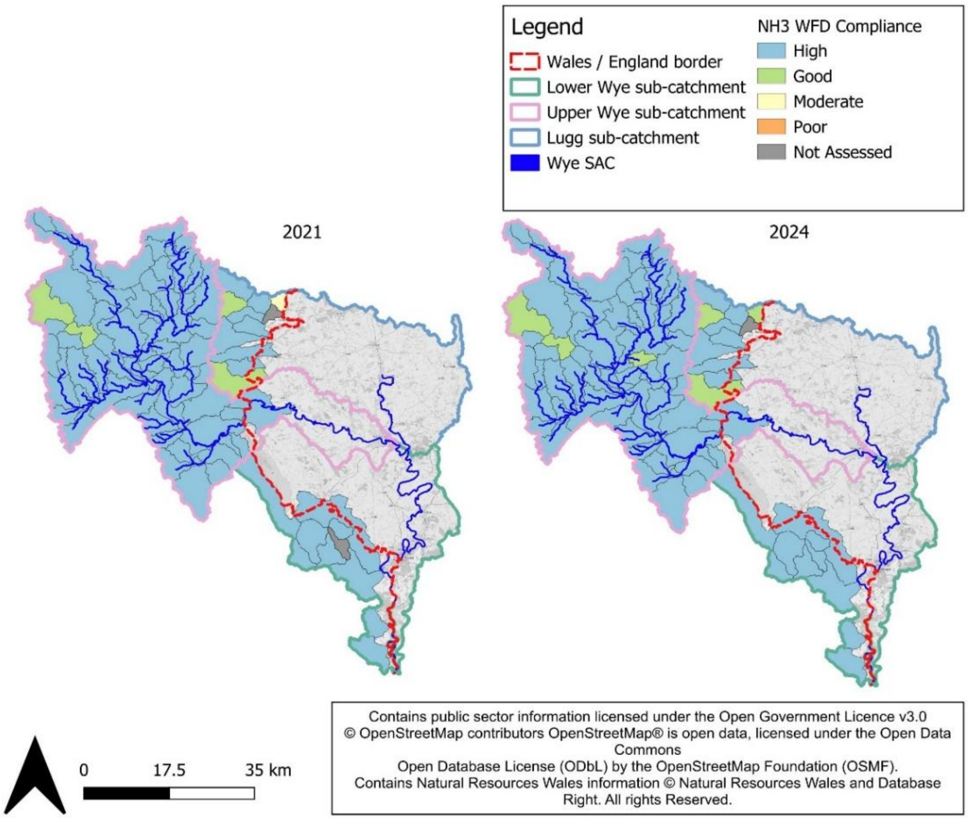
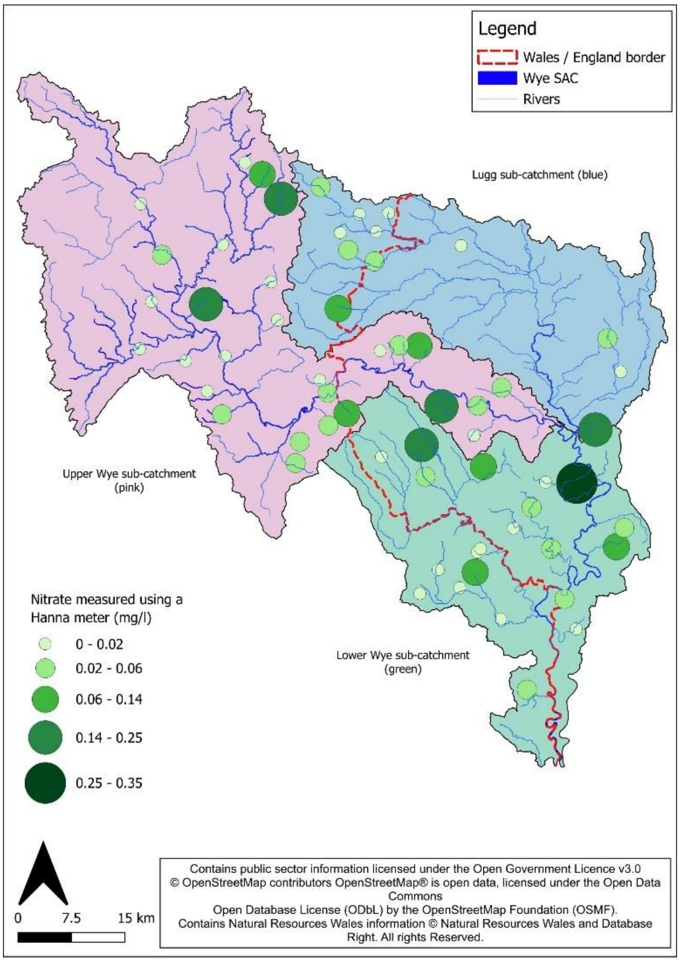



Figure 25: Average Nitrate measured by Citizen Science in mg/l



Nitrogen-containing compounds serve as a source of nutrition for algae and cyanobacteria. Nitrate is stable in aerobic water and is used by plants and cyanobacteria to grow (Litchman *et al.,* 2003; Welsh Government, 2022). Nitrite is typically an intermediate product during ammonium oxidation to nitrate; therefore, nitrite does not remain in solution for long periods and is often not considered to be the most important specie of nitrogen. Nitrite is commonly considered alongside the concentration of nitrate when determining the concentration of total oxidised nitrogen (TON) which can be important when considering nutrient ratios (Litchman *et al.,* 2003; Welsh Government, 2022). Ammonium is also bioavailable to plant and cyanobacteria and may also fuel cyanobacterial growth resulting in toxin production (Litchman *et al.,* 2003; Welsh Government, 2022). Nitrogen is more soluble in water during periods of lower water temperatures whereas warmer water temperatures help remove the nitrogen from the water.

River sediments may act as a sink for nitrogen, with nitrogen being released from the sediment to the water under varying conditions e.g., low pH, anaerobic conditions and sediment disturbance (Welsh Government, 2022). Anthropogenic sources of N contribute towards the N load within a river, e.g., nitrogen is frequently applied to the land as fertiliser in the form of Ammonium Nitrate; however, excess fertiliser is prone to run-off during periods of heavy rainfall, making agricultural processes among the worst N polluters within the UK (Galloway *et al.,* 2008). In non-polluted areas, much of the combined atmospheric nitrogen is in the form of Ammonia a significant amount of which originated from the decomposition of terrestrial organic matter. The main source of entry for N into a water course is through organic waste (fish, bird, mammal) and via run-off from fertilised land during a period of heavy rainfall (Grey *et al*., 2002). When a river water level is lower during the summer season, nitrogen may be released from the peripheral sediment into the water during episodes of heavy rainfall. Plant uptake within exposed sediment during the summer period can significantly reduce sediment N during periods of growth through removal and assimilation of N-fractions during the growing phase but is returned to the river following plant senescence and decay (Welsh Government, 2022).

The whole of Wales is designated a Nitrate Vulnerable Zone (NVZ), introduced under the Water Resources (Control of Agricultural Pollution) (Wales) Regulations in 2021. NVZs aim to improve nutrient management on farms (Gov, 2025d). This includes limiting nitrogen applications from livestock manures to 170kg N per ha on average across the whole farm, with individual fields not receiving more than 250 kg N per ha from all organic manures, ensuring nutrient applications are planned for crop need, risk mapping the farm to reduce nutrient leaching or run-off, storing manure in suitable concrete stores or temporary field heaps and enforcing *"closed periods"* during the month months when nitrate must not be spread in fertilisers or manures (Gov, 2025d). These actions limit the risk of nitrate polluting ground and surface waters.

In addition to nitrate and ammonia monitoring, the EA and NRW are collaborating with partners and stakeholders to tackle water quality issues in the River Wye as part of the River Severn River Basin Management Plan Gov, (2022*)*. This includes increasing farm visits to provide targeted advice, and conducting detailed investigations into the management of poultry manure.

The mitigation measures assessed for the agricultural sector in this report that encourage improvements to soil health and nutrient management will have a positive impact on reducing nitrate and ammonia run-off to surface water. It is expected that if the recommendations are taken forward into the updated NMP, ammonia and nitrate trends will not increase overtime and the management of phosphorus will also support the management of nitrate and ammonia.

# 9. CONCLUSION

This report has demonstrated that phosphorus remains the principal nutrient pressure in the Welsh Wye, driving non-compliance with WFD or SAC targets as well as effecting the ecological health of individual waterbodies. The evidence presented demonstrated that the agricultural sector is the largest source of phosphorus concentration within failing waterbodies, followed by wastewater final treated effluent discharges and urban private sewerage. Extensive modelling and scenario analysis indicated that substantial reductions in agricultural phosphorus loading can be achieved through targeted regulatory compliance, best practice and agri-environment interventions, supported by planned upgrades to WwTW. Upgrades to PSS can reduce phosphorus concentrations from these sources by 97%, however it may not be cost beneficial when compared to the monetary benefit gained from water quality improvement.

The mitigation measures appraised here can deliver contribute to achieving SAC and WFD compliance in 25 failing waterbody catchments, with the remaining catchments expected to make significant progress towards compliance (a minimum of 71%). Not all mitigation measures assessed are cost beneficial (including *“all possible measures”* and land use change for agricultural concentration reductions, and PSS upgrades for other source reductions).

It is recommended that the evidence base and options appraisal presented here for Wales is compared to the Environment Agency’s Diffuse Water Pollution Plan to bring together cross border initiatives and inform potential recommendations for a future Wye Nutrient Management Plan and Wye Catchment Plan. Through collective implementation of mitigation measures on both sides of the border, the River Wye’s internationally important habitats and species can be safeguarded, and the quality of the water environment will be improved.

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# APPENDIX A SAC AND WFD COMPLIANCE

Table 29 Comparison of SAC compliance for 2021 and 2024 at the water body scale for the Wye Catchment.

| Wye sub-catchment | Water body name | Threshold (mg/l) | 2021 Assessment | | 2024 Assessment | |
|---|---|---|---|---|---|---|
| | | | SAC Compliance | Average annual P concentration (mg/l) | SAC Compliance | Average annual P concentration (mg/l) |
| Upper Wye | *Afon Cammarch - source to conf R Irfon* | 0.010 | Fail | 0.046 | Pass | 0.007 |
| | *Afon Chwefru - source to conf R Irfon* | 0.010 | Fail | 0.022 | Fail | 0.015 |
| | *Afon Garth Dulas - source to conf R Irfon* | 0.010 | Fail | 0.015 | Pass | 0.004 |
| | *Afon Gwesyn - source to conf R Irfon*[1] | 0.010 | Fail | 0.012 | Fail | 0.012 |
| | *Cledan - source to conf R Irfon* | 0.010 | Fail | 0.018 | Fail | 0.016 |
| | *Irfon - conf Afon Gwesyn to conf Cledan* | 0.010 | Pass | 0.008 | Pass | 0.004 |
| | *Irfon - conf Cledan to conf R Wye* | 0.010 | Fail | 0.024 | Pass | 0.005 |
| | *Tirabad Dulas - source to conf R Irfon* | 0.010 | Pass | 0.008 | Pass | 0.005 |
| | *Aran - source to conf R Ithon* | 0.015 | N/A | N/A | Fail | 0.020 |
| | *Bachell Bk - source to conf Clywedog Bk* | 0.010 | Pass | 0.004 | Pass | 0.003 |
| | *Camddwr Bk - source to conf R Ithon* | 0.013 | Fail | 0.020 | Fail | 0.024 |
| | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | 0.010 | Fail | 0.015 | Fail | 0.011 |
| | *Clywedog Bk - source to conf Bachell Bk* | 0.010 | Pass | 0.009 | Fail | 0.012 |
| | *Gwenlas Bk - source to conf R Ithon* | 0.010 | Fail | 0.024 | Fail | 0.033 |
| | *Howey Bk - source to conf R Ithon* | 0.015 | Fail | 0.025 | Fail | 0.044 |
| | *Ithon - conf Camddwr Bk to conf R Wye* | 0.025 | Pass | 0.017 | Pass | 0.020 |
| | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 0.010 | Fail | 0.013 | Fail | 0.012 |
| | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | 0.010 | Fail | 0.013 | Fail | 0.012 |
| | *Ithon - source to conf Llaethdy Bk* | 0.010 | Pass | 0.008 | Fail | 0.011 |
| | *Llaethdy Bk - source to conf R Ithon* | 0.010 | Pass | 0.007 | Pass | 0.006 |
| | *Mithil Bk - source to conf R Ithon* | 0.015 | Fail | 0.040 | Fail | 0.042 |
| | *Nantmel Dulas - source to conf R Ithon* | 0.010 | Fail | 0.021 | Fail | 0.019 |
| | *Afon Llynfi - conf Dulas Bk to conf R Wye* | 0.025 | Fail | 0.077 | Fail | 0.059 |
| | *Bach Howey Bk - source to conf R Wye* | 0.015 | Fail | 0.029 | Fail | 0.032 |
| | *Builth Dulas Bk - source to conf R Wye* | 0.015 | Fail | 0.016 | Fail | 0.018 |

| Wye sub-catchment | Water body name | Threshold (mg/l) | 2021 Assessment | | 2024 Assessment | |
|---|---|---|---|---|---|---|
| | | | SAC Compliance | Average annual P concentration (mg/l) | SAC Compliance | Average annual P concentration (mg/l) |
| | *Camnant Brook - source to confluence R Edw* | 0.015 | Fail | 0.024 | Fail | 0.048 |
| | *Clettwr Bk - source to conf R Wye* | 0.015 | Fail | 0.041 | Fail | 0.022 |
| | *Duhonw - source to conf R Wye* | 0.015 | Fail | 0.015 | Pass | 0.008 |
| | *Dulas Bk - source to conf Afon Llynfi* | 0.025 | Fail | 0.074 | Fail | 0.035 |
| | *Edw - conf Camnant Bk to conf Clas Bk* | 0.015 | Fail | 0.020 | Fail | 0.037 |
| | *Edw - conf Clas Bk to conf R Wye* | 0.015 | Fail | 0.020 | Fail | 0.016 |
| | *Edw - source to conf Colwyn Bk* | 0.015 | Fail | 0.030 | Fail | 0.023 |
| | *Scithwen Bk - source to conf R Wye* | 0.015 | Fail | 0.019 | Fail | 0.020 |
| | *Triffrwd - source to Dulas* | 0.015 | Fail | 0.070 | Fail | 0.033 |
| | *Wye - conf R Irfon to Scithwen Bk* | 0.016 | Fail | 0.023 | Pass | 0.007 |
| | *Wye (Avon Gwy) - conf R Ithon to conf R Irfon* | 0.015 | Pass | 0.008 | Pass | 0.008 |
| | *R Wye - conf Walford Bk to Bigsweir Br* | 0.039 | Fail | 0.052 | Pass | 0.034 |
| | *Wye - Scithwen Bk to Brewardine Br* | 0.020 | Pass | 0.019 | Pass | 0.007 |
| | *Afon Bidno - source to conf R Wye* | 0.010 | Pass | 0.001 | Pass | 0.002 |
| | *Afon Elan - Caban-coch Rsvr to conf R Wye* | 0.010 | N/A | N/A | Pass | 0.002 |
| | *Afon Marteg - source to conf R Wye* | 0.013 | Pass | 0.007 | Pass | 0.007 |
| | *Wye - conf Afon Bidno to conf Afon Marteg* | 0.010 | Pass | 0.002 | Pass | 0.002 |
| | *Wye - conf Afon Elan to conf R Ithon* | 0.010 | Fail | 0.037 | Fail | 0.012 |
| | *Wye - conf Afon Tarenig to conf Afon Bidno* | 0.010 | Pass | 0.002 | Pass | 0.002 |
| | *Wye - conf to conf Afon Marteg to conf Afon Elan* | 0.020 | Pass | 0.011 | Pass | 0.012 |

[1]Note this waterbody catchment was not assessed in 2024, the result is 2021 rolled forward.

Table 30 Comparison of WFD phosphorus compliance in 2021 and 2024 for the remaining catchment waterbodies not covered by SAC compliance

| Wye sub-catchment | Waterbody name | WFD 2021 compliance | WFD 2024 compliance |
|---|---|---|---|
| Lugg | *Arrow - source to conf Gladestry Bk* | Good | Good |
| | *Bleddfa Bk - source to conf R Lugg* | Good | Good |

| Wye sub-catchment | Waterbody name | WFD 2021 compliance | WFD 2024 compliance |
|---|---|---|---|
| | *Cascob Bk - source to conf R Lugg* | N/A | N/A |
| | *Gilwern Bk - source to conf R Arrow* | N/A | Moderate |
| | *Gladestry Bk - source to conf R Arrow* | N/A | N/A |
| | *Hindwell Bk - source to conf Knobley Bk* | Good | High |
| | *Knobley Bk - source to conf Hindwell Bk* | Good | High |
| | *Lugg - conf Bleddfa Bk to conf Cascob Bk* | High | N/A |
| | *Lugg - conf Cascob Bk to conf Norton Bk* | N/A | N/A |
| | *Lugg Bk - source to conf Bleddfa Bk* | High | N/A |
| | *Norton Bk - source to conf R Lugg* | Poor | Poor |
| Upper Wye | *Irfon - source to conf Afon Gwesyn* | High | High |
| | *Afon Llynfi - source to conf Dulas Bk* | Moderate | Moderate |
| | *Clas Bk - source to conf R Edw* | Good | N/A |
| | *Clyro Bk - source to conf R Wye* | Poor | Poor |
| | *Digedi Bk - source to conf R Wye* | Poor | Poor |
| | *Ennig - source to conf Afon Llynfi* | Moderate | Good |
| | *Afon Arban - source to conf Afon Claerwen* | Good | N/A |
| | *Afon Claerwen - conf Afon Arban to Caban-coch* | Moderate | Moderate |
| | *Afon Claerwen - source to conf Afon Arban* | Moderate | Moderate |
| | *Afon Elan - source to Pont ar Elan* | High | N/A |
| | *Afon Tarenig - source to conf R Wye* | High | High |
| | *Rhiwnant - source to conf Afon Claerwen* | High | N/A |
| | *Wye - source to conf Afon Tarenig* | High | High |
| Lower Wye | *Afon Honddu - source to conf R Monnow* | High | N/A |
| | *Monnow - conf Afon Honddu to conf R Wye* | High | High |
| | *Norton Bk - source to conf R Monnow* | High | N/A |
| | *Llanymynech Bk - source to conf R Trothy* | Moderate | Moderate |
| | *Llymon Bk - source to conf R Trothy* | N/A | Moderate |
| | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | Moderate | Moderate |
| | *Trothy - conf Llymon Bk to conf R Wye* | Moderate | Moderate |
| | *Trothy - source to conf Llanymynech Bk* | Good | N/A |

| Wye sub-catchment | Waterbody name | WFD 2021 compliance | WFD 2024 compliance |
|---|---|---|---|
| | *Mounton Bk - source to R Severn Estuary* | Good | N/A |
| | *Tintern Bk - source to conf R Wye* | Moderate | Moderate |

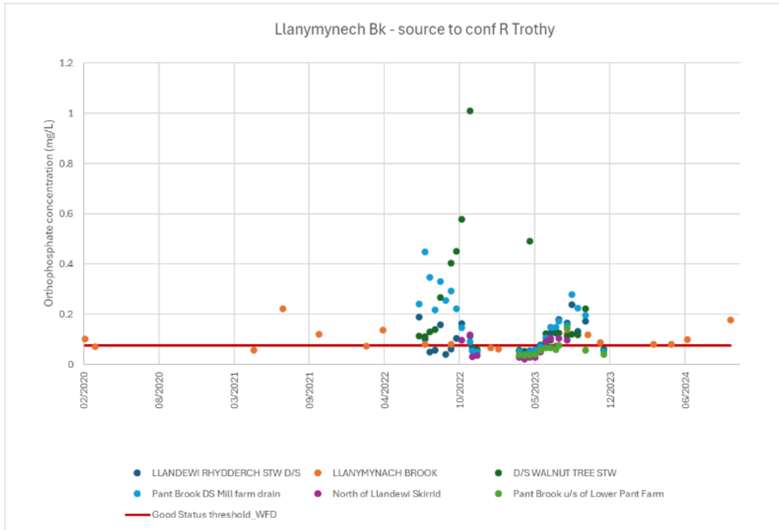
Table 31 Summary of target P concentration and average concentration for SAC and WFD failing waterbodies in 2024 (based on official NRW assessments for SAC using 2020-2023 data and monitored water quality data collected between 2020 and 2024 for WFD).

| Main catchment | Operational catchment | Reference number | Water body name | SAC or WFD Target | 2024 compliance | Target concentration (µg/l) | Average P concentration (µg/l) |
|---|---|---|---|---|---|---|---|
| River Lugg | Arrow Lugg and Frome | 1 | *Gilwern Bk - source to conf R Arrow* | WFD | Moderate | - | - |
| | Lugg | 2 | *Norton Bk - source to conf R Lugg* | WFD | Poor | 35 | 97 |
| River Wye | Irfon | 3 | *Afon Chwefru - source to conf R Irfon* | SAC | Fail | 10 | 15 |
| | | 4 | *Afon Gwesyn - source to conf R Irfon* | SAC | Fail | 10 | 12 |
| | | 5 | *Cledan - source to conf R Irfon* | SAC | Fail | 10 | 16 |
| | Ithon | 6 | *Aran - source to conf R Ithon* | SAC | Fail | 15 | 20 |
| | | 7 | *Camddwr Bk - source to conf R Ithon* | SAC | Fail | 13 | 24 |
| | | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | SAC | Fail | 10 | 11 |
| | | 9 | *Clywedog Bk - source to conf Bachell Bk* | SAC | Fail | 10 | 12 |
| | | 10 | *Gwenlas Bk - source to conf R Ithon* | SAC | Fail | 10 | 33 |
| | | 11 | *Howey Bk - source to conf R Ithon* | SAC | Fail | 15 | 44 |
| | | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | SAC | Fail | 10 | 13 |
| | | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | SAC | Fail | 10 | 12 |
| | | 14 | *Ithon - source to conf Llaethdy Bk* | SAC | Fail | 10 | 11 |
| | | 15 | *Mithil Bk - source to conf R Ithon* | SAC | Fail | 15 | 42 |
| | | 16 | *Nantmel Dulas - source to conf R Ithon* | SAC | Fail | 10 | 19 |
| | Wye - Ithon to Hay | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | SAC | Fail | 25 | 59 |
| | | 18 | *Bach Howey Bk - source to conf R Wye* | SAC | Fail | 15 | 32 |
| | | 19 | *Builth Dulas Bk - source to conf R Wye* | SAC | Fail | 15 | 18 |
| | | 20 | *Camnant Brook - source to confluence R Edw* | SAC | Fail | 15 | 48 |

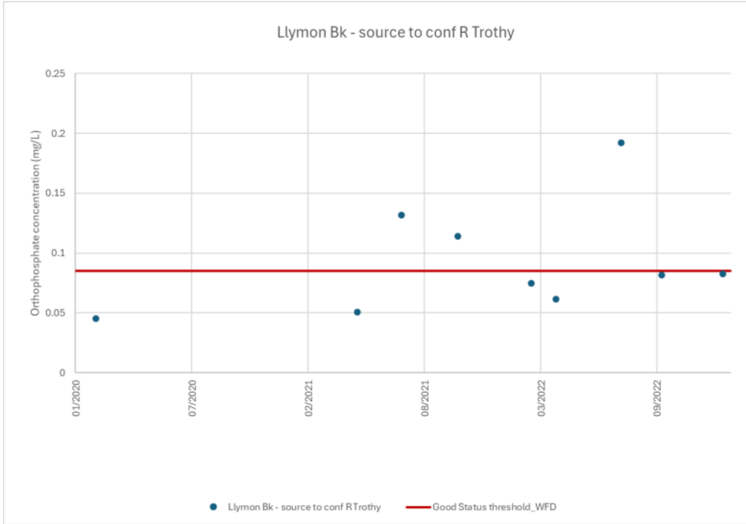
| Main catchment | Operational catchment | Reference number | Water body name | SAC or WFD Target | 2024 compliance | Target concentration (µg/l) | Average P concentration (µg/l) |
|---|---|---|---|---|---|---|---|
| | | 21 | *Clettwr Bk - source to conf R Wye* | SAC | Fail | 15 | 22 |
| | | 22 | *Dulas Bk - source to conf Afon Llynfi* | SAC | Fail | 25 | 35 |
| | | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | SAC | Fail | 15 | 37 |
| | | 24 | *Edw - conf Clas Bk to conf R Wye* | SAC | Fail | 15 | 16 |
| | | 25 | *Edw - source to conf Colwyn Bk* | SAC | Fail | 15 | 23 |
| | | 26 | *Scithwen Bk - source to conf R Wye* | SAC | Fail | 15 | 20 |
| | | 27 | *Triffrwd - source to Dulas* | SAC | Fail | 15 | 33 |
| | | 28 | *Afon Llynfi - source to conf Dulas Bk* | WFD | Moderate | 52 | 76 |
| | | 29 | *Clyro Bk - source to conf R Wye* | WFD | Poor | 62 | 71 |
| | | 30 | *Digedi Bk - source to conf R Wye* | WFD | Poor | 64 | 36 |
| | Wye source to Irthon | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | WFD | Moderate | 28 | 4 |
| | | 32 | *Afon Claerwen - source to conf Afon Arban* | WFD | Moderate | - | - |
| | | 33 | *Wye - conf Afon Elan to conf R Ithon* | SAC | Fail | 10 | 13 |
| | Trothy | 34 | *Llanymynech Bk - source to conf R Trothy* | WFD | Moderate | 75 | 130 |
| | | 35 | *Llymon Bk - source to conf R Trothy* | WFD | Moderate | 85 | 93 |
| | | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | WFD | Moderate | 79 | 90 |
| | | 37 | *Trothy - conf Llymon Bk to conf R Wye* | WFD | Moderate | 84 | 99 |
| | Wye OC | 38 | *Tintern Bk - source to conf R Wye* | WFD | Moderate | - | - |

# APPENDIX B TIME SERIES IN NON-COMPLIANT WATERBODIES

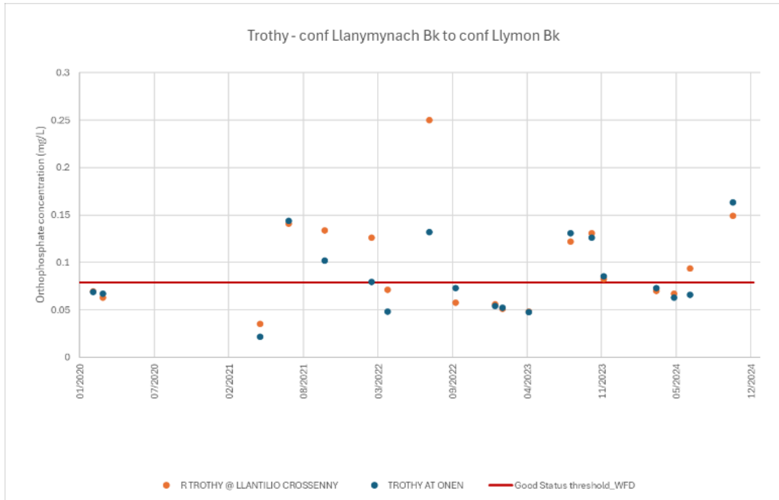
Figure 26: Phosphorus concentration over time, covering 2020-2024 data in WFD non-compliance waterbodies



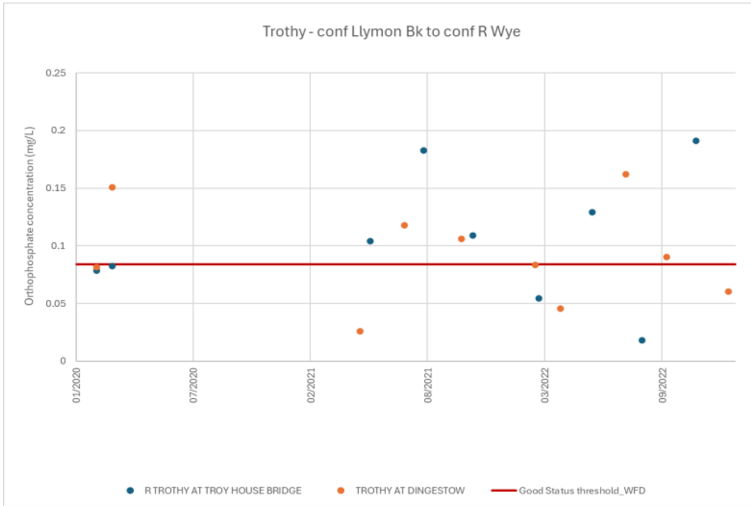
Llanymynech Bk - source to conf R Trothy
Orthophosphate concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
02/2020
08/2020
03/2021
09/2021
04/2022
10/2022
05/2023
12/2023
06/2024
LLANDEWI RHYDDERCH STW D/S
LLANYMYNACH BROOK
D/S WALNUT TREE STW
Pant Brook DS Mill farm drain
North of Llandewi Skirrid
Pant Brook u/s of Lower Pant Farm
Good Status threshold_WFD

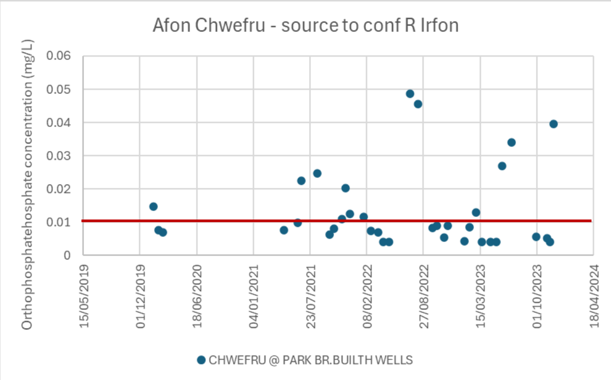
Llymon Bk - source to conf R Trothy
Orthophosphate concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/2020
07/2020
02/2021
08/2021
03/2022
09/2022
Llymon Bk - source to conf R Trothy
Good Status threshold_WFD

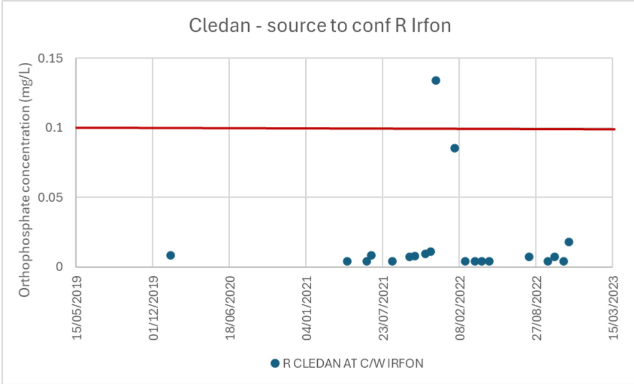



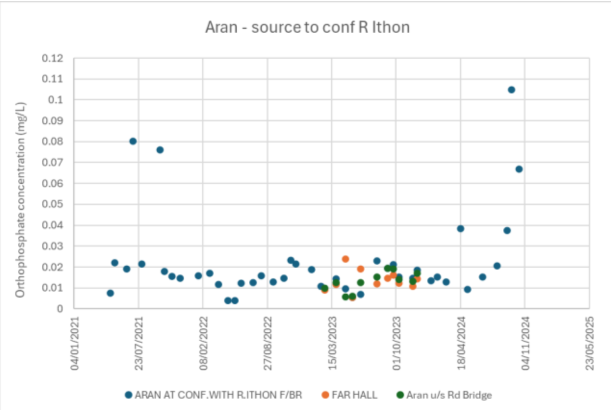
Trothy - conf Llanymynach Bk to conf Llymon Bk
Orthophosphate concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
01/2020
07/2020
02/2021
08/2021
03/2022
09/2022
04/2023
11/2023
05/2024
12/2024
R TROTHY @ LLANTILIO CROSSENNY
TROTHY AT ONEN
Good Status threshold_WFD

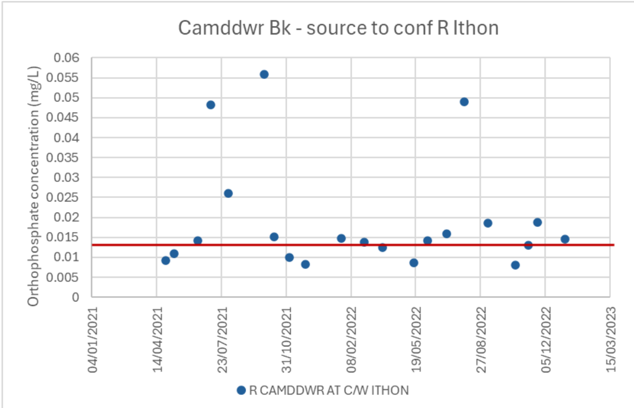



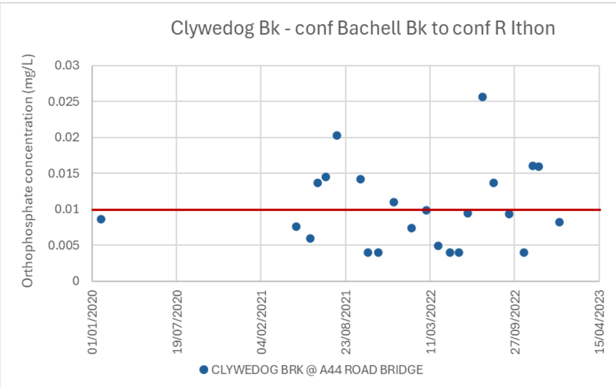
Trothy - conf Llymon Bk to conf R Wye
Orthophosphate concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/2020
07/2020
02/2021
08/2021
03/2022
09/2022
R TROTHY AT TROY HOUSE BRIDGE
TROTHY AT DINGESTOW
Good Status threshold_WFD

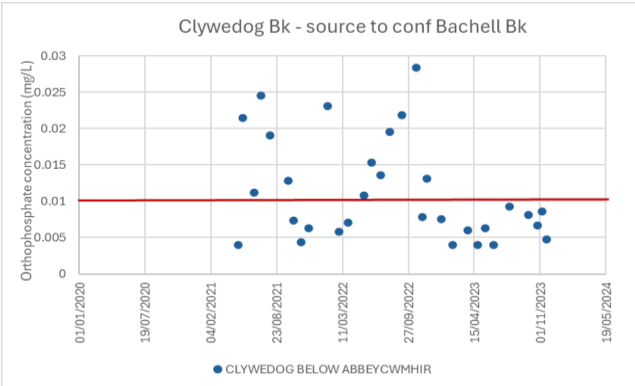

Afon Chwefru - source to conf R Irfon
Orthophosphatehosphate concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
15/05/2019
01/12/2019
18/06/2020
04/01/2021
23/07/2021
08/02/2022
27/08/2022
15/03/2023
01/10/2023
18/04/2024
CHWEFRU @ PARK BR.BUILTH WELLS

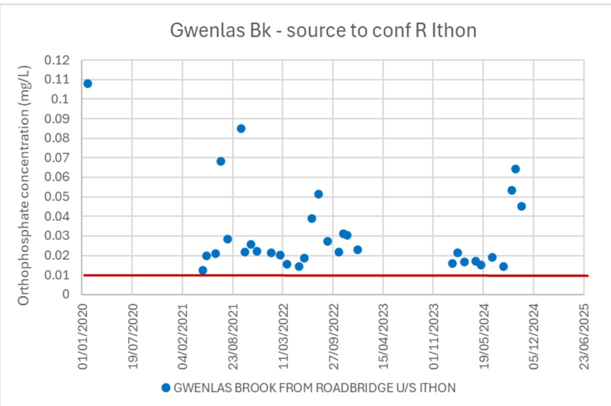

Cledan - source to conf R Irfon
Orthophosphate concentration (mg/L)
0.15
0.1
0.05
0
15/05/2019
01/12/2019
18/06/2020
04/01/2021
23/07/2021
08/02/2022
27/08/2022
15/03/2023
R CLEDAN AT C/W IRFON

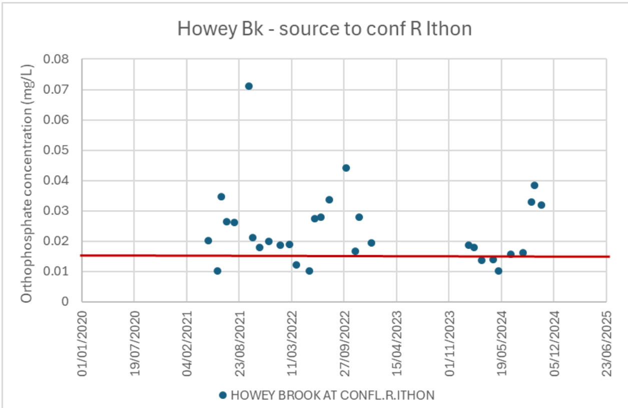

Aran - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
04/01/2021
23/07/2021
08/02/2022
27/08/2022
15/03/2023
01/10/2023
18/04/2024
04/11/2024
23/05/2025
ARAN AT CONF.WITH R.ITHON F/BR
FAR HALL
Aran u/s Rd Bridge

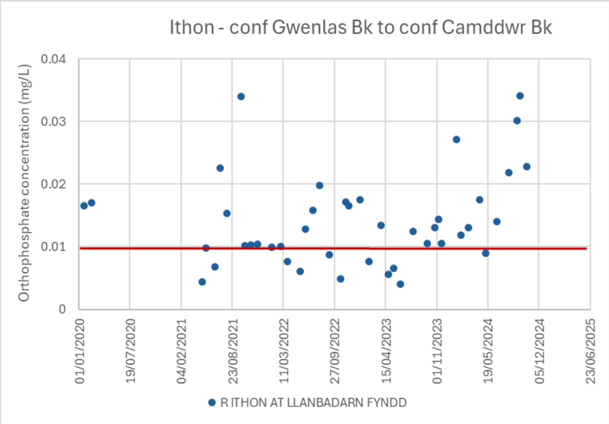

Camddwr Bk - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
04/01/2021
14/04/2021
23/07/2021
31/10/2021
08/02/2022
19/05/2022
27/08/2022
05/12/2022
15/03/2023
R CAMDDWR AT C/W ITHON

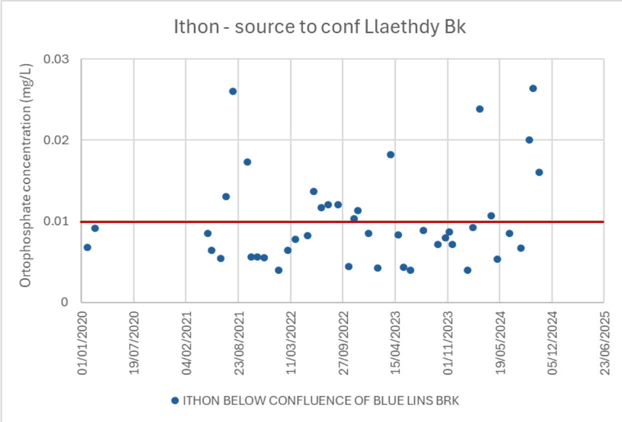

Clywedog Bk - conf Bachell Bk to conf R Ithon
Orthophosphate concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
CLYWEDOG BRK @ A44 ROAD BRIDGE

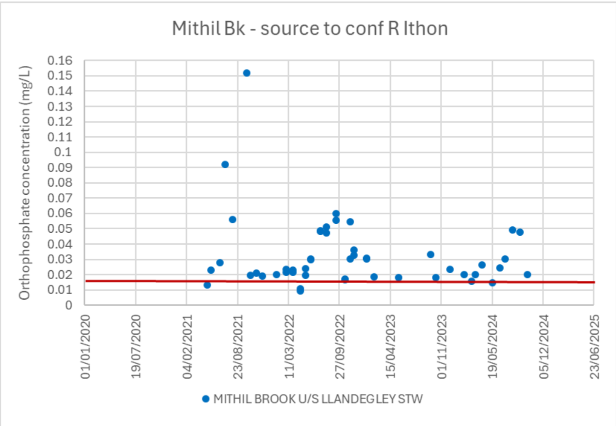

Clywedog Bk - source to conf Bachell Bk
Orthophosphate concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
CLYWEDOG BELOW ABBEYCWMHIR

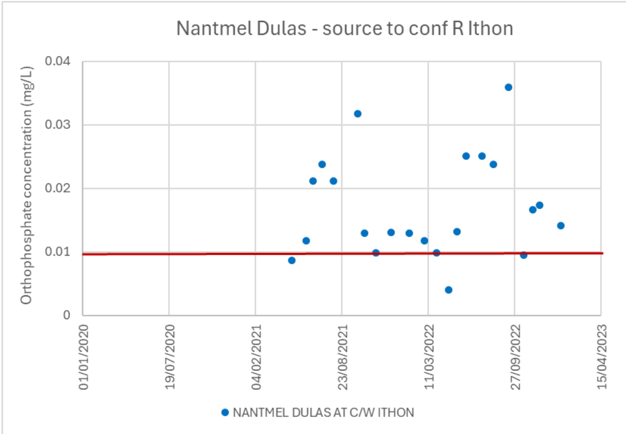

Gwenlas Bk - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
GWENLAS BROOK FROM ROADBRIDGE U/S ITHON

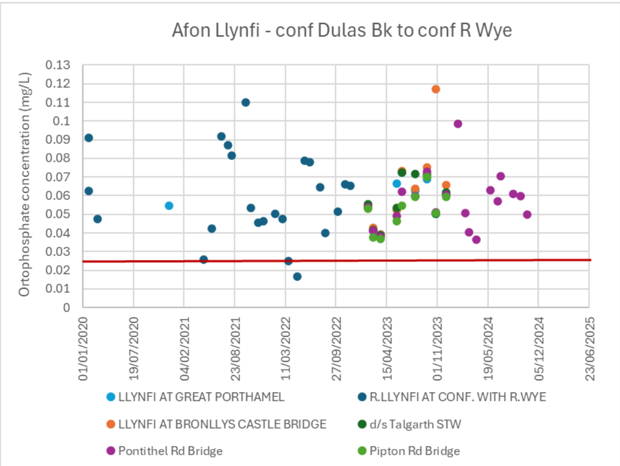

Howey Bk - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
HOWEY BROOK AT CONFL.R.ITHON

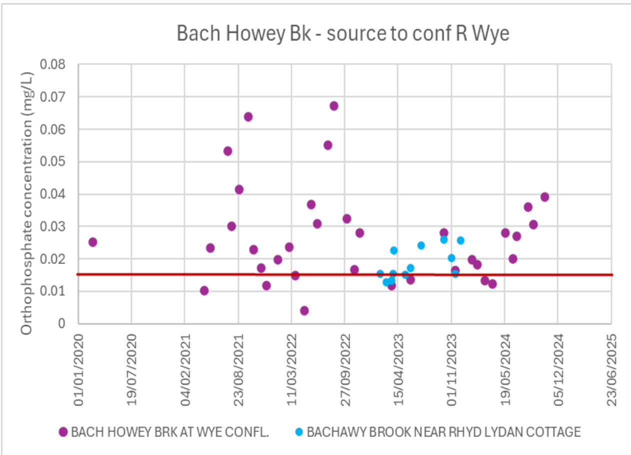

Ithon - conf Gwenlas Bk to conf Camddwr Bk
Orthophosphate concentration (mg/L)
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
R ITHON AT LLANBADARN FYNDD

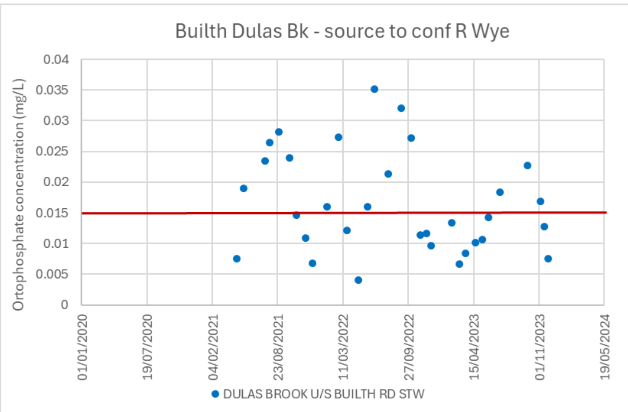

Ithon - source to conf Llaethdy Bk
Orthophosphate concentration (mg/L)
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
ITHON BELOW CONFLUENCE OF BLUE LINS BRK

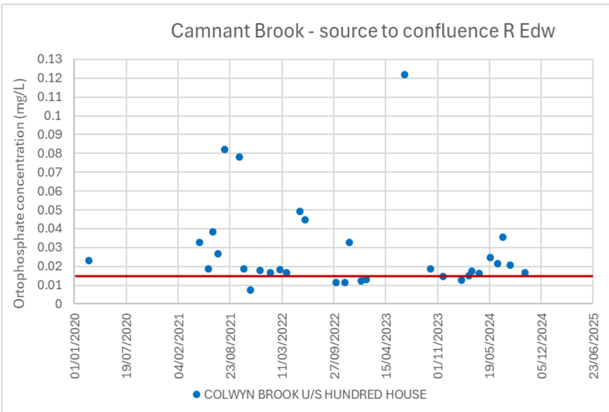

Mithil Bk - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
MITHIL BROOK U/S LLANDEGLEY STW

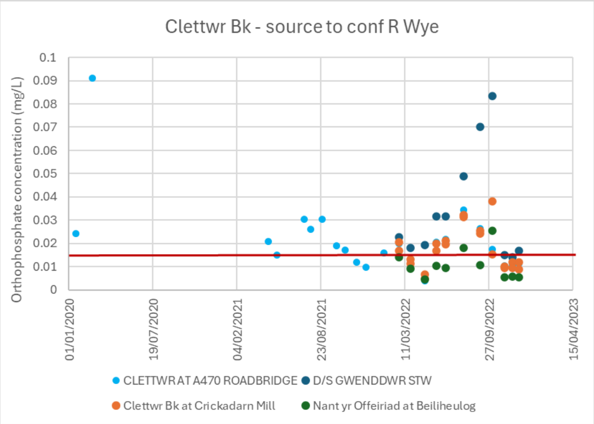

Nantmel Dulas - source to conf R Ithon
Orthophosphate concentration (mg/L)
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
NANTMEL DULAS AT C/W ITHON

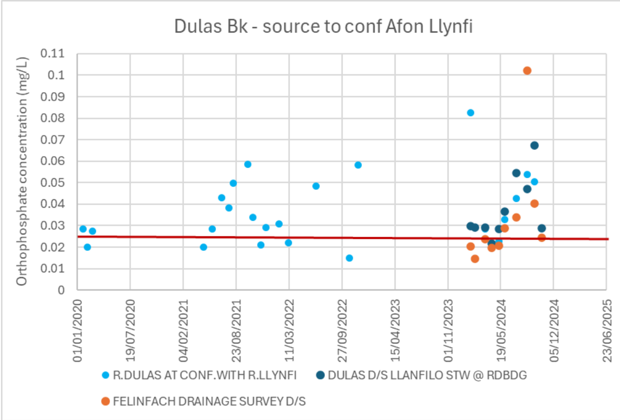

Afon Llynfi - conf Dulas Bk to conf R Wye
Ortophosphate concentration (mg/L)
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
LLYNFI AT GREAT PORTHAMEL
R.LLYNFI AT CONF. WITH R.WYE
LLYNFI AT BRONLLYS CASTLE BRIDGE
d/s Talgarth STW
Pontithel Rd Bridge
Pipton Rd Bridge

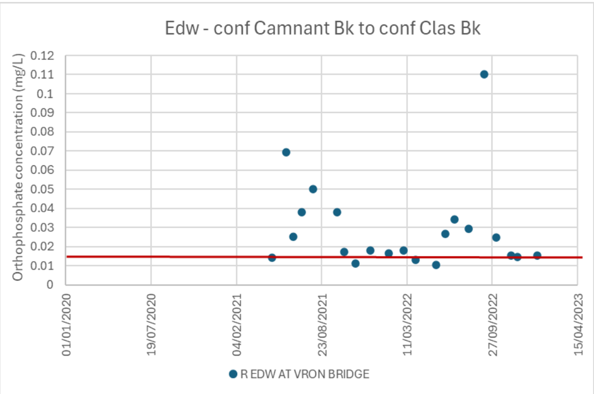

Bach Howey Bk - source to conf R Wye
Orthophosphate concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
BACH HOWEY BRK AT WYE CONFL.
BACHAWY BROOK NEAR RHYD LYDAN COTTAGE

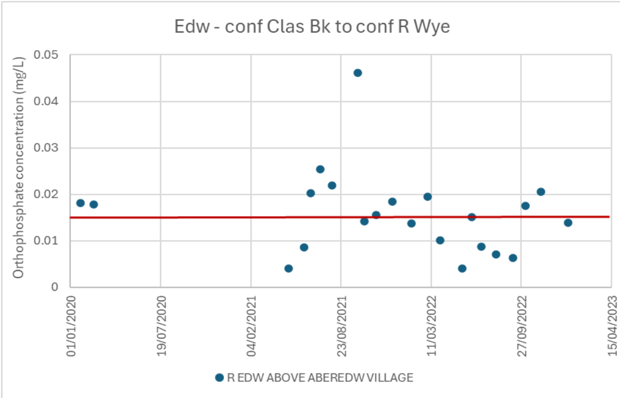

Builth Dulas Bk - source to conf R Wye
Ortophosphate concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
DULAS BROOK U/S BUILTH RD STW

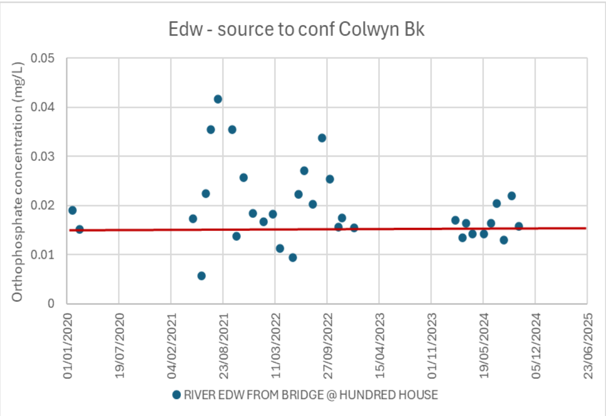

Camnant Brook - source to confluence R Edw
Ortophosphate concentration (mg/L)
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2020
19/07/2020
04/02/2021
23/08/2021
11/03/2022
27/09/2022
15/04/2023
01/11/2023
19/05/2024
05/12/2024
23/06/2025
COLWYN BROOK U/S HUNDRED HOUSE

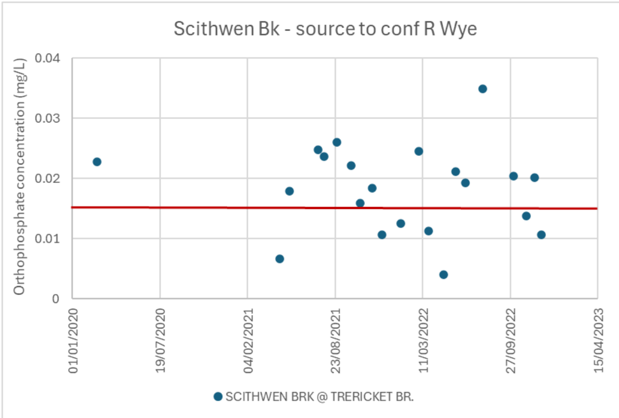

Clettwr Bk - source to conf R Wye
Orthophosphate concentration (mg/L)
CLETTWR AT A470 ROADBRIDGE
D/S GWENDDWR STW
Clettwr Bk at Crickadarn Mill
Nant yr Offeiriad at Beiliheulog

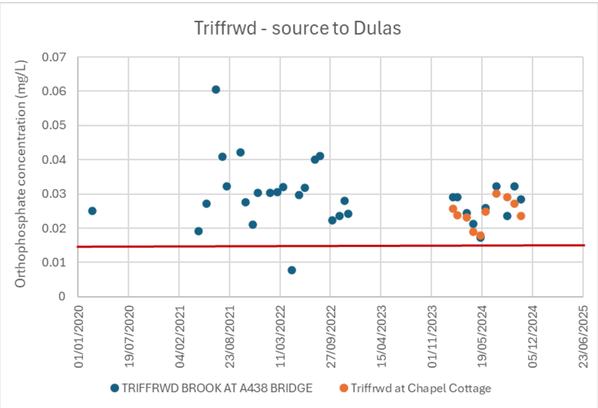

Dulas Bk - source to conf Afon Llynfi
Orthophosphate concentration (mg/L)
R.DULAS AT CONF.WITH R.LLYNFI
DULAS D/S LLANFILO STW @ RDBDG
FELINFACH DRAINAGE SURVEY D/S

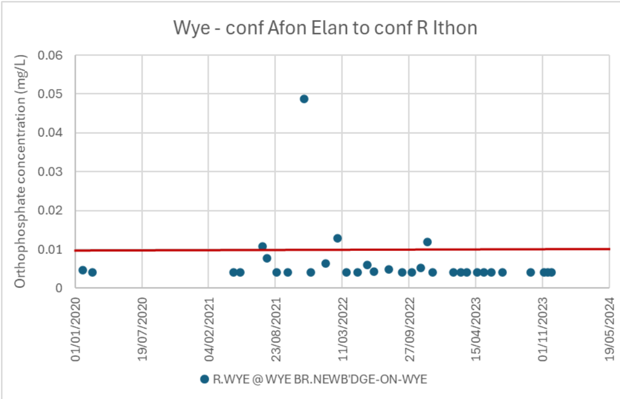

Edw - conf Camnant Bk to conf Clas Bk
Orthophosphate concentration (mg/L)
R EDW AT VRON BRIDGE


Edw - conf Clas Bk to conf R Wye
Orthophosphate concentration (mg/L)
R EDW ABOVE ABEREDW VILLAGE


Edw - source to conf Colwyn Bk
Orthophosphate concentration (mg/L)
RIVER EDW FROM BRIDGE @ HUNDRED HOUSE


Scithwen Bk - source to conf R Wye
Orthophosphate concentration (mg/L)
SCITHWEN BRK @ TRERICKET BR.


Triffrwd - source to Dulas
Orthophosphate concentration (mg/L)
TRIFFRWD BROOK AT A438 BRIDGE
Triffrwd at Chapel Cottage


Wye - conf Afon Elan to conf R Ithon
Orthophosphate concentration (mg/L)
R.WYE @ WYE BR.NEWB'DGE-ON-WYE

# APPENDIX C CITIZEN SCIENCE

Friends of the River Wye have sampled the water at 24 locations along the river's length using a Hanna meter over a period of five years to help identify locations along the river/tributaries that may not be achieving set targets for concentrations of orthophosphate (OP). Of the 24 locations sampled by Friends of the Wye, 12 sites recorded a mean phosphate concentration below that of the designated target (highlighted green, Table 32). Of the 24 sites, 12 recorded a mean phosphate concentration greater than their respective target orthophosphate concentration (highlighted in red), with the *Afon Cammarch source to confluence with the River Irfon* recorded the highest mean phosphate concentration (0.21ppm) relative to its target (0.03ppm), suggesting an increased risk of water quality deterioration at this site relative to all other sites sampled.

Table 32 Average phosphate concentrations relative to phosphate targets (ppm) (WFD) (data from March 2020 – March 2025) (WyeViz: WyeViz (Wye Alliance Citizen Science dashboard) | Tableau Public)

| Water body | Samples | Target (OP (ppm)) | Phosphate (Hanna meter, ppm) | Actual/ Target |
|---|---|---|---|---|
| *Afon Cammarch - source to conf R Irfon* | 8 | 0.03 | 0.21 | 6.9 |
| *Afon Chwefru - source to conf R Irfon* | 9 | 0.03 | 0.01 | 0.2 |
| *Afon Garth Dulas - source to conf R Irfon* | 13 | 0.03 | 0.00 | 0.0 |
| *Afon Llynfi - conf Dulas Bk to conf R Wye* | 472 | 0.08 | 0.17 | 2.2 |
| *Aran - source to conf R Ithon* | 118 | 0.05 | 0.07 | 1.5 |
| *Bach Howey Bk - source to conf R Wye* | 22 | 0.05 | 0.04 | 0.9 |
| *Builth Dulas Bk - source to conf R Wye* | 32 | 0.05 | 0.02 | 0.3 |
| *Camddwr Bk - source to conf R Ithon* | 21 | 0.04 | 0.04 | 1.1 |
| *Clettwr Bk - source to conf R Wye* | 46 | 0.05 | 0.05 | 1.2 |
| *Clywedog Bk - source to conf Bachell Bk* | 15 | 0.03 | 0.01 | 0.2 |
| *Duhonw - source to conf R Wye* | 86 | 0.05 | 0.08 | 1.8 |
| *Dulas Bk - source to conf Afon Llynfi* | 67 | 0.08 | 0.16 | 2.0 |
| *Edw - source to conf Colwyn Bk* | 21 | 0.05 | 0.08 | 1.7 |
| *Irfon - conf Cledan to conf R Wye* | 255 | 0.03 | 0.03 | 0.9 |
| *Ithon - conf Camddwr Bk to conf R Wye* | 384 | 0.08 | 0.04 | 0.5 |
| *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 186 | 0.03 | 0.06 | 1.8 |
| *Scithwen Bk - source to conf R Wye* | 52 | 0.05 | 0.04 | 0.9 |
| *Triffrwd - source to Dulas* | 37 | 0.05 | 0.05 | 1.2 |
| *Wye - conf Afon Bidno to conf Afon Marteg* | 25 | 0.03 | 0.02 | 0.6 |
| *Wye - conf R Irfon to Scithwen Bk* | 87 | 0.05 | 0.11 | 2.2 |
| *Wye - conf to conf Afon Marteg to conf Afon Elan* | 160 | 0.06 | 0.04 | 0.7 |
| *Wye - conf Walford Bk to Bigsweir Br* | 598 | 0.12 | 0.13 | 1.1 |

| Water body | Samples | Target (OP (ppm)) | Phosphate (Hanna meter, ppm) | Actual/ Target |
|---|---|---|---|---|
| *Wye - Scithwen Bk to Brewardine Br* | 836 | 0.06 | 0.05 | 0.8 |
| *Wye (Avon Gwy) - conf R Ithon to conf R Irfon* | 77 | 0.05 | 0.04 | 0.9 |

# APPENDIX D DETAILED DESCRIPTION OF PUBLISHED DATA

This Appendix includes a detailed description of the main findings on water quality issues, pollution sources and mitigation measures reported in published reports.

## D.1 NRW WELSH PART OF THE SEVERN RIVER BASIN MANAGEMENT PLAN (2021-2027)

The River Wye faces significant phosphorus pollution challenges, primarily due to diffuse agricultural pollution and sewage discharges. Agricultural activities, including the use of fertilizers and manure, contribute to high levels of phosphorus entering the river. Additionally, sewage discharges from treatment plants and CSOs exacerbate the problem, releasing untreated or partially treated sewage containing phosphorus into the river during heavy rainfall events. The widespread phosphorus breaches in the River Wye SAC highlight the need for targeted actions to address this issue.

In addition to phosphorus, other nutrients such as nitrates and ammonia also contribute to water quality issues in the River Wye. Sewage discharges are a major source of these nutrients, with sewage containing high levels of nitrates and ammonia. CSOs further contribute to nutrient pollution, releasing untreated or partially treated sewage into the river during heavy rainfall events. Poor land management practices in rural areas also exacerbate nutrient pollution through soil erosion and runoff.

To mitigate phosphorus and overall nutrient pollution, several measures have been implemented. The Wye and Usk Foundation has undertaken riverine habitat restoration work, and the SAC Nutrients Project focuses on improving water quality through collaboration with various stakeholders. Nutrient Management Plans are being developed and implemented to reduce nutrient loading from agricultural sources. The Water Industry Investment Programme, including DCWW's 2020-25 business plan (AMP7), allocates significant funds for environmental improvements, such as reducing the impacts of high spilling CSOs. The Storm Overflow Roadmap, developed by a taskforce including NRW, Welsh Government, Ofwat, DCWW, and Hafren Dyfrdwy, aims to investigate and improve the management of storm overflows. NRW also works with the agricultural sector on sustainable land management, to co-produce a strategic approach to tackle agricultural pollution. This includes regulation, voluntary actions, advice, guidance, skills development, and investment in innovation. Additionally, enhanced monitoring and investigations, as part of the UK Chemicals Investigation Programme (UKCIP), are conducted to understand pollution sources better; and public awareness campaigns aim to reduce nutrient pollution from misconnections and harmful substance disposal. Overall, future plans emphasize nature-based solutions and local actions within Opportunity Catchments to further reduce phosphorus pollution.

## D.2 RIVER POLLUTION SUMMIT EVIDENCE PACK

The River Wye faces significant phosphorus pollution challenges, with around 67% of its water bodies failing to meet the tightened phosphorus targets. The main sources of phosphorus pollution include sewage treatment works (23%), rural land use (72%), storm overflows (2%), and other sources such as ST and urban run-off (3%). This pollution has also negatively impacted housing development, halting many schemes due to high phosphorus levels.

To address these issues, NRW and DCWW have implemented a model to understand phosphorus sources and explore improvement strategies. Additionally, regulations like the Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 aim to tackle nutrient pollution, with £44.5 million made available between 2018 and 2021 to support farmers in reducing farm pollution through capital infrastructure improvements. Local authorities are also working on measures to address phosphorus pollution, including planning conditions to permit development only after phosphate treatment works are completed.

Moreover, training and guidance are provided through an HRA training program for planners and ecologists, and the revised guidance from NRW helps local planning authorities screen specific development types and consider phosphorus reduction technology for private treatment works.

RBMPs take an holistic approach to managing waters within the wider ecosystem, identifying Opportunity Catchments for the third cycle of River Basin Planning (2021-2027) to deliver long-term benefits for waterbodies, habitats, and species. NRW leads several projects, including a River Restoration Programme to reduce diffuse pollution and improve water quality, and The Dairy Project, which aims to reduce agricultural pollution by visiting dairy farms and offering compliance advice.

## D.3 LANCASTER UNIVERSITY REPHOKUS REPORT (UK AND WHOLE CATCHMENT)

The Wye catchment has a high risk of agricultural P loss due to high P input pressure, poorly-buffered and highly dispersible P-rich soils, steep slopes and moderate to high rainfall.

Farming in the Wye catchment generates an annual P surplus (i.e. unused P) of ca. 3000t (17kg P/ha). This P surplus is nearly 60% greater than the national average and is driven by the large amounts of livestock manure produced in the catchment.

Analysis of long-term river P concentration data for the Wye catchment outlet at Redbrook suggests river P pollution may be gradually rising again, but more consistent and higher frequency water quality monitoring is required to confirm. Clear evidence of positive links between annual P input pressure (and P surplus) and river P concentrations and loads exists at regional and catchment scales and this should drive a greater emphasis on reducing the P input pressure in the Wye catchment.

EA/NRW water quality monitoring programmes are not considered adequate to capture river quality impacts of short-term or small area changes in agricultural practice. Similarly, the general provision of up-to-date census data is not at a sufficiently fine resolution to accurately quantify spatially distributed P input pressure in catchments. These are both generic problems confounding provision of robust evidence of cause and effect.

Water quality in the Wye catchment, and many other livestock-dominated catchments, will not greatly improve without reducing the agricultural P surplus and drawing-down P-rich soils to at least the agronomic optimum. This will take many years.

A combination of reducing the number of livestock and processing of livestock manures to recover renewable fertilisers that can substitute for imported P products is needed to effectively reduce the P surplus.

Catchment stakeholders have a nascent capacity to change practice but require a firmer evidence base and on-the-ground support to implement both incremental and transformative change in practices to improve river water quality. Experience in Northern Ireland suggests support schemes have a measurable impact on behavioural change.

The Wye catchment faces a significant risk of phosphorus loss from agriculture due to high P input pressures, poorly buffered and highly dispersible P-rich soils, steep slopes, and moderate to high rainfall.

## D.4 NRW CORE MANAGEMENT PLAN

River SACs designated under the Habitats Regulations 2017 overlap river water bodies designated under Water Framework Directive Regulations. Water quality targets and standards for SAC rivers are set via agreement at a UK-level and presented to and revised by the CSM guidance through the Joint Nature Conservation Committee (JNCC) (JNCC, 2025a). In 2009, Welsh Ministers decided that where SAC and SPA conservation objectives are more stringent than 'Good Ecological Status' (GES) as defined in the WFD, they (and the standards they contain) are the objectives referred to in Article 4(1c) of the WFD. In relation to Phosphorus, the process for Phosphorus standards includes an alignment procedure to ensure standards are never less stringent than WFD Phosphorus standards for the same water body; if WFD standards are more stringent than CSM standards, the WFD standards applies therefore.

Reactive Phosphorus - The process also includes an alignment procedure to ensure that standards are never less stringent than the WFD phosphorus standard for the same water body. If the WFD standard is more stringent than the CSM standard then the WFD standard applies.

Six out of 45 WFD water bodies in the Wye are classified as at risk of acidification however, to comply with CSM guidance, acid standards have been applied for all relevant water bodies in the catchment.

## D.5 NRW PRIORITY IMPROVEMENT PLANS (PIPS)

Prioritised Improvement Plans (PIPs) are prioritised, costed actions plans that are produced for each SAC and SPA in Wales to help maintain or improve condition status of designated habitats and species features of the site. PIPs are not formal consultation documents and should be used to indicate the priority of conservation management issues at designated sites to support collaboration and discussion of future management decisions. First produced as part of the NRW LIFE Natura 2000 Programme, the aim is to provide a current reflection of NRW-hosted Actions Database Safle.

The purpose of RBMPs is to protect and improve the water environment for the wider benefits to people and wildlife. It includes a summary of measures needed to achieve WFD Regulation objectives together with the predicted environmental outcomes.

# APPENDIX E ECOLOGY DATA ASSESSMENT

**Diatoms**

The ecological status of diatoms was assessed using the Average of two replicated Trophic Diatom Index (TDI) calculations, i.e. TDI3 and TDI4 data. TDI values are indicative of the ecological health of the water body, with values ranging from 20 to 50 generally considered to represent good ecological status. Specifically:

- **TDI > 20**: Indicates good ecological status.
- **TDI > 50**: Indicates high ecological status.

**Macroinvertebrates**

The classification of macroinvertebrates was based on the WHPT (Walley, Hawkes, Paisley, Trigg) scoring system, which has replaced the BMWP (Biological Monitoring Working Party) scoring system under the WFD for RBMP. The WHPT system provides updated taxon scores related to susceptibility to pollution, with the most susceptible families scoring the highest. The methodology includes:

- **Taxon Scores**: Scores are adjusted based on the total abundance of individuals found within each family. Pollution-tolerant families have their scores adjusted down when high abundance is present, and up when low abundance is present. Conversely, families susceptible to pollution have their scores adjusted up when high abundance is present, and down when low abundance is present.
- **Indices Derived**:
  - **ASPT (Average Score Per Taxon)**: Calculated by dividing the BMWP or WHPT score by the NST (Number of Scoring Taxa). ASPT scores are considered less sensitive to differences in sampling effort and provide a more reliable means of assessing biological quality.
    - **ASPT > 5**: Indicative of reasonably good water quality.
    - **ASPT > 6**: Indicative of exceptionally good quality.
    - **ASPT < 5**: Indicative of poor water quality.

The NRW macroinvertebrate dataset also includes ‘wfd_awic_eqr’ and corresponding ‘wfd_awic_status_class’ data. The WFD-AWICS method generates EQRs via type-specific reference conditions based on a mixture of chemical (dissolved organic carbon, DOC) and geographical factors. This method is primarily designed to respond to anthropogenic acidification and has been calibrated against pH and ANC environmental gradients. It can also be applicable to nutrient load impacts, such as eutrophication, which can result in water pH changes and related acidification. However, this index was not used in this study since not all sites were assessed and we used WHPT_ASTP data as approximate values for a more complete dataset.

**Macrophytes**

The ecological status of macrophytes was assessed using RMNI (River Macrophyte Nutrient Index). RMNI focuses on nutrient levels in rivers, particularly nitrogen and phosphorus. It is useful for assessing nutrient enrichment and its impact on macrophyte communities. The following classes were used in the assessment:

- **High Ecological Status**: RMNI scores typically below 5, indicating low nutrient levels and a healthy macrophyte community.
- **Good Ecological Status**: RMNI scores between 5 and 6, suggesting moderate nutrient levels and a relatively healthy ecosystem.
- **Moderate Ecological Status**: RMNI scores between 6 and 7, indicating higher nutrient levels and some ecological stress.
- **Poor Ecological Status**: RMNI scores between 7 and 8, reflecting significant nutrient enrichment and ecological degradation.
- **Bad Ecological Status**: RMNI scores above 8, indicating very high nutrient levels and severe ecological stress.

# APPENDIX F SAGIS MODEL OUTPUTS

Table 33 details the SAGIS outputs of phosphorus concentration from each sector in mg/L and Table 34 provides the percentage contribution from each sector calculated from the SAGIS outputs for all failing waterbodies.

Table 33 SAGIS modelling data for all failing waterbodies in mg/L.

| Main catchment | Operational catchment | Reference number | Water body name | Target | Wastewater (mg/l) | Intermittents (CSOs) (mg/l) | Other (mg/l) | Rural (mg/l) |
|---|---|---|---|---|---|---|---|---|
| Lugg | Arrow Lugg and Frome | 1 | *Gilwern Bk - source to conf R Arrow* | WFD | 0.000 | <0.000 | 0.006 | 0.064 |
| | Lugg | 2 | *Norton Bk - source to conf R Lugg* | WFD | 0.018 | <0.000 | 0.004 | 0.083 |
| Upper Wye | Irfon | 3 | *Afon Chwefru - source to conf R Irfon* | SAC | 0.002 | <0.000 | 0.001 | 0.015 |
| | | 4 | *Afon Gwesyn - source to conf R Irfon* | SAC | 0.000 | 0.000 | <0.000 | 0.013 |
| | | 5 | *Cledan - source to conf R Irfon* | SAC | 0.000 | 0.000 | <0.000 | 0.012 |
| | Ithon | 6 | *Aran - source to conf R Ithon* | SAC | 0.000 | 0.000 | <0.000 | 0.025 |
| | | 7 | *Camddwr Bk - source to conf R Ithon* | SAC | 0.000 | 0.000 | 0.001 | 0.015 |
| | | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | SAC | 0.001 | 0.000 | <0.000 | 0.013 |
| | | 9 | *Clywedog Bk - source to conf Bachell Bk* | SAC | 0.004 | 0.000 | <0.000 | 0.005 |
| | | 10 | *Gwenlas Bk - source to conf R Ithon* | SAC | 0.000 | 0.000 | <0.000 | 0.026 |
| | | 11 | *Howey Bk - source to conf R Ithon* | SAC | 0.000 | <0.000 | <0.000 | 0.046 |
| | | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | SAC | 0.002 | <0.000 | 0.000 | 0.011 |
| | | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | SAC | 0.000 | 0.000 | <0.000 | 0.006 |
| | | 14 | *Ithon - source to conf Llaethdy Bk* | SAC | 0.000 | 0.000 | <0.000 | 0.009 |
| | | 15 | *Mithil Bk - source to conf R Ithon* | SAC | 0.012 | <0.000 | <0.000 | 0.021 |
| | | 16 | *Nantmel Dulas - source to conf R Ithon* | SAC | 0.000 | 0.000 | 0.007 | 0.014 |
| | Wye - Ithon to Hay | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | SAC | 0.013 | <0.000 | 0.004 | 0.058 |
| | | 18 | *Bach Howey Bk - source to conf R Wye* | SAC | 0.001 | <0.000 | 0.002 | 0.028 |

| Main catchment | Operational catchment | Reference number | Water body name | Target | Wastewater (mg/l) | Intermittents (CSOs) (mg/l) | Other (mg/l) | Rural (mg/l) |
|---|---|---|---|---|---|---|---|---|
| | | 19 | *Builth Dulas Bk - source to conf R Wye* | SAC | 0.006 | <0.000 | <0.000 | 0.018 |
| | | 20 | *Camnant Brook - source to confluence R Edw* | SAC | 0.001 | <0.000 | <0.000 | 0.031 |
| | | 21 | *Clettwr Bk - source to conf R Wye* | SAC | 0.001 | <0.000 | 0.003 | 0.031 |
| | | 22 | *Dulas Bk - source to conf Afon Llynfi* | SAC | 0.004 | <0.000 | 0.004 | 0.054 |
| | | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | SAC | 0.000 | <0.000 | <0.000 | 0.025 |
| | | 24 | *Edw - conf Clas Bk to conf R Wye* | SAC | 0.001 | <0.000 | <0.000 | 0.022 |
| | | 25 | *Edw - source to conf Colwyn Bk* | SAC | 0.000 | 0.000 | <0.000 | 0.017 |
| | | 26 | *Scithwen Bk - source to conf R Wye* | SAC | 0.000 | 0.000 | 0.001 | 0.019 |
| | | 27 | *Triffrwd - source to Dulas* | SAC | 0.003 | 0.000 | 0.002 | 0.042 |
| | | 28 | *Afon Llynfi - source to conf Dulas Bk* | WFD | 0.000 | <0.000 | 0.012 | 0.134 |
| | | 29 | *Clyro Bk - source to conf R Wye* | WFD | 0.017 | <0.000 | 0.009 | 0.138 |
| | | 30 | *Digedi Bk - source to conf R Wye* | WFD | 0.021 | <0.000 | 0.013 | 0.147 |
| | Wye source to Ithon | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | WFD | 0.000 | 0.000 | <0.000 | 0.011 |
| | | 32 | *Afon Claerwen - source to conf Afon Arban* | WFD | 0.000 | 0.000 | 0.000 | 0.011 |
| | | 33 | *Wye - conf Afon Elan to conf R Ithon* | SAC | 0.003 | <0.000 | 0.001 | 0.003 |
| Lower Wye | Trothy | 34 | *Llanymynech Bk - source to conf R Trothy* | WFD | 0.007 | <0.000 | 0.008 | 0.145 |
| | | 35 | *Llymon Bk - source to conf R Trothy* | WFD | 0.000 | <0.000 | 0.002 | 0.081 |
| | | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | WFD | 0.002 | <0.000 | 0.004 | 0.087 |
| | | 37 | *Trothy - conf Llymon Bk to conf R Wye* | WFD | 0.009 | <0.000 | 0.005 | 0.106 |
| | Wye OC | 38 | *Tintern Bk - source to conf R Wye* | WFD | 0.000 | 0.000 | 0.027 | 0.081 |

Table 34 Percentage contribution of phosphorus concentration from each sector (derived from SAGIS).

| Main catchment | Operational catchment | Water body name | Wastewater | Intermittents (CSOs) | Agriculture | Other |
|---|---|---|---|---|---|---|
| Lugg | Arrow Lugg and Frome | *1 Gilwern Bk - source to conf R Arrow* | 0% | 0% | 92% | 8% |
| | Lugg | *2 Norton Bk - source to conf R Lugg* | 17% | 0% | 78% | 4% |
| Upper Wye | Irfon | *3 Afon Chwefru - source to conf R Irfon* | 9% | 0% | 87% | 4% |
| | | *4 Afon Gwesyn - source to conf R Irfon* | 0% | 0% | 98% | 2% |
| | | *5 Cledan - source to conf R Irfon* | 0% | 0% | 97% | 3% |
| | Ithon | *6 Aran - source to conf R Ithon* | 0% | 0% | 100% | 0% |
| | | *7 Camddwr Bk - source to conf R Ithon* | 0% | 0% | 93% | 7% |
| | | *8 Clywedog Bk - conf Bachell Bk to conf R Ithon* | 7% | 0% | 92% | 1% |
| | | *9 Clywedog Bk - source to conf Bachell Bk* | 46% | 0% | 54% | 1% |
| | | *10 Gwenlas Bk - source to conf R Ithon* | 0% | 0% | 100% | 0% |
| | | *11 Howey Bk - source to conf R Ithon* | 0% | 1% | 99% | 0% |
| | | *12 Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 13% | 0% | 87% | 0% |
| | | *13 Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | 0% | 0% | 99% | 1% |
| | | *14 Ithon - source to conf Llaethdy Bk* | 0% | 0% | 99% | 1% |
| | | *15 Mithil Bk - source to conf R Ithon* | 35% | 0% | 64% | 1% |
| | | *16 Nantmel Dulas - source to conf R Ithon* | 0% | 0% | 66% | 34% |
| | Wye - Ithon to Hay | *17 Afon Llynfi - conf Dulas Bk to conf R Wye* | 17% | 1% | 76% | 6% |
| | | *18 Bach Howey Bk - source to conf R Wye* | 2% | 0% | 92% | 6% |
| | | *19 Builth Dulas Bk - source to conf R Wye* | 26% | 0% | 73% | 1% |
| | | *20 Camnant Brook - source to confluence R Edw* | 4% | 0% | 95% | 1% |
| | | *21 Clettwr Bk - source to conf R Wye* | 3% | 0% | 90% | 7% |
| | | *22 Dulas Bk - source to conf Afon Llynfi* | 7% | 0% | 87% | 6% |
| | | *23 Edw - conf Camnant Bk to conf Clas Bk* | 1% | 0% | 98% | 1% |
| | | *24 Edw - conf Clas Bk to conf R Wye* | 3% | 0% | 96% | 1% |
| | | *25Edw - source to conf Colwyn Bk* | 0% | 0% | 99% | 1% |
| | | *26 Scithwen Bk - source to conf R Wye* | 0% | 0% | 97% | 3% |

| Main catchment | Operational catchment | Water body name | Wastewater | Intermittents (CSOs) | Agriculture | Other |
|---|---|---|---|---|---|---|
| | | *27 Triffrwd - source to Dulas* | 6% | 0% | 89% | 5% |
| | | *28 Afon Llynfi - source to conf Dulas Bk* | 0% | 0% | 92% | 8% |
| | | *29 Clyro Bk - source to conf R Wye* | 10% | 0% | 84% | 5% |
| | | *30 Digedi Bk - source to conf R Wye* | 12% | 0% | 81% | 7% |
| | Wye source to Ithon | *31 Afon Claerwen - conf Afon Arban to Caban-coch* | 0% | 0% | 99% | 1% |
| | | *32 Afon Claerwen - source to conf Afon Arban* | 0% | 0% | 100% | 0% |
| | | *33 Wye - conf Afon Elan to conf R Ithon* | 45% | 1% | 41% | 12% |
| Lower Wye | Trothy | *34 Llanymynech Bk - source to conf R Trothy* | 4% | 0% | 91% | 5% |
| | | *35 Llymon Bk - source to conf R Trothy* | 0% | 0% | 97% | 3% |
| | | *36 Trothy - conf Llanymynach Bk to conf Llymon Bk* | 2% | 0% | 94% | 4% |
| | | *37 Trothy - conf Llymon Bk to conf R Wye* | 8% | 0% | 88% | 4% |
| | Wye OC | *38 Tintern Bk - source to conf R Wye* | 0% | 0% | 75% | 25% |

# APPENDIX G FARMSCOPER MODELLING

The baseline phosphorus load from agriculture was modelled in Farmscoper Upscale V5 for the Wye catchment.

Livestock numbers were increased to represent the increase in poultry numbers (as outlined by Natural England, 2024) and the land areas were increased to represent the land that the poultry farms would need to spread manure on and achieved a nitrogen limit of below 170 kg N per ha as per regulatory requirements (Table 35 and Table 36).

Table 35 Changes to poultry numbers in Farmscoper Upscale V5

| | Layers (Caged) | Layers (Uncaged) | Pullet | Broilers | Turkeys | Breeding Birds | Other Poultry | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Default | 214,725 | 319,798 | 305,918 | 1,687,751 | 71,843 | 186,347 | 44,826 | 2,831,209 |
| New | 2,254,621 | 3,357,881 | 3,212,143 | 17,721,382 | 754,351 | 1,956,644 | 470,674 | 29,727,696 |

Table 36 Changes to poultry farm land areas in Farmscoper Upscale V5

| Cropping | Default area (ha) | New area (ha) |
|---|---|---|
| Permanent Pasture | 23 | 300 |
| Rotational Grassland | 9 | 100 |
| Rough Grazing | 2 | 2 |
| Winter Wheat | 16 | 350 |
| Winter Barley | 2 | 125 |
| Spring Barley | 1 | 75 |
| Winter OSR | 5 | 5 |
| Maize | 0 | 0 |
| Potatoes | 2 | 2 |
| Sugar Beet | 1 | 1 |
| Peas | 0 | 0 |
| Beans | 1 | 1 |
| Fodder Crops | 1 | 1 |
| Other Crops | 2 | 2 |
| Vegetables (Brassica) | 0 | 0 |
| Vegetables (Other) | 0 | 0 |
| Orchards | 4 | 4 |
| Soft Fruit | 1 | 1 |
| Bare Fallow | 1 | 1 |
| Land for outdoor pigs | 1 | 1 |
| Set Aside | 0 | 0 |
| Woodland | 6 | 6 |

# APPENDIX H SECTOR SHARE AND PHOSPHORUS CONCENTRATION REDUCTIONS

The following sections outline the methodology used to identify current and target in-river phosphorus concentration and phosphorus concentration reductions required by each sector

## H.1 CURRENT AND TARGET PHOSPHORUS CONCENTRATION

The average annual phosphorus concentration and target concentrations for each waterbody was identified from the most recent compliance assessment (NRW 2025c). The monitoring point locations are presented in Figure 27. The phosphorus concentration and target phosphorus concentrations for each waterbody identified from the compliance assessment is detailed in Table 37.

Figure 27: Welsh Wye NRFA flow gauges

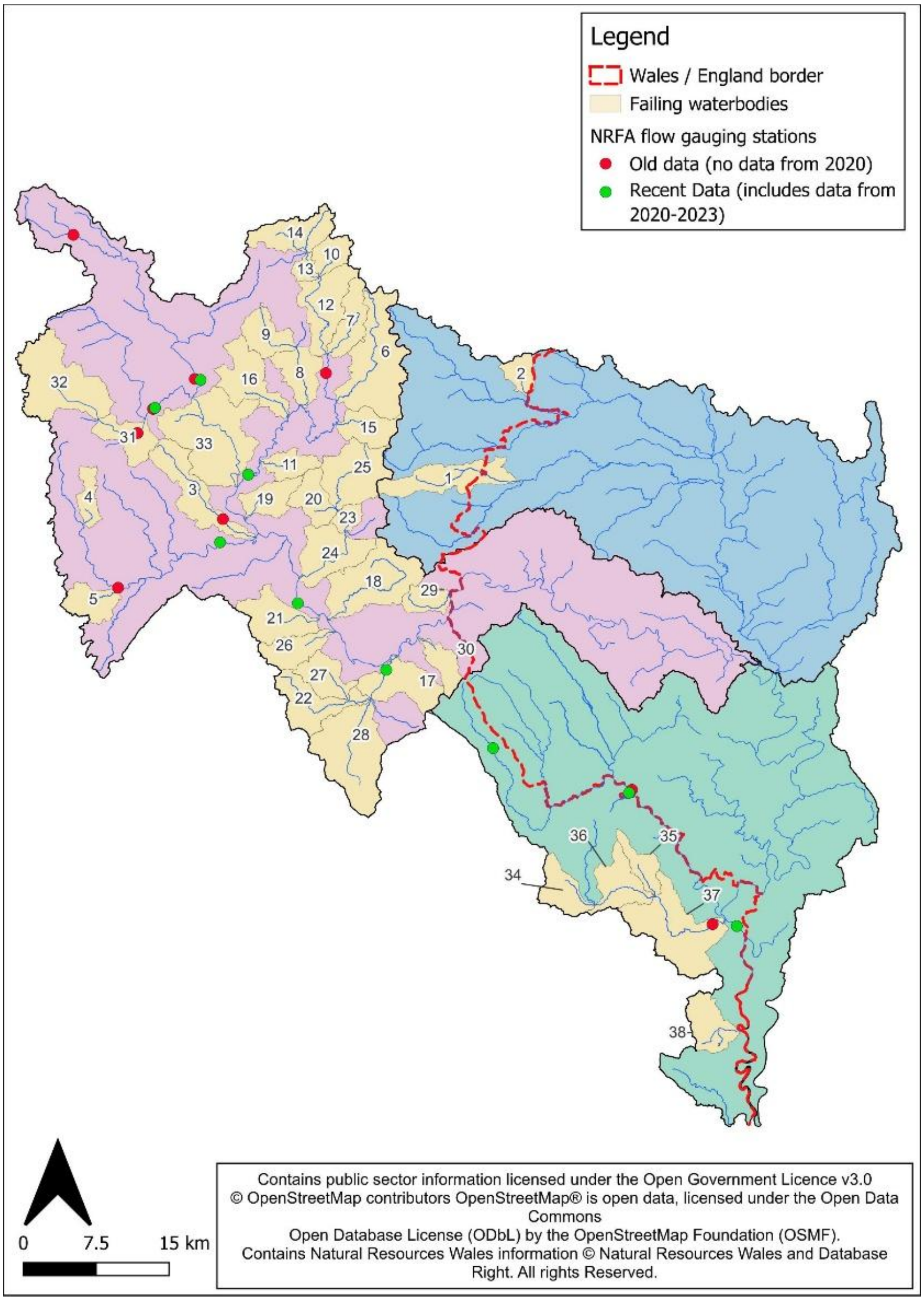


Table 37 Estimated current and target in-river phosphorus concentration per failing waterbody.

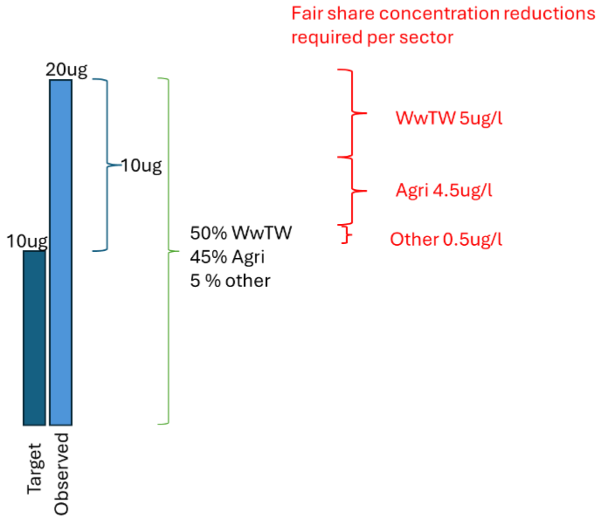
| Main catchment | Ref | Water body name | Average annual P concentration (mg/l) | Target concentration (mg/l) |
|---|---|---|---|---|
| Lugg | 1 | *Gilwern Bk - source to conf R Arrow* | - | 0.05 |
| | 2 | *Norton Bk - source to conf R Lugg* | 0.11 | 0.04 |
| Upper Wye | 3 | *Afon Chwefru - source to conf R Irfon* | 0.02 | 0.01 |
| | 4 | *Afon Gwesyn - source to conf R Irfon* | 0.01 | 0.01 |
| | 5 | *Cledan - source to conf R Irfon* | 0.02 | 0.01 |
| | 6 | *Aran - source to conf R Ithon* | 0.02 | 0.02 |
| | 7 | *Camddwr Bk - source to conf R Ithon* | 0.02 | 0.01 |
| | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | 0.01 | 0.01 |
| | 9 | *Clywedog Bk - source to conf Bachell Bk* | 0.01 | 0.01 |
| | 10 | *Gwenlas Bk - source to conf R Ithon* | 0.03 | 0.01 |
| | 11 | *Howey Bk - source to conf R Ithon* | 0.04 | 0.02 |
| | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 0.01 | 0.01 |
| | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | 0.01 | 0.01 |
| | 14 | *Ithon - source to conf Llaethdy Bk* | 0.01 | 0.01 |
| | 15 | *Mithil Bk - source to conf R Ithon* | 0.04 | 0.02 |
| | 16 | *Nantmel Dulas - source to conf R Ithon* | 0.02 | 0.01 |
| | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | 0.06 | 0.03 |
| | 18 | *Bach Howey Bk - source to conf R Wye* | 0.03 | 0.02 |
| | 19 | *Builth Dulas Bk - source to conf R Wye* | 0.02 | 0.02 |
| | 20 | *Camnant Brook - source to confluence R Edw* | 0.05 | 0.02 |
| | 21 | *Clettwr Bk - source to conf R Wye* | 0.02 | 0.02 |
| | 22 | *Dulas Bk - source to conf Afon Llynfi* | 0.03 | 0.03 |
| | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | 0.04 | 0.02 |
| | 24 | *Edw - conf Clas Bk to conf R Wye* | 0.02 | 0.02 |
| | 25 | *Edw - source to conf Colwyn Bk* | 0.02 | 0.02 |

| Main catchment | Ref | Water body name | Average annual P concentration (mg/l) | Target concentration (mg/l) |
|---|---|---|---|---|
| | 26 | *Scithwen Bk - source to conf R Wye* | 0.02 | 0.02 |
| | 27 | *Triffrwd - source to Dulas* | 0.03 | 0.02 |
| | 28 | *Afon Llynfi - source to conf Dulas Bk* | 0.08 | 0.05 |
| | 29 | *Clyro Bk - source to conf R Wye* | 0.08 | 0.06 |
| | 30 | *Digedi Bk - source to conf R Wye* | 0.08 | 0.06 |
| | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | 0.04 | 0.03 |
| | 32 | *Afon Claerwen - source to conf Afon Arban* | 0.00 | 0.03 |
| | 33 | *Wye - conf Afon Elan to conf R Ithon* | 0.01 | 0.01 |
| Lower Wye | 34 | *Llanymynech Bk - source to conf R Trothy* | 0.13 | 0.08 |
| | 35 | *Llymon Bk - source to conf R Trothy* | 0.09 | 0.09 |
| | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | 0.09 | 0.08 |
| | 37 | *Trothy - conf Llymon Bk to conf R Wye* | 0.10 | 0.08 |
| | 38 | *Tintern Bk - source to conf R Wye* | - | 0.08 |

## H.2 SECTOR PERCENTAGE CONCENTRATION REDUCTION TARGETS

Sector percentage concentration reduction targets were calculated using the following guidance provided by NRW:

Figure 28 Example of fair share methodology provided by NRW.




The following steps were followed to calculate the percentage reductions each sector would need to achieve their "fair share" reduction of phosphorus concentration to achieve SAC and WFD compliance in failing waterbodies, using the SAGIS outputs:

Step 1: Calculate phosphorus exceedance above the target concentration compared to monitored concentration:

$$Exceedance\ (mg/L) = monitored\ concentration\ (mg/L) - target\ concentration\ (mg/L)$$

Step 2: Calculate the percentage contribution of phosphorus concentration attributed to each sector:

$$Phosphorus\ contribution\ from\ each\ sector\ (\%) = (sector\ concentration\ (mg/L)\ /\ total\ concentration\ (mg/L)) \times 100$$

Step 3: Calculate concentration reduction required by each sector to achieve target:

$$Concentration\ reduction\ required\ by\ each\ sector = sector\ concentration\ (mg/L) * percentage\ contribution\ from\ sector\ (\%)$$

Step 4: Calculate sector concentration at target:

$$Sector\ concentration\ at\ target\ (mg/L) = sector\ concentration\ (mg/L) - concentration\ reduction\ required\ by\ sector\ (mg/L)$$

Step 5: Calculate concentration reduction required by each sector as a percentage decrease from the current concentration:

$$Concentration\ reduction\ required\ by\ each\ sector\ (\%) = ((Sector\ concentration\ (mg/L) - sector\ concentration\ at\ target\ (mg/L))\ /\ sector\ concentration\ (mg/L)) \times 100$$

# APPENDIX I AGRICULTURE MITIGATION MEASURES

## I.1 EXISTING MITIGATION MEASURES

Farmscoper Upscale and Evaluate V5 were used to estimate the impact of existing mitigation measures delivered as part of regulatory compliance, best practice or agri-environment scheme measures on phosphorus loading from agriculture. The mitigation measures that can be implemented under The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 were selected and set to a standard current implementation rate of 41% in Farmscoper Evaluate V5 (as derived from Service Level Agreement Inspections) (Welsh government, 2025a). These mitigation measures were:

- Fertiliser spreader calibration.
- Use a fertiliser recommendation system.
- Integrate fertiliser and manure nutrient supply.
- Do not apply manufactured fertiliser to high-risk areas.
- Avoid spreading manufactured fertiliser to fields at high-risk times.
- Do not apply P fertilisers to high P index soils.
- Increase the capacity of farm slurry stores to improve timing of slurry applications.
- Minimise the volume of dirty water produced (sent to dirty water store).
- Minimise the volume of dirty water produced (sent to slurry store).
- Site solid manure heaps away from watercourses/field drains.
- Manure Spreader Calibration.
- Do not apply manure to high-risk areas.
- Do not spread slurry or poultry manure at high-risk times.
- Do not spread FYM to fields at high-risk times.
- Incorporate manure into the soil.
- Capture of dirty water in a dirty water store.

All other mitigation measures remained at the standard implementation level to estimate current uptake of best practices or agri-environment measures (derived from Farmscoper Evaluate V5 prior implementation values, which represent national average rates of mitigation measure implementation on farms). The current uptake of measures input into Farmscoper Evaluate V5 is provided in Table 38.

Table 38 Estimated current level of uptake of mitigation measures input into Farmscoper Evaluate V5.

| Method Name | Current uptake of measures on farms (%) |
|---|---|
| Establish cover crops in the autumn | 2 |
| Early harvesting and establishment of crops in the autumn | 50 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 2 |
| Adopt reduced cultivation systems | 25 |
| Cultivate compacted tillage soils | 25 |
| Cultivate and drill across the slope | 25 |
| Leave autumn seedbeds rough | 10 |
| Manage over-winter tramlines | 10 |
| Establish in-field grass buffer strips | 10 |
| Establish riparian buffer strips | 10 |
| Loosen compacted soil layers in grassland fields | 50 |
| Allow grassland field drainage systems to deteriorate | 2 |
| Ditch management on arable land | 50 |
| Ditch management on grassland | 25 |
| Improved livestock through breeding | 10 |

| Method Name | Current uptake of measures on farms (%) |
|---|---|
| Use plants with improved nitrogen use efficiency | 0 |
| Fertiliser spreader calibration | 41 |
| Use a fertiliser recommendation system | 41 |
| Integrate fertiliser and manure nutrient supply | 41 |
| Do not apply manufactured fertiliser to high-risk areas | 41 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 41 |
| Use manufactured fertiliser placement technologies | 10 |
| Use nitrification inhibitors | 0 |
| Replace urea fertiliser to grassland with another form | 0 |
| Replace urea fertiliser to arable land with another form | 0 |
| Incorporate a urease inhibitor into urea fertilisers for grassland | 0 |
| Incorporate a urease inhibitor into urea fertilisers for arable land | 0 |
| Use clover in place of fertiliser nitrogen | 10 |
| Do not apply P fertilisers to high P index soils | 41 |
| Reduce dietary N and P intakes: Dairy | 10 |
| Reduce dietary N and P intakes: Pigs | 80 |
| Reduce dietary N and P intakes: Poultry | 80 |
| Adopt phase feeding of livestock: Dairy | 80 |
| Adopt phase feeding of livestock: Pigs | 80 |
| Reduce the length of the grazing day/grazing season | 10 |
| Extend the grazing season for cattle | 10 |
| Reduce field stocking rates when soils are wet | 80 |
| Move feeders at regular intervals | 50 |
| Construct troughs with concrete base | 2 |
| Increase scraping frequency in dairy cow cubicle housing | 10 |
| Additional targeted bedding for straw-bedded cattle housing | 10 |
| Washing down of dairy cow collecting yards | 25 |
| Frequent removal of slurry from beneath-slat storage in pig housing | 2 |
| Install air-scrubbers: mechanically ventilated pig housing | 2 |
| Install air-scrubbers: mechanically ventilated poultry housing | 2 |
| More frequent manure removal from laying hen housing with manure belt systems | 10 |
| In-house poultry manure drying | 10 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 41 |
| Adopt batch storage of slurry | 0 |
| Install covers to slurry stores | 10 |
| Allow cattle slurry stores to develop a natural crust | 80 |
| Anaerobic digestion of livestock manures | 0 |
| Minimise the volume of dirty water produced (sent to dirty water store) | 41 |
| Minimise the volume of dirty water produced (sent to slurry store) | 41 |
| Compost solid manure | 2 |
| Site solid manure heaps away from watercourses/field drains | 41 |
| Store solid manure heaps on an impermeable base and collect effluent | 10 |
| Cover solid manure stores with sheeting | 2 |
| Use liquid/solid manure separation techniques | 2 |
| Use poultry litter additives | 0 |

| Method Name | Current uptake of measures on farms (%) |
| --- | --- |
| Manure Spreader Calibration | 41 |
| Do not apply manure to high-risk areas | 41 |
| Do not spread slurry or poultry manure at high-risk times | 41 |
| Use slurry band spreading application techniques | 2 |
| Use slurry injection application techniques | 0 |
| Do not spread FYM to fields at high-risk times | 41 |
| Incorporate manure into the soil | 41 |
| Fence off rivers and streams from livestock | 25 |
| Construct bridges for livestock crossing rivers/streams | 80 |
| Re-site gateways away from high-risk areas | 25 |
| Farm track management | 25 |
| Establish new hedges | 2 |
| Establish and maintain artificial wetlands - steading runoff | 2 |
| Irrigate crops to achieve maximum yield | 2 |
| Establish tree shelter belts around livestock housing | 10 |
| Calibration of sprayer | 50 |
| Fill/Mix/Clean sprayer in field | 25 |
| Avoid PPP application at high risk timings | 10 |
| Drift reduction methods | 25 |
| PPP substitution | 0 |
| Construct bunded impermeable PPP filling/mixing/cleaning area | 2 |
| Treatment of PPP washings through disposal, activated carbon or biobeds | 50 |
| Protection of in-field trees | 0 |
| Management of woodland edges | 2 |
| Management of in-field ponds | 2 |
| Management of arable field corners | 2 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 2 |
| Beetle banks | 2 |
| Uncropped cultivated margins | 2 |
| Skylark plots | 2 |
| Uncropped cultivated areas | 2 |
| Unfertilised cereal headlands | 2 |
| Unharvested cereal headlands | 2 |
| Undersown spring cereals | 2 |
| Management of grassland field corners | 2 |
| Leave residual levels of non-aggressive weeds in crops | 2 |
| Use correctly-inflated low ground pressure tyres on machinery | 25 |
| Locate out-wintered stock away from watercourses | 10 |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 0 |
| Capture of dirty water in a dirty water store | 41 |
| Irrigation/water supply equipment is maintained and leaks repaired | 10 |
| Avoid irrigating at high risk times | 2 |
| Use efficient irrigation techniques (boom trickle, self closing nozzles) | 0 |
| Use high sugar grasses | 10 |
| Monitor and amend soil pH status for grassland | 0 |

| Method Name | Current uptake of measures on farms (%) |
|---|---|
| Increased use of maize silage | 0 |
| Improved crop health | 0 |
| Better health planning: dairy | 0 |
| Better health planning: beef | 0 |
| Better health planning: sheep | 0 |
| Improve livestock through genetic modification | 0 |
| Slurry acidification during storage | 0 |
| Slurry acidification at spreading | 0 |
| Install covers to slurry stores and burn off methane | 0 |
| Use feed additives to reduce enteric methane emissions | 0 |

The mitigation measures were modelled in Farmscoper Upscale V5 as a “set”, this estimates the load from agriculture if all the mitigation measures are implemented at the above level on all applicable land.

## I.2 OTHER ACTIONS

The actions completed by other projects (detailed in section 5.1.1) were matched to the Farmscoper Mitigation Measures list. The locations of the projects were matched to the rainfall bands and the farm types were cross referenced with CORINE 2018 and ESRI satellite, to select the load reduction per ha (kg phosphorus) for the farm type and rainfall band. The method from estimating land area influenced is provided in Table 39.

Table 39 Method and results for calculating estimated phosphorus reduction achieved from other projects.

| Project | Area influenced | Action | Estimated land area (ha) | Method | Phosphorus load reduction per ha from measures (kg) | Total estimated phosphorous load reduction achieved[1] (kg) |
|---|---|---|---|---|---|---|
| **First farm scheme** | 1.6 km of the River Irfon, south-west of Builth Wells. | Watercourse fencing | 16.00 | Assuming minimum of 100m of land adjacent to the river is grazed by livestock. | 0.10 | 1.61 |
| | | Riparian buffer | 0.96 | Assuming riparian buffer is minimum 6m wide. | 0.10 | 0.10 |
| | | Floodplain wetland creation | 16.00 | Assuming minimum of 100m of land adjacent to the river is grazed by livestock. | 0.10 | 1.55 |

[1] Total estimated phosphorous load reduction achieved (kg) = Estimated land area (ha) x Phosphorus load reduction per ha from measures (kg)

In addition, the following mitigation measures were delivered or recommended by catchment stakeholders.

Table 40 Mitigation measures delivered or recommended from various stakeholders.

| Mitigation measures delivered or recommended | Source |
|---|---|
| • The Wye and Usk Foundation have delivered riverine habitat restoration work.<br>• SAC Nutrients Project improved water quality through collaboration with various stakeholders.<br>• Nutrient Management Plans were developed and implemented to reduce nutrient loading from agriculture.<br>• The Water Industry Investment Programme allocated significant funds to reduce the impacts of high spilling CSOs. | NRW Welsh part of the Severn River Basin Management Plan (2021-2027) |

| Mitigation measures delivered or recommended | Source |
|---|---|
| • The Storm Overflow Roadmap, developed by a taskforce including NRW, Welsh Government, Ofwat, DCWW, and Hafren Dyfrdwy, aims to investigate and improve the management of storm overflows.<br>• NRW have created a SAC Nutrients Project to focus on water quality issues in designated rivers (Wye) and marine sites; working with Welsh Government, Planning Authorities, Land Managers and Water Companies to determine the best way to address the situation – locally, there is an NMB for the Wye SAC, used to identify and deliver actions to deliver water quality improvements in the SACs. *Note: NRW have advised The Oversight Group no longer meets in 2025 and their structure will be reviewed under the Ministerial Summit.*<br>• NRW works with the agricultural sector to tackle agricultural pollution including: regulation, voluntary actions, advice, guidance, skills development, and investment in innovation, particularly through the Wales Land Management Forum (WLMF)<br>• Enhanced monitoring and investigations, as part of the UK Chemicals Investigation Programme (UKCIP), are conducted to understand pollution sources.<br>• Public awareness campaigns aim to reduce nutrient pollution from misconnections and harmful substance disposal.<br>• Future plans emphasize nature-based solutions and local actions within Opportunity Catchments to further reduce phosphorus pollution. | |
| • Regulations like the Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 aim to tackle nutrient pollution, with £44.5 million made available between 2018 and 2021 to support farmers in reducing farm pollution through capital infrastructure improvements.<br>• Local authorities are also working on measures to address phosphorus pollution, including planning conditions to permit development only after phosphate treatment works are completed.<br>• Training and guidance are provided through a HRA training program for planners and ecologists, and the revised guidance from NRW helps local planning authorities screen specific development types and consider phosphorus reduction technology for private treatment works.<br>• RBMPs take a holistic approach to managing waters within the wider ecosystem, identifying Opportunity Catchments for the third cycle of River Basin Planning (2021-2027) to deliver long-term benefits for waterbodies, habitats, and species.<br>• NRW leads several projects, including a River Restoration Programme to reduce diffuse pollution and improve water quality, and The Dairy Project (note this has ended at the time of writing), which aims to reduce agricultural pollution by visiting dairy farms and offering compliance advice. | River Pollution Summit Evidence Pack |
| • Long-term improvement requires reducing P-rich soils to agronomic optimum.<br>• Need for processing livestock manures to recover renewable fertilisers. | Lancaster University RephoKUs report |
| • Flow regime, water quality and physical habitat should be maintained in, or restored as far as possible to, a near-natural state, in order to support the coherence of ecosystem structure and function across the whole area of the SAC.<br>• The relatively demanding water quality and spawning substrate quality requirements mean that reduction in diffuse pollution and siltation impacts is a high priority. | NRW Core Management Plans |

| Mitigation measures delivered or recommended | Source |
| --- | --- |
| • Measures to address these problems include the establishment of buffer zones on reaches adjacent to intensively managed livestock grazing or arable land. Tree management, especially coppicing and pollarding to increase light levels to the channel, is also often carried out. Liming has also been carried out in some of the acidified headwaters.<br>• The Wye and Usk Foundation through their pHISH project have carried out much of this work in recent years. Other work has included removal of weirs and construction of fish passes to ease artificial barriers to salmon migration, reduction in exploitation pressure through buying out net fisheries in the estuary and the introduction of 'catch and release' byelaws.<br>• In general, management for other SAC features is expected to result in favourable habitat for bullhead, through improvements in water quality and flow regime and maintenance of suitable physical habitat;<br>• Factors that are important to the favourable conservation status of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation include flow, substrate quality and water quality, which in turn influence species composition and abundance. Favourable management for this feature is therefore largely dependent on ensuring that sufficient depth, velocity and duration of flow and sufficiently low phosphate levels are maintained within the natural range of the vegetation.<br>• To reduce agricultural runoff, preventative measures can include surfacing of tracks and gateways, moving feeding areas, and separating clean and dirty water in farmyards. Farm operations should avoid ploughing land which is vulnerable to soil erosion or leaving such areas without crop cover during the winter.<br>• [For sea lamprey]: the potential impact of flow depletion resulting from a small number of major abstraction licences, if they were to be fully utilised, was highlighted in the Review of Consents process. As a result of this process, flow targets have been set which are considered likely to significantly reduce or remove the potential impacts on SAC features. The species is likely to benefit from positive management for the other SAC features, which could see further improvement in condition. | |
| • Ongoing projects (at the time of publication, 2022): River Restoration Plan 2020 + Salmon for tomorrow; Wye NMB; Wye Catchment Partnership; WFD work / Diffuse pollution farm visits; Water company and non-water company discharge compliance; Central Monmouthshire Opportunity Catchment work.<br>• NRW and DCWW have implemented a programme of water quality modelling to develop an improved understanding of the sources of phosphorus within the catchment, and to explore approaches for improving water quality. In this instance, the form of phosphorus that was modelled was 'orthophosphate'.<br>• £9.5million from the Welsh Government to improve water quality in Wales in 2021-2022, including £802,000 for water quality improvement plans led by NRW to tackle areas affected by increased pollutant levels, such as phosphate. | First Minister's Special Area of Conservation Rivers Summit |
| • NRW and DCWW have implemented a programme of water quality modelling to develop an improved understanding of the sources of phosphorus within the catchment, and to explore approaches for improving water quality. | Phosphorus Source Apportionment Summary: Updating the SAGIS Upper Wye Model |

## I.3 FUTURE MITIGATION MEASURES

### I.3.1 Mitigation scenarios

Farmscoper mitigation measures were categorised into five mitigation scenarios (Table 41) to assess the impact of improving agricultural practices or infrastructure on phosphorus loading from the agricultural sector, if all applicable measures were implemented on 100% of applicable land or farm types in the Wye catchment.

Table 41 Mitigation measure scenarios.

| Mitigation scenario | Description |
|---|---|
| Regulation | Measures that allow maximum regulatory compliance with The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021. |
| Best practice | Regulation + measures that can be implemented to ensure best practice. |
| Welsh agri-environment measures | Regulation + best practice + measures that can be implemented under current agri-environment schemes or grants in Wales. |
| All possible agri-environment measures | Regulation + best practices + Welsh agri-environment measures + all possible measures that can be implemented as part of an agri-environment schemes or grants. |
| All possible measures | All possible measures that can be implemented on farms to improve practices or infrastructure. |

Table 42 provides the level of implementation of each mitigation measure included in each of the five mitigation scenarios that were modelled in Farmscoper Upscale and Evaluate V5.

Table 42 The level of implementation (%) of each mitigation measure included in each mitigation scenario.

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Establish cover crops in the autumn | 2 | 100 | 100 | 100 | 100 |
| Early harvesting and establishment of crops in the autumn | 50 | 100 | 100 | 100 | 100 |
| Cultivate land for crops in spring rather than autumn, retaining over-winter stubbles | 2 | 100 | 100 | 100 | 100 |
| Adopt reduced cultivation systems | 25 | 25 | 25 | 100 | 100 |
| Cultivate compacted tillage soils | 25 | 100 | 100 | 100 | 100 |
| Cultivate and drill across the slope | 25 | 25 | 25 | 100 | 100 |
| Leave autumn seedbeds rough | 10 | 100 | 100 | 100 | 100 |
| Manage over-winter tramlines | 10 | 100 | 100 | 100 | 100 |
| Establish in-field grass buffer strips | 10 | 10 | 10 | 100 | 100 |
| Establish riparian buffer strips | 10 | 100 | 100 | 100 | 100 |
| Loosen compacted soil layers in grassland fields | 50 | 100 | 100 | 100 | 100 |
| Allow grassland field drainage systems to deteriorate | 2 | 2 | 2 | 100 | 100 |
| Ditch management on arable land | 50 | 50 | 100 | 100 | 100 |
| Ditch management on grassland | 25 | 25 | 100 | 100 | 100 |
| Improved livestock through breeding | 10 | 10 | 10 | 10 | 100 |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Use plants with improved nitrogen use efficiency | 0 | 0 | 100 | 100 | 100 |
| Fertiliser spreader calibration | 100 | 100 | 100 | 100 | 100 |
| Use a fertiliser recommendation system | 100 | 100 | 100 | 100 | 100 |
| Integrate fertiliser and manure nutrient supply | 100 | 100 | 100 | 100 | 100 |
| Do not apply manufactured fertiliser to high-risk areas | 100 | 100 | 100 | 100 | 100 |
| Avoid spreading manufactured fertiliser to fields at high-risk times | 100 | 100 | 100 | 100 | 100 |
| Use manufactured fertiliser placement technologies | 10 | 10 | 10 | 100 | 100 |
| Use nitrification inhibitors | 0 | 0 | 0 | 100 | 100 |
| Replace urea fertiliser to grassland with another form | 0 | 0 | 0 | 100 | 100 |
| Replace urea fertiliser to arable land with another form | 0 | 0 | 0 | 100 | 100 |
| Incorporate a urease inhibitor into urea fertilisers for grassland | 0 | 0 | 0 | 100 | 100 |
| Incorporate a urease inhibitor into urea fertilisers for arable land | 0 | 0 | 0 | 100 | 100 |
| Use clover in place of fertiliser nitrogen | 10 | 10 | 100 | 100 | 100 |
| Do not apply P fertilisers to high P index soils | 100 | 100 | 100 | 100 | 100 |
| Reduce dietary N and P intakes: Dairy | 10 | 10 | 10 | 100 | 100 |
| Reduce dietary N and P intakes: Pigs | 80 | 80 | 80 | 100 | 100 |
| Reduce dietary N and P intakes: Poultry | 80 | 80 | 80 | 100 | 100 |
| Adopt phase feeding of livestock: Dairy | 80 | 80 | 80 | 100 | 100 |
| Adopt phase feeding of livestock: Pigs | 80 | 80 | 80 | 100 | 100 |
| Reduce the length of the grazing day/grazing season | 10 | 10 | 10 | 100 | 100 |
| Extend the grazing season for cattle | 10 | 10 | 10 | 100 | 100 |
| Reduce field stocking rates when soils are wet | 80 | 100 | 100 | 100 | 100 |
| Move feeders at regular intervals | 50 | 100 | 100 | 100 | 100 |
| Construct troughs with concrete base | 2 | 2 | 2 | 100 | 100 |
| Increase scraping frequency in dairy cow cubicle housing | 10 | 10 | 100 | 100 | 100 |
| Additional targeted bedding for straw-bedded cattle housing | 10 | 10 | 10 | 100 | 100 |
| Washing down of dairy cow collecting yards | 25 | 25 | 25 | 100 | 100 |
| Frequent removal of slurry from beneath-slat storage in pig housing | 2 | 2 | 2 | 100 | 100 |
| Install air-scrubbers: mechanically ventilated pig housing | 2 | 2 | 2 | 2 | 100 |
| Install air-scrubbers: mechanically ventilated poultry housing | 2 | 2 | 2 | 2 | 100 |
| More frequent manure removal from laying hen housing with manure belt systems | 10 | 10 | 10 | 10 | 100 |
| In-house poultry manure drying | 10 | 10 | 10 | 10 | 100 |
| Increase the capacity of farm slurry stores to improve timing of slurry applications | 100 | 100 | 100 | 100 | 100 |
| Adopt batch storage of slurry | 0 | 0 | 0 | 100 | 100 |
| Install covers to slurry stores | 10 | 10 | 100 | 100 | 100 |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Allow cattle slurry stores to develop a natural crust | 80 | 80 | 80 | 100 | 100 |
| Anaerobic digestion of livestock manures | 0 | 0 | 0 | 100 | 100 |
| Minimise the volume of dirty water produced (sent to dirty water store) | 100 | 100 | 100 | 100 | 100 |
| Minimise the volume of dirty water produced (sent to slurry store) | 100 | 100 | 100 | 100 | 100 |
| Compost solid manure | 2 | 2 | 2 | 100 | 100 |
| Site solid manure heaps away from watercourses/field drains | 100 | 100 | 100 | 100 | 100 |
| Store solid manure heaps on an impermeable base and collect effluent | 10 | 10 | 10 | 100 | 100 |
| Cover solid manure stores with sheeting | 2 | 2 | 100 | 100 | 100 |
| Use liquid/solid manure separation techniques | 2 | 2 | 100 | 100 | 100 |
| Use poultry litter additives | 0 | 0 | 0 | 0 | 100 |
| Manure Spreader Calibration | 100 | 100 | 100 | 100 | 100 |
| Do not apply manure to high-risk areas | 100 | 100 | 100 | 100 | 100 |
| Do not spread slurry or poultry manure at high-risk times | 100 | 100 | 100 | 100 | 100 |
| Use slurry band spreading application techniques | 2 | 2 | 100 | 100 | 100 |
| Use slurry injection application techniques | 0 | 0 | 100 | 100 | 100 |
| Do not spread FYM to fields at high-risk times | 100 | 100 | 100 | 100 | 100 |
| Incorporate manure into the soil | 100 | 100 | 100 | 100 | 100 |
| Fence off rivers and streams from livestock | 25 | 100 | 100 | 100 | 100 |
| Construct bridges for livestock crossing rivers/streams | 80 | 80 | 80 | 100 | 100 |
| Re-site gateways away from high-risk areas | 25 | 25 | 25 | 100 | 100 |
| Farm track management | 25 | 25 | 25 | 100 | 100 |
| Establish new hedges | 2 | 2 | 100 | 100 | 100 |
| Establish and maintain artificial wetlands - steading runoff | 2 | 2 | 2 | 100 | 100 |
| Irrigate crops to achieve maximum yield | 2 | 2 | 2 | 100 | 100 |
| Establish tree shelter belts around livestock housing | 10 | 10 | 100 | 100 | 100 |
| Calibration of sprayer | 50 | 50 | 50 | 100 | 100 |
| Fill/Mix/Clean sprayer in field | 25 | 25 | 25 | 100 | 100 |
| Avoid Plant Protection Products application at high risk timings | 10 | 10 | 10 | 100 | 100 |
| Drift reduction methods | 25 | 25 | 25 | 100 | 100 |
| PPP substitution | 0 | 0 | 0 | 100 | 100 |
| Construct bunded impermeable PPP filling/mixing/cleaning area | 2 | 2 | 2 | 100 | 100 |
| Treatment of PPP washings through disposal, activated carbon or biobeds | 50 | 50 | 50 | 100 | 100 |
| Protection of in-field trees | 0 | 0 | 0 | 0 | 100 |
| Management of woodland edges | 2 | 2 | 100 | 100 | 100 |
| Management of in-field ponds | 2 | 2 | 100 | 100 | 100 |

| Method Name | Regulation | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures |
|---|---|---|---|---|---|
| Management of arable field corners | 2 | 2 | 2 | 2 | 100 |
| Plant areas of farm with wild bird seed / nectar flower mixtures | 2 | 2 | 100 | 100 | 100 |
| Beetle banks | 2 | 2 | 2 | 2 | 100 |
| Uncropped cultivated margins | 2 | 2 | 2 | 2 | 100 |
| Skylark plots | 2 | 2 | 2 | 2 | 100 |
| Uncropped cultivated areas | 2 | 2 | 100 | 100 | 100 |
| Unfertilised cereal headlands | 2 | 2 | 100 | 100 | 100 |
| Unharvested cereal headlands | 2 | 2 | 100 | 100 | 100 |
| Undersown spring cereals | 2 | 100 | 100 | 100 | 100 |
| Management of grassland field corners | 2 | 2 | 2 | 2 | 100 |
| Leave residual levels of non-aggressive weeds in crops | 2 | 2 | 100 | 100 | 100 |
| Use correctly-inflated low ground pressure tyres on machinery | 25 | 100 | 100 | 100 | 100 |
| Locate out-wintered stock away from watercourses | 10 | 100 | 100 | 100 | 100 |
| Use dry-cleaning techniques to remove solid waste from yards prior to cleaning | 0 | 0 | 0 | 0 | 100 |
| Capture of dirty water in a dirty water store | 100 | 100 | 100 | 100 | 100 |
| Irrigation/water supply equipment is maintained and leaks repaired | 10 | 10 | 10 | 10 | 100 |
| Avoid irrigating at high risk times | 2 | 2 | 2 | 2 | 100 |
| Use efficient irrigation techniques (boom trickle, self closing nozzles) | 0 | 0 | 0 | 0 | 100 |
| Use high sugar grasses | 10 | 10 | 10 | 10 | 100 |
| Monitor and amend soil pH status for grassland | 0 | 0 | 0 | 0 | 100 |
| Increased use of maize silage | 0 | 0 | 0 | 0 | 100 |
| Improved crop health | 0 | 0 | 0 | 0 | 100 |
| Better health planning: dairy | 0 | 0 | 0 | 0 | 100 |
| Better health planning: beef | 0 | 0 | 0 | 0 | 100 |
| Better health planning: sheep | 0 | 0 | 0 | 0 | 100 |
| Improve livestock through genetic modification | 0 | 0 | 0 | 0 | 100 |
| Slurry acidification during storage | 0 | 0 | 0 | 0 | 100 |
| Slurry acidification at spreading | 0 | 0 | 0 | 0 | 100 |
| Install covers to slurry stores and burn off methane | 0 | 0 | 100 | 100 | 100 |
| Use feed additives to reduce enteric methane emissions | 0 | 0 | 0 | 0 | 100 |

### I.3.2 P index 2 or below soils

To model the impact of P index 2 or below soils the Farmscoper Upscale V5 create results for each farm type were modified to have 100% of the soils at P index 2 or below. The baseline results were deducted from the baseline results with soils at the at 30% P index 2 or below, 55% at P index 3 and 15% at P index 4 to provide the likely load reduction achieved by farming at optimal or below P indexes (Table 43).

Table 43 Baseline phosphorus load modelled in Farmscoper Upscale V5 for the Wye catchment under current or optimal P indexes.

| | Baseline phosphorus load (kg) |
|---|---|
| Current P index | 187,014 |
| All soils at P index 2 or below | 184,918 |
| Load reduction achieved* | 2,096 |

* *Load reduction achieved (kg) = Current P index phosphorus load - All soils at P index 2 or below phosphorus load.*

The load reduction achieved was deducted from the *"all possible measures"* phosphorus load with the current P index soils to provide a total estimated load from the agricultural sector where soils were at optimal or below P index with all possible mitigation measures in place (a total phosphorus load of 99,854kg and load reduction of 87,160kg relative to the baseline load of 187,014kg).

### I.3.3 Land use change

The impact of land use change was estimated by reducing the farmed area in the Wye catchment modelled in Farmscoper Upscale V5 by 5% (which represents a total reduction of farmland by 21,882ha across the whole of the Wye catchment) and replacing this with woodland, with the different mitigation scenarios in place on the remaining agricultural land.

The farmed area for the whole of the Wye catchment was calculated by multiplying each farm type within each soil type and climate (rainfall) zone by the average area (hectares) per farm type using the results provided from Farmscoper Upscale V5 and the following formula:

$$Farmed\ area\ (ha) = Farm\ count\ \times Area\ per\ farm\ (ha)$$

This area was reduced by 5% to calculate how much land area in hectares could be converted to woodland:

$$Farmland\ reduced\ by\ 5\%\ (ha) = Farm\ area\ \times 0.95$$

The phosphorus load from each farm type calculated in Farmscoper Upscale V5 was converted to kg phosphorus per hectare by:

$$Phosphorus\ load\ per\ ha\ (kg) = Phosphorus\ load\ per\ farm\ (kg)\ \div Area\ per\ farm\ (ha)$$

The total phosphorus load from the remaining agricultural land in production was calculated by:

$$Total\ phosphorus\ load\ (kg) = Farmland\ reduced\ by\ 5\%\ (ha) \times Phosphorus\ load\ per\ ha$$

The total phosphorus load from agriculture from the 5% of converted agricultural land before it was converted to woodland was calculated by:

$$Total\ phosphorus\ load\ (kg) = 5\%\ \text{of farmed area}\ (ha) \times Phosphorus\ load\ per\ ha$$

This was completed for each of the phosphorus loads modelled for each of the five mitigation scenarios (regulation, best practice, Welsh agri-environment measures, all possible agri-environment measures and all possible measures).

The phosphorus load from one hectare of woodland was modelled for each soil type and climate (rainfall) zone combination in Farmscoper Create V5 (Table 44). The soil types include freely draining (FreeDrain), Drained for Arable only (DrainedAr) and Drained for Arable and Grassland (DrainedArGr).

Table 44 Phosphorus load from one hectare of woodland across the different climate and soil types in the Wye catchment.

| Rainfall (mm) | Soil type | Phosphorus load per ha (kg) |
|---|---|---|
| 600 to 700 | FreeDrain | 0.001 |
| | DrainedAr | 0.002 |
| | DrainedArGr | 0.001 |
| 700 to 900 | FreeDrain | 0.002 |
| | DrainedAr | 0.004 |
| | DrainedArGr | 0.002 |
| 900 to 1200 | FreeDrain | 0.008 |
| | DrainedAr | 0.011 |
| | DrainedArGr | 0.008 |
| 1200 to 1500 | FreeDrain | 0.023 |
| | DrainedAr | 0.024 |
| | DrainedArGr | 0.016 |
| Over 1500 | FreeDrain | 0.060 |
| | DrainedAr | 0.056 |
| | DrainedArGr | 0.038 |

The phosphorus load from woodland per ha was then calculated by multiplying the woodland phosphorus load per ha by the land area converted to woodland (5% of farmland) for each farm type respective to the corresponding rainfall and soil type.

The phosphorus load reduction achieved from converting 5% of the agricultural land to woodland was calculated by:

$$Phosphorus\ load\ reduction\ achieved\ (kg) \\ = \text{Phosphorus load from 5\% of agricultural land before coversion to woodland (kg)} \\ - \text{Phosphorus load from woodland (kg)}$$

The new phosphorus load from the agricultural sector was then calculated by:

$$Agricultural\ phosphorus\ load\ (kg) \\ = \text{Phosphorus load from all farmland (kg)} - \text{Phosphorus load reduction achieved (kg)}$$

## Table 45 Extract of results

| Farm | Climate (rainfall) (mm) | Soil | Farm Count | Area per Farm (ha) | Phosphorus per farm (kg) | Total farmed area (ha) | Total phosphorus (kg) | Phosphorus per ha (kg) | Farmland reduced by 5% (ha) | Total phosphorus from farmland reduced by 5% (kg) | Phosphorus load from agriculture before conversion to woodland (kg) | Woodland area (ha) | Phosphorus load from woodland (ha) | Load reduction achieved (kg P) | New load from agriculture with 5% land use change to woodland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arable | 600to700 | FreeDrain | 34 | 105.8 | 5 | 3,597 | 172 | 0.05 | 3,417 | 164 | 9 | 180 | 0.12 | 8 | 164 |
| Arable | 600to700 | DrainedAr | 69 | 105.8 | 27 | 7,300 | 1,880 | 0.26 | 6,935 | 1,786 | 94 | 365 | 0.79 | 93 | 1,787 |
| Arable | 600to700 | DrainedArGr | 4 | 105.8 | 47 | 423 | 190 | 0.45 | 402 | 180 | 9 | 21 | 0.02 | 9 | 180 |
| Arable | 700to900 | FreeDrain | 55 | 105.8 | 15 | 5,819 | 799 | 0.14 | 5,528 | 759 | 40 | 291 | 0.65 | 39 | 760 |
| Arable | 700to900 | FreeDrain | 241 | 105.8 | 15 | 25,498 | 3,502 | 0.14 | 24,223 | 3,327 | 175 | 1,275 | 2.86 | 172 | 3,330 |
| Arable | 700to900 | DrainedAr | 22 | 105.8 | 61 | 2,328 | 1,336 | 0.57 | 2,211 | 1,270 | 67 | 116 | 0.42 | 66 | 1,270 |
| Arable | 700to900 | DrainedAr | 170 | 105.8 | 61 | 17,986 | 10,326 | 0.57 | 17,087 | 9,810 | 516 | 899 | 3.26 | 513 | 9,813 |
| Arable | 700to900 | DrainedArGr | 19 | 105.8 | 84 | 2,010 | 1,602 | 0.80 | 1,910 | 1,522 | 80 | 101 | 0.20 | 80 | 1,522 |
| Arable | 700to900 | DrainedArGr | 24 | 105.8 | 84 | 2,539 | 2,024 | 0.80 | 2,412 | 1,922 | 101 | 127 | 0.25 | 101 | 1,923 |
| Arable | 900to1200 | FreeDrain | 83 | 105.8 | 26 | 8,781 | 2,158 | 0.25 | 8,342 | 2,050 | 108 | 439 | 3.56 | 104 | 2,054 |
| Arable | 900to1200 | FreeDrain | 12 | 105.8 | 26 | 1,270 | 312 | 0.25 | 1,206 | 296 | 16 | 63 | 0.52 | 15 | 297 |
| Arable | 900to1200 | DrainedAr | 46 | 105.8 | 116 | 4,867 | 5,320 | 1.09 | 4,623 | 5,054 | 266 | 243 | 2.57 | 263 | 5,057 |

The results for each farm type and the corresponding soil type and rainfall zone were then summed.

The results show that converting 5% of the agricultural land to woodland and implementing the different mitigation scenarios on the remaining agricultural land could achieve a phosphorus load reduction of between 13,309kg and 64,786kg of phosphorus, which represents a load reduction of between 22% and 50% compared to the baseline (Table 46). Land use change by 5% of the farmed area would reduce the phosphorus load from agriculture by a further 4% compared to no land use change when each mitigation scenario is implemented on the remaining farmed land.

Table 46 The phosphorus load reduction that could be achieved from implementing a range of mitigation scenarios, if all applicable mitigation measures are implemented on all applicable land and farm types across the Wye catchment.

| Mitigation scenario | Phosphorus load (kg) | Phosphorus load reduction (kg) | Phosphorus load reduction (%) |
|---|---|---|---|
| Baseline (no mitigation) | 187,014 | - | - |
| Regulation | 145,292 | 13,309 | 22 |
| Best practice | 118,343 | 40,258 | 37 |
| Welsh agri-environment measures | 106,776 | 51,825 | 43 |
| All possible agri-environment measures | 96,965 | 61,636 | 48 |
| All possible measures | 93,815 | 64,786 | 50 |

### I.3.4 Waterbody catchment load reductions

The load reductions achieved from each mitigation scenario (Table 47) were applied to the current agricultural load to assess whether the load reduction that could be achieved from each mitigation scenario. Table 47 displays the results.

Table 47 Current phosphorus load, load reduction target, and the load reductions that can be achieved from each mitigation measure scenario in the failing waterbodies. Green cells indicate that the target load reduction can be met from the mitigation measure scenario

| Main catchment | Ref | Water body name | Phosphorus load (kg) | Load reduction target (kg) | Load reduction achieved (kg) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| Lugg | 1 | Gilwern Bk - source to conf R Arrow | No data | No data | - | - | - | - | - | - | - |
| Lugg | 2 | Norton Bk - source to conf R Lugg | 568 | 392 | 102 | 184 | 219 | 249 | 258 | 265 | 283 |
| Upper Wye | 3 | Afon Chwefru - source to conf R Irfon | 412 | 153 | 74 | 133 | 159 | 181 | 188 | 192 | 205 |
| Upper Wye | 4 | Afon Gwesyn - source to conf R Irfon | 165 | 59 | 30 | 53 | 64 | 72 | 75 | 77 | 82 |
| Upper Wye | 5 | Cledan - source to conf R Irfon | 343 | 158 | 62 | 111 | 132 | 150 | 156 | 160 | 171 |
| Upper Wye | 6 | Aran - source to conf R Ithon | 593 | 151 | 106 | 192 | 228 | 260 | 270 | 276 | 295 |
| Upper Wye | 7 | Camddwr Bk - source to conf R Ithon | 313 | 147 | 56 | 101 | 121 | 137 | 142 | 146 | 156 |
| Upper Wye | 8 | Clywedog Bk - conf Bachell Bk to conf R Ithon | 419 | 37 | 75 | 136 | 162 | 184 | 191 | 195 | 209 |
| Upper Wye | 9 | Clywedog Bk - source to conf Bachell Bk | 51 | 15 | 9 | 17 | 20 | 22 | 23 | 24 | 25 |
| Upper Wye | 10 | Gwenlas Bk - source to conf R Ithon | 289 | 204 | 52 | 93 | 111 | 126 | 131 | 135 | 144 |
| Upper Wye | 11 | Howey Bk - source to conf R Ithon | 393 | 261 | 71 | 127 | 152 | 172 | 179 | 183 | 196 |
| Upper Wye | 12 | Ithon - conf Gwenlas Bk to conf Camddwr Bk | 256 | 52 | 46 | 83 | 99 | 112 | 117 | 119 | 128 |
| Upper Wye | 13 | Ithon - conf Llaethdy Bk to conf Gwenlas Bk | 395 | 75 | 71 | 128 | 152 | 173 | 179 | 184 | 197 |
| Upper Wye | 14 | Ithon - source to conf Llaethdy Bk | 194 | 14 | 35 | 63 | 75 | 85 | 88 | 90 | 96 |
| Upper Wye | 15 | Mithil Bk - source to conf R Ithon | 409 | 268 | 73 | 132 | 158 | 179 | 186 | 190 | 204 |
| Upper Wye | 16 | Nantmel Dulas - source to conf R Ithon | 310 | 157 | 56 | 100 | 120 | 136 | 141 | 145 | 155 |
| Upper Wye | 17 | Afon Llynfi - conf Dulas Bk to conf R Wye | 3,339 | 1,935 | 600 | 1,081 | 1,288 | 1,463 | 1,519 | 1,556 | 1,664 |
| Upper Wye | 18 | Bach Howey Bk - source to conf R Wye | 1,332 | 716 | 239 | 431 | 513 | 583 | 606 | 621 | 664 |

| Main catchment | Ref | Water body name | Phosphorus load (kg) | Load reduction target (kg) | Load reduction achieved (kg) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| | 19 | Builth Dulas Bk - source to conf R Wye | 199 | 34 | 36 | 64 | 77 | 87 | 90 | 93 | 99 |
| | 20 | Camnant Brook - source to confluence R Edw | 706 | 491 | 127 | 228 | 272 | 309 | 321 | 329 | 352 |
| | 21 | Clettwr Bk - source to conf R Wye | 524 | 180 | 94 | 170 | 202 | 229 | 238 | 244 | 261 |
| | 22 | Dulas Bk - source to conf Afon Llynfi | 470 | 132 | 84 | 152 | 181 | 206 | 214 | 219 | 234 |
| | 23 | Edw - conf Camnant Bk to conf Clas Bk | 1,935 | 1,146 | 348 | 627 | 746 | 848 | 880 | 902 | 965 |
| | 24 | Edw - conf Clas Bk to conf R Wye | 1,235 | 60 | 222 | 400 | 476 | 541 | 562 | 575 | 615 |
| | 25 | Edw - source to conf Colwyn Bk | 740 | 266 | 133 | 240 | 285 | 324 | 337 | 345 | 369 |
| | 26 | Scithwen Bk - source to conf R Wye | 321 | 80 | 58 | 104 | 124 | 141 | 146 | 150 | 160 |
| | 27 | Triffrwd - source to Dulas | 265 | 146 | 48 | 86 | 102 | 116 | 121 | 124 | 132 |
| | 28 | Afon Llynfi - source to conf Dulas Bk | 2,147 | 677 | 386 | 695 | 828 | 940 | 977 | 1,001 | 1,070 |
| | 29 | Clyro Bk - source to conf R Wye | 572 | 106 | 103 | 185 | 221 | 251 | 260 | 267 | 285 |
| | 30 | Digedi Bk - source to conf R Wye | 673 | 157 | 121 | 218 | 260 | 295 | 306 | 314 | 336 |
| | 31 | Afon Claerwen - conf Afon Arban to Caban-coch | 3,446 | 1,101 | 619 | 1,115 | 1,328 | 1,509 | 1,567 | 1,606 | 1,717 |
| | 32 | Afon Claerwen - source to conf Afon Arban | No data | No data | - | - | - | - | - | - | - |
| | 33 | Wye - conf Afon Elan to conf R Ithon | 4,369 | 769 | 785 | 1,414 | 1,684 | 1,913 | 1,987 | 2,036 | 2,177 |
| Lower Wye | 34 | Llanymynech Bk - source to conf R Trothy | 1,275 | 537 | 229 | 413 | 492 | 559 | 580 | 594 | 636 |
| | 35 | Llymon Bk - source to conf R Trothy | 641 | 54 | 115 | 207 | 247 | 281 | 292 | 299 | 319 |
| | 36 | Trothy - conf Llanymynach Bk to conf Llymon Bk | 2,030 | 228 | 365 | 657 | 783 | 889 | 923 | 946 | 1,012 |
| | 37 | Trothy - conf Llymon Bk to conf R Wye | 5,411 | 805 | 972 | 1,751 | 2,086 | 2,370 | 2,461 | 2,522 | 2,696 |
| | 38 | Tintern Bk - source to conf R Wye | No data | No data | - | - | - | - | - | - | - |

### I.3.5 Cost benefit analysis

#### *I.3.5.1 Costs of implementing mitigation measures*

Farmscoper Cost V5 provides annualised capital and operational cost per unit per year for each mitigation measure (see example in Figure 29). The annual unit costs are used to calculate total operational and capital costs per year from mitigation measures modelled in Farmscoper Evaluate V5 across all applicable land and farm types.

Figure 29 Extract from Farmscoper Cost V5 showing estimated costs for establishing cover crops in the autumn, note highlighted yellow cells provide annualised capital and operational costs for each mitigation measure which is used by Farmscoper Evaluate V5 to calculate total cost per of implementing the measure per year.

| | | | |
|---|---|---|---|
| ID | 4 | Name | Establish cover crops in the autumn |
| Category | - | | |
| Description | If land would be 'bare' over-winter, a cover crop is established immediately post-harvest or, at the latest, by mid-September, using light cultivation and low cost seed. In order to protect the soil surface throughout the period when surface runoff could occur, the cover crop is not destoyed until the land is due to be prepared for the following crop. | | |

Go to: Control | Unit Costs | Farm Details | Summary

| | Time | Cost (£) |
|---|---|---|
| Capital | Upfront | 0.00 |
| Capital | Annual | 0.00 |
| Gross Margin | Annual | 0.00 |
| Fixed | Annual | 2,557.92 |
| Total | Annual | 2,557.92 |
| Update Max (95th %) | Annual | 2,702.73 |
| Min (95th %) | Annual | 2,403.93 |
| Units for Cost Per Unit | Area affected | |

| Farm Assumptions | Units | Value |
|---|---|---|
| Spring barley area | ha | 27.00 |
| Potato area | ha | 7.00 |
| Maize area | ha | 10.00 |
| Peas area | ha | 4.00 |

| Other Assumptions | Units | Value |
|---|---|---|
| Area affected | ha | 48.00 |

| Data For Farmscoper_Evaluate | |
|---|---|
| Annual Capital Cost | 0.00 |
| Annual Operating Cost | 53.29 |
| Cost Per Unit | Area (ha) |
| Area Type | Arable |
| Livestock Type | - |
| Waste Type | - |
| Associated Plan | - |

| Description | Type | Amount | Units | Actual Costs (£) Upfront | Actual Costs (£) Annual | Unit Cost Name | Unit Costs (£) Upfront | Unit Costs (£) Annual |
|---|---|---|---|---|---|---|---|---|
| Light harrowing | Fixed | 48.00 | ha | - | 1,108.32 | Light harrowing (farmer) | - | 23.09 |
| Seed broadcasting | Fixed | 48.00 | ha | - | 998.40 | Broadcasting seed (farmer) | - | 20.80 |
| Rolling seed bed | Fixed | 48.00 | ha | - | 451.20 | Rolling seedbed (farmer) | - | 9.40 |

The cost of implementing the mitigation measure scenarios was modelled in Farmscoper Evaluate V5 using the default 2021 cost values from Farmscoper Cost V5. The results were converted to 2025 price year based on a 24% cost increase (Bank of England, 2025) and are presented in Table 48.

Table 48 Estimated costs of implementing the mitigation scenarios (2025 values).

| Mitigation scenario | Annualised capital cost (£/yr) | Annualised operational cost (£/yr) | Total annualised cost (£/yr) |
|---|---|---|---|
| Existing measures | £8,164,614 | £5,460,770 | £13,625,384 |
| Regulatory compliance | £10,384,135 | £7,247,447 | £17,631,582 |
| Best practice | £20,169,382 | £18,856,514 | £39,025,896 |
| Welsh agri-environment measures | £53,829,510 | £38,747,532 | £92,577,042 |
| All possible agri-environment measures | £81,520,746 | £52,829,708 | £134,350,454 |
| All possible measures | £96,804,156 | £77,774,836 | £174,578,993 |
| All possible measures + P index 2 or below soils | £96,804,156 | £78,806,202 | £175,610,359 |

Table 49 displays the estimate cost for the *"All possible measures + 5% land use change"* mitigation scenario. This was calculated by reducing the *"All possible measures"* costs by 5% to represent 5% less agricultural land that the measures would be implemented on. The total cost of broadleaved woodland establishment and maintenance was estimated to be £17,883 over 100 years in 2023 (Forestry Research, 2023). This equates to £18,777 over 100 years in 2025 values, based on a 5% cost increase (Bank of England, 2025). This equates to an estimated annualised capital and operational cost of £188 per ha per year for land use change to woodland. This value was multiplied by the total hectares that would be converted to woodland (21,882ha) to obtain a total annual capital and operational cost for 5% land use change to woodland across the whole of the Wye catchment.

Table 49 Estimated total cost of implementing all possible measures and 5% land use change.

| Mitigation scenario | Total cost (£/yr) |
|---|---|
| All possible measures + 5% land use change | £209,762,813 |

The total costs for each mitigation measure scenario (Table 50) were divided by the total phosphorus load reduction achieved for all farms across the Wye as modelled in Farmscoper Evaluate V5. This provided a total cost per kg phosphorus load reduction achieved. The cost per kg was multiplied by the load reductions achieved in each waterbody catchment to provide a total estimated cost of implementing measures within the mitigation scenarios at the waterbody scale (Table 51).

Table 50 Load reductions, total cost and cost per kg phosphorus load reduction achieved from each mitigation scenario across the whole of the Wye catchment.

| Mitigation scenario | Load reduction achieved (kg/yr) | Total cost (£/yr) | Cost per kg (£/yr) |
|---|---|---|---|
| Existing measures | 24,650 | £13,625,384 | £553 |
| Regulatory compliance | 33,587 | £17,631,582 | £525 |
| Best practice | 60,536 | £39,025,896 | £645 |
| Welsh agri-environment measures | 72,104 | £92,577,042 | £1,284 |
| All possible agri-environment measures | 81,914 | £134,350,454 | £1,640 |
| All possible measures | 85,065 | £174,578,993 | £2,052 |
| All possible measures + P index 2 or below soils | 87,160 | £175,610,359 | £2,015 |
| All possible measures + 5% land use change | 93,199 | £209,762,813 | £2,251 |

Table 51 Total estimated cost of implementing each mitigation scenario in each waterbody catchment (based on the cost effectiveness of the phosphorus load reduction that could be achieved).

| Main catchment | Ref | Water body name | Total cost (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| Lugg | 1 | *Gilwern Bk - source to conf R Arrow* | - | - | - | - | - | - | - |
| | 2 | *Norton Bk - source to conf R Lugg* | £53,572 | £118,576 | £281,285 | £408,209 | £530,439 | £533,573 | £637,341 |
| Upper Wye | 3 | *Afon Chwefru - source to conf R Irfon* | £38,877 | £86,050 | £204,127 | £296,235 | £384,936 | £387,210 | £462,514 |
| | 4 | *Afon Gwesyn - source to conf R Irfon* | £15,556 | £34,432 | £81,680 | £118,536 | £154,029 | £154,939 | £185,071 |
| | 5 | *Cledan - source to conf R Irfon* | £32,326 | £71,550 | £169,730 | £246,317 | £320,071 | £321,962 | £384,577 |
| | 6 | *Aran - source to conf R Ithon* | £55,863 | £123,647 | £293,315 | £425,666 | £553,124 | £556,391 | £664,598 |
| | 7 | *Camddwr Bk - source to conf R Ithon* | £29,514 | £65,326 | £154,965 | £224,890 | £292,229 | £293,955 | £351,123 |
| | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | £39,502 | £87,433 | £207,409 | £300,998 | £391,126 | £393,436 | £469,951 |
| | 9 | *Clywedog Bk - source to conf Bachell Bk* | £4,808 | £10,643 | £25,246 | £36,638 | £47,609 | £47,890 | £57,204 |
| | 10 | *Gwenlas Bk - source to conf R Ithon* | £27,226 | £60,263 | £142,956 | £207,462 | £269,583 | £271,175 | £323,913 |
| | 11 | *Howey Bk - source to conf R Ithon* | £37,060 | £82,030 | £194,591 | £282,396 | £366,953 | £369,121 | £440,907 |
| | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | £24,166 | £53,489 | £126,886 | £184,141 | £239,278 | £240,692 | £287,501 |
| | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | £37,202 | £82,344 | £195,335 | £283,476 | £368,358 | £370,534 | £442,595 |
| | 14 | *Ithon - source to conf Llaethdy Bk* | £18,255 | £40,406 | £95,851 | £139,101 | £180,752 | £181,820 | £217,180 |
| | 15 | *Mithil Bk - source to conf R Ithon* | £38,532 | £85,287 | £202,317 | £293,608 | £381,523 | £383,777 | £458,413 |
| | 16 | *Nantmel Dulas - source to conf R Ithon* | £29,252 | £64,746 | £153,591 | £222,896 | £289,637 | £291,348 | £348,009 |
| | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | £314,834 | £696,857 | £1,653,081 | £2,398,999 | £3,117,331 | £3,135,747 | £3,745,583 |
| | 18 | *Bach Howey Bk - source to conf R Wye* | £125,559 | £277,912 | £659,262 | £956,740 | £1,243,217 | £1,250,561 | £1,493,769 |
| | 19 | *Builth Dulas Bk - source to conf R Wye* | £18,748 | £41,498 | £98,441 | £142,860 | £185,636 | £186,733 | £223,049 |
| | 20 | *Camnant Brook - source to confluence R Edw* | £66,514 | £147,223 | £349,242 | £506,831 | £658,591 | £662,482 | £791,320 |
| | 21 | *Clettwr Bk - source to conf R Wye* | £49,398 | £109,339 | £259,372 | £376,409 | £489,117 | £492,006 | £587,691 |
| | 22 | *Dulas Bk - source to conf Afon Llynfi* | £44,350 | £98,165 | £232,867 | £337,943 | £439,134 | £441,728 | £527,634 |
| | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | £182,477 | £403,896 | £958,119 | £1,390,450 | £1,806,792 | £1,817,466 | £2,170,925 |

| Main catchment | Ref | Water body name | Total cost (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 24 | *Edw - conf Clas Bk to conf R Wye* | £116,397 | £257,633 | £611,157 | £886,928 | £1,152,501 | £1,159,310 | £1,384,771 |
| | 25 | *Edw - source to conf Colwyn Bk* | £69,803 | £154,503 | £366,512 | £531,892 | £691,156 | £695,240 | £830,449 |
| | 26 | *Scithwen Bk - source to conf R Wye* | £30,248 | £66,951 | £158,822 | £230,487 | £299,501 | £301,271 | £359,861 |
| | 27 | *Triffrwd - source to Dulas* | £24,989 | £55,311 | £131,207 | £190,412 | £247,427 | £248,889 | £297,292 |
| | 28 | *Afon Llynfi - source to conf Dulas Bk* | £202,432 | £448,064 | £1,062,896 | £1,542,505 | £2,004,378 | £2,016,219 | £2,408,330 |
| | 29 | *Clyro Bk - source to conf R Wye* | £53,959 | £119,434 | £283,321 | £411,164 | £534,279 | £537,435 | £641,955 |
| | 30 | *Digedi Bk - source to conf R Wye* | £63,482 | £140,512 | £333,321 | £483,725 | £628,566 | £632,280 | £755,245 |
| | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | £324,857 | £719,041 | £1,705,705 | £2,475,368 | £3,216,567 | £3,235,569 | £3,864,818 |
| | 32 | *Afon Claerwen - source to conf Afon Arban* | - | - | - | - | - | - | - |
| | 33 | *Wye - conf Afon Elan to conf R Ithon* | £411,869 | £911,634 | £2,162,574 | £3,138,389 | £4,078,116 | £4,102,209 | £4,900,001 |
| Lower Wye | 34 | *Llanymynech Bk - source to conf R Trothy* | £120,248 | £266,159 | £631,381 | £916,278 | £1,190,639 | £1,197,673 | £1,430,595 |
| | 35 | *Llymon Bk - source to conf R Trothy* | £60,432 | £133,760 | £317,305 | £460,482 | £598,364 | £601,899 | £718,955 |
| | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | £191,403 | £423,652 | £1,004,986 | £1,458,464 | £1,895,172 | £1,906,368 | £2,277,116 |
| | 37 | *Trothy - conf Llymon Bk to conf R Wye* | £510,116 | £1,129,095 | £2,678,433 | £3,887,019 | £5,050,909 | £5,080,748 | £6,068,845 |
| | 38 | *Tintern Bk - source to conf R Wye* | - | - | - | - | - | - | - |

#### I.3.5.2 Monetary benefits

**Agricultural benefit**

The cost benefit to the agricultural sector from implementing the mitigation scenarios was calculated based on the value of phosphorus fertiliser. The value of phosphorus to agriculture was based on the value of triple superphosphate fertiliser (46% phosphorus) at £460 per tonne (46p per kg) (AHDB, 2025), which equates to a cost of £1 per kg of phosphorus. This was calculated using the following formula

$$Phosphorus\ cost\ to\ agriculture\ (£/kg)\ =\ phosphorus\ per\ kg\ (0.46)\ /\ cost\ per\ kg\ (£0.46)$$

The agricultural benefit (reduced fertiliser costs) was calculated by multiplying the phosphorus cost to agriculture by the load reductions achieved in the waterbody catchments (Table 52).

Table 52 Agricultural benefit (£/yr) that could be achieved from fertiliser savings from reduced phosphorus losses in the failing waterbodies.

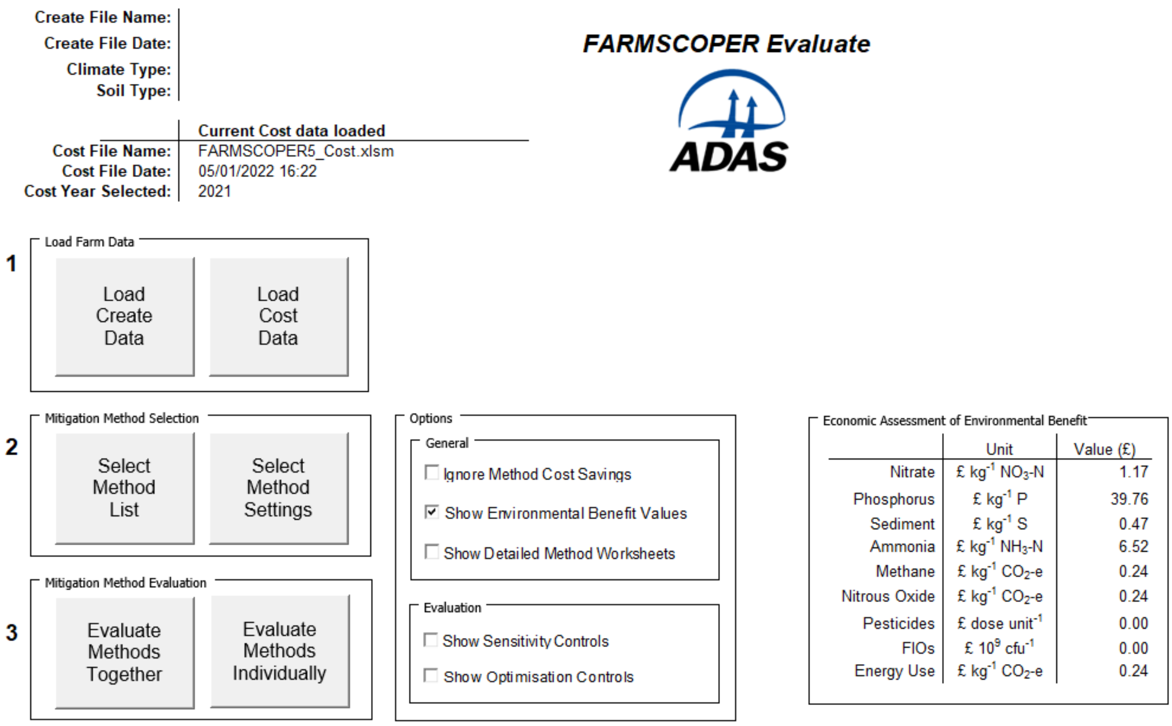
| Main catchment | Ref | Water body name | Agricultural benefit (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| Lugg | 1 | *Gilwern Bk - source to conf R Arrow* | - | - | - | - | - | - | - |
| | 2 | *Norton Bk - source to conf R Lugg* | £102 | £184 | £219 | £249 | £258 | £265 | £283 |
| Upper Wye | 3 | *Afon Chwefru - source to conf R Irfon* | £74 | £133 | £159 | £181 | £188 | £192 | £205 |
| | 4 | *Afon Gwesyn - source to conf R Irfon* | £30 | £53 | £64 | £72 | £75 | £77 | £82 |
| | 5 | *Cledan - source to conf R Irfon* | £62 | £111 | £132 | £150 | £156 | £160 | £171 |
| | 6 | *Aran - source to conf R Ithon* | £106 | £192 | £228 | £260 | £270 | £276 | £295 |
| | 7 | *Camddwr Bk - source to conf R Ithon* | £56 | £101 | £121 | £137 | £142 | £146 | £156 |
| | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | £75 | £136 | £162 | £184 | £191 | £195 | £209 |
| | 9 | *Clywedog Bk - source to conf Bachell Bk* | £9 | £17 | £20 | £22 | £23 | £24 | £25 |
| | 10 | *Gwenlas Bk - source to conf R Ithon* | £52 | £93 | £111 | £126 | £131 | £135 | £144 |
| | 11 | *Howey Bk - source to conf R Ithon* | £71 | £127 | £152 | £172 | £179 | £183 | £196 |
| | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | £46 | £83 | £99 | £112 | £117 | £119 | £128 |
| | 13 | *Ithon - conf Llaethdy Bk to conf Gwenlas Bk* | £71 | £128 | £152 | £173 | £179 | £184 | £197 |
| | 14 | *Ithon - source to conf Llaethdy Bk* | £35 | £63 | £75 | £85 | £88 | £90 | £96 |
| | 15 | *Mithil Bk - source to conf R Ithon* | £73 | £132 | £158 | £179 | £186 | £190 | £204 |
| | 16 | *Nantmel Dulas - source to conf R Ithon* | £56 | £100 | £120 | £136 | £141 | £145 | £155 |
| | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | £600 | £1,081 | £1,288 | £1,463 | £1,519 | £1,556 | £1,664 |
| | 18 | *Bach Howey Bk - source to conf R Wye* | £239 | £431 | £513 | £583 | £606 | £621 | £664 |
| | 19 | *Builth Dulas Bk - source to conf R Wye* | £36 | £64 | £77 | £87 | £90 | £93 | £99 |
| | 20 | *Camnant Brook - source to confluence R Edw* | £127 | £228 | £272 | £309 | £321 | £329 | £352 |
| | 21 | *Clettwr Bk - source to conf R Wye* | £94 | £170 | £202 | £229 | £238 | £244 | £261 |
| | 22 | *Dulas Bk - source to conf Afon Llynfi* | £84 | £152 | £181 | £206 | £214 | £219 | £234 |
| | 23 | *Edw - conf Camnant Bk to conf Clas Bk* | £348 | £627 | £746 | £848 | £880 | £902 | £965 |

| Main catchment | Ref | Water body name | Agricultural benefit (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| | 24 | *Edw - conf Clas Bk to conf R Wye* | £222 | £400 | £476 | £541 | £562 | £575 | £615 |
| | 25 | *Edw - source to conf Colwyn Bk* | £133 | £240 | £285 | £324 | £337 | £345 | £369 |
| | 26 | *Scithwen Bk - source to conf R Wye* | £58 | £104 | £124 | £141 | £146 | £150 | £160 |
| | 27 | *Triffrwd - source to Dulas* | £48 | £86 | £102 | £116 | £121 | £124 | £132 |
| | 28 | *Afon Llynfi - source to conf Dulas Bk* | £386 | £695 | £828 | £940 | £977 | £1,001 | £1,070 |
| | 29 | *Clyro Bk - source to conf R Wye* | £103 | £185 | £221 | £251 | £260 | £267 | £285 |
| | 30 | *Digedi Bk - source to conf R Wye* | £121 | £218 | £260 | £295 | £306 | £314 | £336 |
| | 31 | *Afon Claerwen - conf Afon Arban to Caban-coch* | £619 | £1,115 | £1,328 | £1,509 | £1,567 | £1,606 | £1,717 |
| | 32 | *Afon Claerwen - source to conf Afon Arban* | - | - | - | - | - | - | - |
| | 33 | *Wye - conf Afon Elan to conf R Ithon* | £785 | £1,414 | £1,684 | £1,913 | £1,987 | £2,036 | £2,177 |
| Lower Wye | 34 | *Llanymynech Bk - source to conf R Trothy* | £229 | £413 | £492 | £559 | £580 | £594 | £636 |
| | 35 | *Llymon Bk - source to conf R Trothy* | £115 | £207 | £247 | £281 | £292 | £299 | £319 |
| | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | £365 | £657 | £783 | £889 | £923 | £946 | £1,012 |
| | 37 | *Trothy - conf Llymon Bk to conf R Wye* | £972 | £1,751 | £2,086 | £2,370 | £2,461 | £2,522 | £2,696 |
| | 38 | *Tintern Bk - source to conf R Wye* | - | - | - | - | - | - | - |

### *Environmental benefit*

The environmental benefit of the mitigation measures to reduce nitrate, phosphorus, sediment, ammonia, methane, nitrous oxide, pesticides, faecal indicator organisms (FIOs) and carbon losses to the environment is calculated by Farmscoper Evaluate V5 using standard values (Figure 30).

Figure 30 Standard cost values for environmental benefits used in Farmscoper Evaluate V5, based on 2021 values.




The environmental benefit calculated by Farmscoper Evaluate V5 using 2021 values was calculated to 2025 based on a 24% cost increase (Bank of England, 2025) (Table 53). The environmental benefit per kg phosphorus load reduction achieved was calculated by:

$$Environmental\ benefit\ per\ kg\ phosphorus\ (£/yr) = Environmental\ benefit\ (2025)\ (£/yr) \div Phosphorus\ load\ reduction\ (kg/yr)$$

Table 53 Environmental benefit modelled in Farmscoper Evaluate V5 and equivalent values.

| Mitigation scenario | Phosphorus load reduction (kg/yr) | Environmental benefit (£/yr) | Environmental benefit (2025) (£/yr) | Environmental benefit per kg phosphorus (£/yr) |
|---|---|---|---|---|
| Existing measures | 24,650 | £28,584,702 | £35,445,030 | £1,439 |
| Regulatory compliance | 33,587 | £39,535,429 | £49,023,932 | £1,461 |
| Best practice | 60,536 | £53,462,301 | £66,293,254 | £1,096 |
| Welsh agri-environment measures | 72,104 | £83,412,914 | £103,432,014 | £1,435 |
| All possible agri-environment measures | 81,914 | £98,528,577 | £122,175,435 | £1,493 |
| All possible measures | 85,065 | £124,469,446 | £154,342,113 | £1,815 |
| All possible measures + P index 2 or below soils | 87,160 | £124,469,446 | £154,342,113 | £1,772 |
| All possible measures + 5% land use change | 93,199 | £118,245,974 | £186,008,785 | £1,997 |

The environmental benefit per kg phosphorus was multiplied by the load reductions achieved in each failing waterbody catchment to calculate an estimated environmental benefit from the mitigation scenarios in each waterbody catchment (Table 54).

Table 54 Environmental benefit from the phosphorus load reductions that could be achieved for each mitigation scenario in the failing waterbody catchments.

| Main catchment | Ref | `Water body name | Environmental benefit (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| Lugg | 1 | Gilwern Bk - source to conf R Arrow | - | - | - | - | - | - | - |
| | 2 | Norton Bk - source to conf R Lugg | £149,056 | £201,609 | £314,486 | £371,465 | £469,210 | £469,216 | £565,450 |
| Upper Wye | 3 | Afon Chwefru - source to conf R Irfon | £108,169 | £146,306 | £228,220 | £269,570 | £340,503 | £340,507 | £410,344 |
| | 4 | Afon Gwesyn - source to conf R Irfon | £43,283 | £58,543 | £91,320 | £107,866 | £136,249 | £136,251 | £164,196 |
| | 5 | Cledan - source to conf R Irfon | £89,942 | £121,652 | £189,763 | £224,145 | £283,125 | £283,129 | £341,197 |
| | 6 | Aran - source to conf R Ithon | £155,430 | £210,231 | £327,935 | £387,352 | £489,276 | £489,283 | £589,632 |
| | 7 | Camddwr Bk - source to conf R Ithon | £82,118 | £111,070 | £173,256 | £204,647 | £258,497 | £258,500 | £311,517 |
| | 8 | Clywedog Bk - conf Bachell Bk to conf R Ithon | £109,908 | £148,659 | £231,890 | £273,905 | £345,978 | £345,982 | £416,942 |
| | 9 | Clywedog Bk - source to conf Bachell Bk | £13,378 | £18,095 | £28,226 | £33,340 | £42,113 | £42,114 | £50,751 |
| | 10 | Gwenlas Bk - source to conf R Ithon | £75,754 | £102,463 | £159,830 | £188,788 | £238,465 | £238,468 | £287,376 |
| | 11 | Howey Bk - source to conf R Ithon | £103,116 | £139,471 | £217,559 | £256,977 | £324,596 | £324,600 | £391,174 |
| | 12 | Ithon - conf Gwenlas Bk to conf Camddwr Bk | £67,238 | £90,945 | £141,863 | £167,566 | £211,658 | £211,661 | £255,072 |
| | 13 | Ithon - conf Llaethdy Bk to conf Gwenlas Bk | £103,510 | £140,005 | £218,391 | £257,960 | £325,838 | £325,842 | £392,671 |
| | 14 | Ithon - source to conf Llaethdy Bk | £50,792 | £68,700 | £107,164 | £126,581 | £159,888 | £159,890 | £192,683 |
| | 15 | Mithil Bk - source to conf R Ithon | £107,210 | £145,009 | £226,197 | £267,180 | £337,483 | £337,488 | £406,705 |
| | 16 | Nantmel Dulas - source to conf R Ithon | £81,389 | £110,085 | £171,720 | £202,832 | £256,204 | £256,208 | £308,755 |
| | 17 | Afon Llynfi - conf Dulas Bk to conf R Wye | £875,985 | £1,184,832 | £1,848,198 | £2,183,061 | £2,757,495 | £2,757,532 | £3,323,089 |
| | 18 | Bach Howey Bk - source to conf R Wye | £349,350 | £472,520 | £737,076 | £870,622 | £1,099,711 | £1,099,726 | £1,325,275 |
| | 19 | Builth Dulas Bk - source to conf R Wye | £52,165 | £70,557 | £110,060 | £130,001 | £164,208 | £164,211 | £197,889 |
| | 20 | Camnant Brook - source to confluence R Edw | £185,067 | £250,316 | £390,464 | £461,210 | £582,569 | £582,577 | £702,061 |
| | 21 | Clettwr Bk - source to conf R Wye | £137,444 | £185,903 | £289,987 | £342,527 | £432,657 | £432,663 | £521,400 |

| Main catchment | Ref | `Water body name | Environmental benefit (£/yr) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Regulatory compliance | Best practice | Welsh agri-environment measures | All possible agri-environment measures | All possible measures | All possible measures + P index 2 or below soils | All possible measures + 5% land use change |
| | 22 | Dulas Bk - source to conf Afon Llynfi | £123,399 | £166,905 | £260,353 | £307,524 | £388,444 | £388,449 | £468,118 |
| | 23 | Edw - conf Camnant Bk to conf Clas Bk | £507,717 | £686,724 | £1,071,208 | £1,265,293 | £1,598,233 | £1,598,254 | £1,926,049 |
| | 24 | Edw - conf Clas Bk to conf R Wye | £323,858 | £438,041 | £683,293 | £807,095 | £1,019,467 | £1,019,481 | £1,228,572 |
| | 25 | Edw - source to conf Colwyn Bk | £194,218 | £262,694 | £409,772 | £484,016 | £611,376 | £611,384 | £736,776 |
| | 26 | Scithwen Bk - source to conf R Wye | £84,161 | £113,834 | £177,568 | £209,740 | £264,930 | £264,933 | £319,270 |
| | 27 | Triffrwd - source to Dulas | £69,528 | £94,042 | £146,694 | £173,273 | £218,866 | £218,869 | £263,758 |
| | 28 | Afon Llynfi - source to conf Dulas Bk | £563,240 | £761,822 | £1,188,352 | £1,403,662 | £1,773,010 | £1,773,034 | £2,136,675 |
| | 29 | Clyro Bk - source to conf R Wye | £150,135 | £203,068 | £316,762 | £374,154 | £472,606 | £472,613 | £569,543 |
| | 30 | Digedi Bk - source to conf R Wye | £176,630 | £238,905 | £372,663 | £440,184 | £556,010 | £556,018 | £670,055 |
| | 31 | Afon Claerwen - conf Afon Arban to Caban-coch | £903,870 | £1,222,549 | £1,907,033 | £2,252,556 | £2,845,275 | £2,845,314 | £3,428,874 |
| | 32 | Afon Claerwen - source to conf Afon Arban | - | - | - | - | - | - | - |
| | 33 | Wye - conf Afon Elan to conf R Ithon | £1,145,970 | £1,550,006 | £2,417,827 | £2,855,897 | £3,607,376 | £3,607,425 | £4,347,290 |
| Lower Wye | 34 | Llanymynech Bk - source to conf R Trothy | £334,575 | £452,537 | £705,904 | £833,802 | £1,053,203 | £1,053,217 | £1,269,227 |
| | 35 | Llymon Bk - source to conf R Trothy | £168,143 | £227,425 | £354,757 | £419,033 | £529,294 | £529,301 | £637,858 |
| | 36 | Trothy - conf Llanymynach Bk to conf Llymon Bk | £532,552 | £720,315 | £1,123,607 | £1,327,186 | £1,676,411 | £1,676,434 | £2,020,262 |
| | 37 | Trothy - conf Llymon Bk to conf R Wye | £1,419,329 | £1,919,744 | £2,994,575 | £3,537,142 | £4,467,878 | £4,467,938 | £5,384,291 |
| | 38 | Tintern Bk - source to conf R Wye | - | - | - | - | - | - | - |

The agricultural and environmental monetary benefits were summed to calculate a total benefit (£/yr) for each failing waterbody catchment.

#### *I.3.5.3 Cost benefit*

A cost benefit analysis was completed using the Benefit-Cost Ratio (BCR) method:

$$Cost\ benefit\ (£)\ =\ benefit\ (£)\ /\ cost\ (£)$$

The total benefits (to the environment and farmers) that could be achieved from each mitigation scenario were divided by the total estimated cost of delivering the interventions in each mitigation scenario at the Wye catchment (Table 55).

Table 55 Benefit-cost ratio of each mitigation scenario.

| Mitigation scenario | Phosphorus load (kg/yr) | Total cost (£/yr) | Total benefits (£/yr) | BCR |
|---|---|---|---|---|
| Existing measures | 162,364 | £13,625,384 | £35,469,680 | 2.60 |
| Regulatory compliance | 153,426 | £17,631,582 | £49,057,520 | 2.78 |
| Best practice | 126,478 | £39,025,896 | £66,353,790 | 1.70 |
| Welsh agri-environment measures | 114,910 | £92,577,042 | £103,504,117 | 1.12 |
| All possible agri-environment measures | 105,100 | £134,350,454 | £122,257,349 | 0.91 |
| All possible measures | 101,949 | £174,578,993 | £154,427,178 | 0.88 |
| All possible measures + P index 2 or below soils | 99,854 | £175,610,359 | £154,429,273 | 0.88 |
| All possible measures + 5% land use change | 93,815 | £209,762,813 | £186,101,984 | 0.89 |

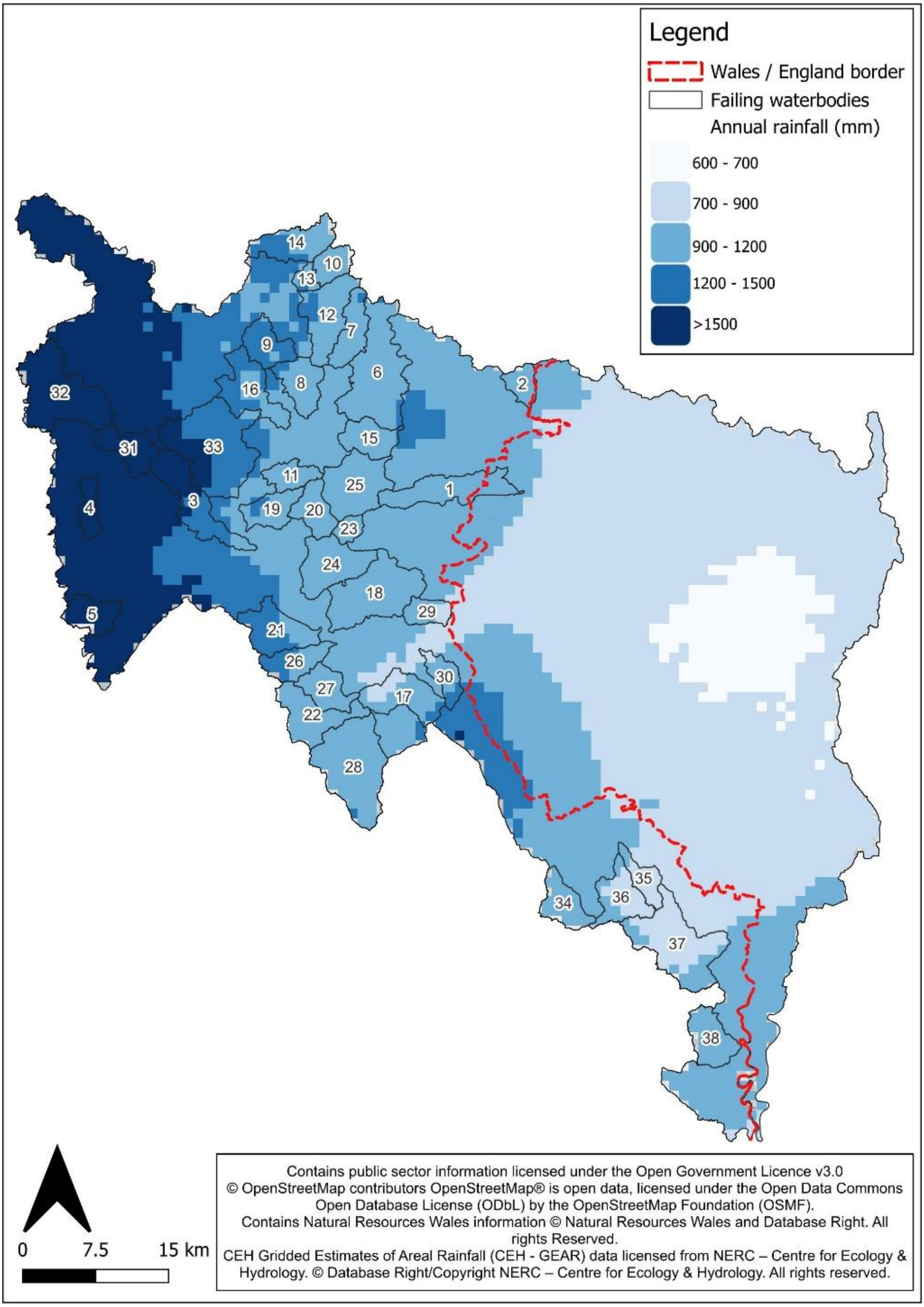
## I.4 INDIVIDUAL MEASURES

The impact of individual measures was modelled in Farmscoper Upscale V5. The results provided the load from each farm type within each rainfall band with the individual measure implemented on 100% of applicable land.

The percentage difference between the load with the measure implemented at 100% relative to the baseline load was calculated. The phosphorus load reduction achieved per hectare was calculated by deducting the percentage difference in phosphorus load achieved from baseline phosphorus export per ha for each farm type in the applicable rainfall and soil type categories. This provided an estimated load reduction per hectare from each farm type within each rainfall area and soil type that was ranked high to low.

The failing water bodies were categorised into rainfall areas (Figure 31) and the land use was assessed using CORINE 2018 and ESRI satellite within each failing waterbody.

Figure 31: Water bodies categorised by rainfall bands.




The analysis produced four mitigation categories that included the rainfall, most likely land use and farm types within each failing waterbody catchment Table 56.

Table 56 Mitigation measure categories which include farms categorised by rainfall band, farm types and practices present and the applicable failing waterbodies these farm types are located in.

| Mitigation measures category | Annual rainfall (mm) | Land use | Farm type / practices | Applicable failing waterbody catchments |
|---|---|---|---|---|
| 1 | >1500mm | Upland Grassland | Extensive Grazing (no fertiliser applied)<br>Extensive Grazing (fertiliser applied)<br>Dairy (grassland) | *Upper Afon Chwefru - source to conf R Irfon*<br>*Afon Claerwen - conf Afon Arban to Caban-coch*<br>*Afon Claerwen - source to conf Afon Arban*<br>*Afon Gwesyn - source to conf R Irfon*<br>*Afon Llynfi - conf Dulas Bk to conf R Wye*<br>*Cledan - source to conf R Irfon* |
| 2 | 1200-1500mm | Upland Grassland | Extensive Grazing (no fertiliser applied)<br>Extensive Grazing (fertiliser applied)<br>Dairy (grassland)<br>Dairy (maize, cereals)<br>Pigs and Poultry (grassland)<br>Pigs and Poultry (arable) | *Lower Afon Chwefru – source to conf R Irfon*<br>*Clywedog Bk - source to conf Bachell Bk*<br>*Ithon - conf Llaethdy Bk to conf Gwenlas Bk*<br>*Ithon - source to conf Llaethdy Bk*<br>*Nantmel Dulas - source to conf R Ithon*<br>*Wye - conf Afon Elan to conf R Ithon*<br>*Ithon - conf Llaethdy Bk to conf Gwenlas Bk*<br>*Ithon - source to conf Llaethdy Bk* |
| 3 | 900-1200mm | Upland Grassland<br>Arable | Extensive Grazing (no fertiliser applied)<br>Extensive Grazing (fertiliser applied)<br>Dairy (grassland)<br>Dairy (maize, cereals)<br>Pigs and Poultry (grassland)<br>Pigs and Poultry (arable)<br>Mixed Livestock (grassland)<br>Mixed Livestock (arable) | *Afon Llynfi - source to conf Dulas Bk*<br>*Aran - source to conf R Ithon*<br>*Bach Howey Bk - source to conf R Wye*<br>*Builth Dulas Bk - source to conf R Wye*<br>*Camddwr Bk - source to conf R Ithon*<br>*Camnant Brook - source to confluence R Edw*<br>*Clettwr Bk - source to conf R Wye*<br>*Clyro Bk - source to conf R Wye*<br>*Clywedog Bk - conf Bachell Bk to conf R Ithon*<br>*Digedi Bk - source to conf R Wye*<br>*Dulas Bk - source to conf Afon Llynfi*<br>*Edw - conf Camnant Bk to conf Clas Bk*<br>*Edw - conf Clas Bk to conf R Wye*<br>*Edw - source to conf Colwyn Bk*<br>*Gilwern Bk - source to conf R Arrow*<br>*Gwenlas Bk - source to conf R Ithon*<br>*Howey Bk - source to conf R Ithon*<br>*Ithon - conf Gwenlas Bk to conf Camddwr Bk*<br>*Llanymynech Bk - source to conf R Trothy*<br>*Mithil Bk - source to conf R Ithon* |

| Mitigation measures category | Annual rainfall (mm) | Land use | Farm type / practices | Applicable failing waterbody catchments |
|---|---|---|---|---|
| | | | | *Norton Bk - source to conf R Lugg*<br>*Scithwen Bk - source to conf R Wye*<br>*Tintern Bk - source to conf R Wye*<br>*Triffrwd - source to Dulas*<br>*Ithon - conf Llaethdy Bk to conf Gwenlas Bk*<br>*Ithon - source to conf Llaethdy Bk* |
| 4 | 700-900mm | Grassland, arable | Extensive Grazing (no fertiliser applied)<br>Extensive Grazing (fertiliser applied)<br>Dairy (grassland)<br>Dairy (maize, cereals)<br>Pigs and Poultry (grassland)<br>Pigs and Poultry (arable)<br>Mixed Livestock (grassland)<br>Mixed Livestock (arable)<br>Arable | Llymon Bk - source to conf R Trothy<br>Trothy - conf Llanymynach Bk to conf Llymon Bk<br>Trothy - conf Llymon Bk to conf R Wye |

The Farmscoper results were then filtered by farm type and rainfall band on drained soils to provide a list of tailored measures and the load reductions that can be achieved per ha within the failing waterbodies on different farm types.

The mitigation practices were then screened based on whether the measure reduced phosphorus loading to surface water. Measures were then categorised for each farm type based on whether there is grassland only on the farm or grassland and arable, as well as whether fertilisers are applied for extensive grazing (to match the 26 farm types in Table 56 above). This provided a tailored list of measures that would be most applicable to a farm based on the rainfall, farm type, land use and fertiliser practices.

For each farm type in the table above within the respective rainfall category, the measures were ranked high to low and the top ten measures were selected. These measures are presented in Section 4.1.2.2. The full list of mitigation measures and the farm type and failing waterbodies they are applicable to has been provided in a separate Excel Workbook.

# APPENDIX J STW UPGRADE CALCULATIONS

Table 57 STW upgrades completed from Phosphate Action Plan (PAP) Recommendations.

| STW | Phosphorus load reduction (kg/yr) | Delivery period |
|---|---|---|
| Aberllynfi (Three Cocks) STW | 45 | AMP8 |
| Beulah STW | 49 | AMP8 |
| Builth Wells STW | 1,850 | AMP7 |
| Crossgates STW | 336 | AMP8 |
| Dingestow STW | No upgrade | |
| Llandewi Ystradenny STW | No upgrade | |
| Llandrindod Wells STW | 368 | AMP7 |
| Llangammarch Wells STW | No upgrade | |
| Llanwrtyd Wells STW | 523 | AMP8 |
| Presteigne STW | 2,081 | AMP7 |
| Rhayader STW | 782 | AMP7 |
| Talgarth STW | 671 | AMP8 |
| Total achieved from PAP actions | 6,914 | |

Table 58 Estimated load reductions achieved from AMP8 STW upgrades in the Upper Wye sub-catchment

| STW Name | WB Name | WB ID | Failing WB | Current Permit (mg/l) | Permitted average dry weather flow ($m^3/d$) | 2030 Permit (mg/l) | Permitted average current load (kg/yr) | Proposed 2030 load (kg/yr) | Load reduction (kg/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|---|---|
| Aberllynfi (Three Cocks) STW | 17. Afon Llynfi - conf Dulas Bk to conf R Wye | GB109055036950 | Yes | 5 | 82.50 | 3.5 | 150.56 | 105.47 | 45.10 | 30 |
| Talgarth STW | 17. Afon Llynfi - conf Dulas Bk to conf R Wye | GB109055036950 | Yes | 2 | 1051.25 | 0.25 | 767.41 | 95.99 | 671.42 | 87 |

| STW Name | WB Name | WB ID | Failing WB | Current Permit (mg/l) | Permitted average dry weather flow ($m^3/d$) | 2030 Permit (mg/l) | Permitted average current load (kg/yr) | Proposed 2030 load (kg/yr) | Load reduction (kg/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|---|---|
| Beulah STW | Afon Cammarch - source to conf R Irfon | GB109055041880 | No | 5 | 67.50 | 3 | 123.19 | 73.96 | 49.22 | 40 |
| Llanwrtyd Wells STW | Irfon - conf Cledan to conf R Wye | GB109055037090 | No | 5 | 477.63 | 2 | 871.67 | 139.56 | 732.10 | 84 |
| Crossgates STW | Ithon - conf Camddwr Bk to conf R Wye | GB109055042270 | No | 5 | 307.00 | 2 | 560.28 | 224.26 | 336.01 | 60 |
| Llanbister STW | 12. Ithon - conf Gwenlas Bk to conf Camddwr Bk | GB109055042140 | Yes | 5 | 18.26 | 4 | 33.33 | 26.68 | 6.65 | 20 |
| Builth Road STW | 19. Builth Dulas Bk - source to conf R Wye | GB109055037160 | Yes | 5 | 32.50 | 3 | 59.31 | 35.61 | 23.70 | 40 |
| Hundred House STW | 20. Camnant Brook - source to confluence R Edw | GB109055042370 | Yes | 5 | 6.38 | 4 | 11.63 | 9.31 | 2.32 | 20 |
| Cilmery STW | 3. Afon Chwefru - source to conf R Irfon | GB109055042190 | Yes | 5 | 28.75 | 4 | 52.47 | 42.00 | 10.47 | 20 |
| Llanigon STW | 30. Digedi Bk - source to conf R Wye | GB109055036980 | Yes | 5 | 40.38 | 0.5 | 73.68 | 7.37 | 66.31 | 90 |
| Painscastle STW | 18. Bach Howey Bk - source to conf R Wye | GB109055037060 | Yes | 5 | 17.50 | 3.5 | 31.94 | 22.37 | 9.57 | 30 |
| Llandegley STW | 15. Mithil Bk - source to conf R Ithon | GB109055041960 | Yes | 5 | 16.25 | 1 | 29.66 | 5.94 | 23.72 | 80 |
| Llanfilo STW | 22. Dulas Bk - source to conf Afon Llynfi | GB109055036920 | Yes | 5 | 16.25 | 2 | 29.66 | 11.87 | 17.79 | 60 |
| Tirabad STW | Tirabad Dulas - source to conf R Irfon | GB109055036690 | No | 5 | 15.00 | 4 | 27.38 | 21.92 | 5.46 | 20 |

Table 59 Estimated phosphorus load reduction from upgrading PTP with exempted discharges

| Sub-catchment | Failing WB Name | Exemption type | Flow ($m^3/d$) | Estimated annual P load (kg/yr) | Estimated P load with an upgraded system (kg/yr) | P load reduction (kg/yr) | % phosphorus load reduction |
|---|---|---|---|---|---|---|---|
| Upper Wye | 3. *Afon Chwefru - source to conf R Irfon* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 5. *Cledan - source to conf R Irfon* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 6. *Aran - source to conf R Ithon* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 8. *Clywedog Bk - conf Bachell Bk to conf R Ithon* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 9. *Clywedog Bk - source to conf Bachell Bk* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub-catchment | Failing WB Name | Exemption type | Flow ($m^3/d$) | Estimated annual P load (kg/yr) | Estimated P load with an upgraded system (kg/yr) | P load reduction (kg/yr) | % phosphorus load reduction |
|---|---|---|---|---|---|---|---|
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 11. *Howey Bk - source to conf R Ithon* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 12. *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 15. *Mithil Bk - source to conf R Ithon* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 16. *Nantmel Dulas - source to conf R Ithon* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 17. *Afon Llynfi - conf Dulas Bk to conf R Wye* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 18. *Bach Howey Bk - source to conf R Wye* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 19. *Builth Dulas Bk - source to conf R Wye* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 22. *Dulas Bk - source to conf Afon Llynfi* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub-catchment | Failing WB Name | Exemption type | Flow (m³/d) | Estimated annual P load (kg/yr) | Estimated P load with an upgraded system (kg/yr) | P load reduction (kg/yr) | % phosphorus load reduction |
|---|---|---|---|---|---|---|---|
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 25. *Edw - source to conf Colwyn Bk* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 26. *Scithwen Bk - source to conf R Wye* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 27. *Triffrwd - source to Dulas* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 28. *Afon Llynfi - source to conf Dulas Bk* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 29. *Clyro Bk - source to conf R Wye* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 30. *Digedi Bk - source to conf R Wye* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 33. *Wye - conf Afon Elan to conf R Ithon* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub-catchment | Failing WB Name | Exemption type | Flow ($m^3/d$) | Estimated annual P load (kg/yr) | Estimated P load with an upgraded system (kg/yr) | P load reduction (kg/yr) | % phosphorus load reduction |
|---|---|---|---|---|---|---|---|
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| Lower Wye | 34. *Llanymynech Bk - source to conf R Trothy* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 35. *Llymon Bk - source to conf R Trothy* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 36. *Trothy - conf Llanymynach Bk to conf Llymon Bk* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 37. *Trothy - conf Llymon Bk to conf R Wye* | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub-catchment | Failing WB Name | Exemption type | Flow ($m^3$/d) | Estimated annual P load (kg/yr) | Estimated P load with an upgraded system (kg/yr) | P load reduction (kg/yr) | % phosphorus load reduction |
|---|---|---|---|---|---|---|---|
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | 38. *Tintern Bk - source to conf R Wye* | 001 - New discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 002 - Existing discharge to surface water of five cubic metres or less | 5 | 17.71 | 0.73 | 16.98 | 95.88 |

# APPENDIX K PRIVATE SEWERAGE SYSTEMS

## K.1 ESTIMATED LOAD CALCULATIONS

To calculate the annual phosphorus load entering the catchment, the default ST and PTP concentrations obtained from the Wales Nutrient Budget Calculator (Herefordshire Council, 2019) and the flow rates from the Permitted Discharges Register (NRW, 2025d) and the Water Quality Exemptions Register (NRW, 2025b) were used. The default concentration of total phosphorus (TP) from the calculators for ST is 11.6kg TP/l and for PTP is 9.7kg TP/l, and the following equation was used to estimate the annual nutrient load:

$$Pollutant\ load\ (kg) = \ flow\ (m3)\ \times\ 1{,}000\ \times\ concentration\ (mg/l)\ /\ 1{,}000{,}000\ \times\ 365$$

The load reduction that can be achieved from upgrading PSS to a newer unit is based on the following assumptions:

- The current ST system discharges the full quantity of daily flow of effluent detailed in the Permitted Discharges Register (NRW, 2025d) and the Water Quality Exemptions Register (NRW, 2025b).
- The current effluent has a TP concentration of 11.5mg TP/l for ST and 9.7mg TP/l for PTP (Herefordshire Council, 2019)).
- The upgraded system achieves a concentration of 0.4mg TP/l with chemical treatment (GRAF, 2023).

It is important to note that manufacturers provide different guarantees on the concentration of TP in the final effluent, and not all system upgrades will provide the same removal rates. GRAF UK systems can also achieve a TP removal rate of 1.6mg/l for non-chemical treatment systems (GRAF,2023).

Table 60 details the potential load reduction calculations for all PSS identified in the Welsh Wye catchment.

Table 60 Phosphorus loads from registered private sewerage systems and the load reduction that can be achieved from upgrades.

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Private sewerage system | Annual load (kg) | Upgraded load (kg) | Load reduction (kg TP/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|
| Lugg | Arrow Lugg Frome | 1 | *Gilwern Bk - source to conf R Arrow* | PTP | 9.32 | 0.32 | 9.00 | 96.55 |
| | | | | PTP | 11.65 | 0.40 | 11.25 | 96.55 |
| Upper Wye | Irfon | 3 | *Afon Chwefru - source to conf R Irfon* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 4 | *Afon Gwesyn - source to conf R Irfon* | PTP | 10.17 | 0.35 | 9.82 | 96.55 |
| | | 5 | *Cledan - source to conf R Irfon* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 6 | *Aran - source to conf R Ithon* | PTP | 23.30 | 0.80 | 22.50 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Private sewerage system | Annual load (kg) | Upgraded load (kg) | Load reduction (kg TP/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 8 | *Clywedog Bk - conf Bachell Bk to conf R Ithon* | PTP | 27.12 | 0.94 | 26.18 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 9 | *Clywedog Bk - source to conf Bachell Bk* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 11 | *Howey Bk - source to conf R Ithon* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 12 | *Ithon - conf Gwenlas Bk to conf Camddwr Bk* | PTP | 4.66 | 0.16 | 4.50 | 96.55 |
| | | | | PTP | 13.98 | 0.48 | 13.50 | 96.55 |
| | | | | PTP | 17.37 | 0.60 | 16.77 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 15 | *Mithil Bk - source to conf R Ithon* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 16 | *Nantmel Dulas - source to conf R Ithon* | ST | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | Wye Ithon to Hay | 17 | *Afon Llynfi - conf Dulas Bk to conf R Wye* | PTP | 42.37 | 1.46 | 40.91 | 96.55 |
| | | | | PTP | 26.48 | 0.91 | 25.57 | 96.55 |
| | | | | PTP | 16.95 | 0.58 | 16.36 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 18 | *Bach Howey Bk - source to conf R Wye* | PTP | 2.97 | 0.10 | 2.86 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 19 | *Builth Dulas Bk - source to conf R Wye* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Private sewerage system | Annual load (kg) | Upgraded load (kg) | Load reduction (kg TP/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 22 | *Dulas Bk - source to conf Afon Llynfi* | PTP | 31.78 | 1.10 | 30.68 | 96.55 |
| | | | | PTP | 19.07 | 0.66 | 18.41 | 96.55 |
| | | | | PTP | 6.36 | 0.22 | 6.14 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 24 | *Edw - conf Clas Bk to conf R Wye* | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | 25 | *Edw - source to conf Colwyn Bk* | PTP | 8.47 | 0.29 | 8.18 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 26 | *Scithwen Bk - source to conf R Wye* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 27 | *Triffrwd - source to Dulas* | PTP | 30.51 | 1.05 | 29.45 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 28 | *Afon Llynfi - source to conf Dulas Bk* | ST | 8.13 | 0.28 | 7.85 | 96.55 |
| | | | | PTP | 10.59 | 0.37 | 10.23 | 96.55 |
| | | | | PTP | 17.79 | 0.61 | 17.18 | 96.55 |
| | | | | PTP | 6.36 | 0.22 | 6.14 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 29 | *Clyro Bk - source to conf R Wye* | PTP | 6.36 | 0.22 | 6.14 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 30 | *Digedi Bk - source to conf R Wye* | PTP | 8.47 | 0.29 | 8.18 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Private sewerage system | Annual load (kg) | Upgraded load (kg) | Load reduction (kg TP/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|
| | Wye Source to Ithon | 33 | *Wye - conf Afon Elan to conf R Ithon* | PTP | 6.36 | 0.22 | 6.14 | 96.55 |
| | | | | ST | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 10.17 | 0.35 | 9.82 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| Lower Wye | Trothy | 34 | *Llanymynech Bk - source to conf R Trothy* | ST | 6.36 | 0.22 | 6.14 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 35 | *Llymon Bk - source to conf R Trothy* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 36 | *Trothy - conf Llanymynach Bk to conf Llymon Bk* | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | 37 | *Trothy - conf Llymon Bk to conf R Wye* | PTP | 7.41 | 0.26 | 7.16 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 9.15 | 0.32 | 8.84 | 96.55 |
| | | | | PTP | 3.43 | 0.12 | 3.31 | 96.55 |
| | | | | PTP | 5.08 | 0.18 | 4.91 | 96.55 |
| | | | | PTP | 19.24 | 0.66 | 18.57 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |

| Sub Catchment | Operational Catchment | Ref | Failing WB name | Private sewerage system | Annual load (kg) | Upgraded load (kg) | Load reduction (kg TP/yr) | % load reduction |
|---|---|---|---|---|---|---|---|---|
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | Wye OP Catch | 38 | *Tintern Bk - source to conf R Wye* | PTP | 6.99 | 0.24 | 6.75 | 96.55 |
| | | | | PTP | 4.24 | 0.15 | 4.09 | 96.55 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |
| | | | | PTP | 17.71 | 0.73 | 16.98 | 95.88 |

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