Herefordshire Council Interim Phosphate Delivery Plan

Stage 1 – Phosphate Budget Methodology Non-Technical Summary

1. The Requirement for a Phosphate Budget Methodology

The River Wye Special Area of Conservation (SAC) is a protected nature conservation site (hereafter, National site) under the "Habitats Regulations" (The Conservation of Habitats and Species Regulations 2017 (as amended)). To help conserve the ecology of the River Wye SAC, Natural England have set targets for phosphorous concentrations in the river. Excess phosphorous concentrations in aquatic environments can drive a process known as eutrophication, whereby runaway algal growth results in a range of negative impacts on the ecology of a river. The River Wye SAC is divided into different sections and includes parts of the River Lugg. Within the Herefordshire Council authority area, the section of the River Lugg from Leominster to the Wye confluence is currently failing its phosphorous target. The section of the River Wye from the English/Welsh Border to River Lugg confluence is close to failing its phosphorous targets. The River Lugg is thus classified as being in "unfavourable condition" and is breaching the statutory protections afforded to it by the Habitat Regulations. Under the Habitat Regulations, it is illegal to consent any plans or projects that may contribute to a National site being in unfavourable condition.

Habitat Regulations Assessments (HRAs) are used to assess the potential impact that new developments may have on National sites. HRAs are designed to make new developments compliant with the Habitats Regulations by avoiding impacts that could contribute to National sites being in unfavourable condition. A recent ruling in the Court of Justice of the European Union (CJEU) known as the "Dutch Nitrogen Cases"[1] has changed the way HRAs now need to consider the potential impacts on National sites of increased nutrient inputs from new developments. It is now considered that new developments which increase nutrient inputs (phosphorous being a key nutrient) to National sites *already in unfavourable condition due to excess nutrients* will contribute to the site remaining in unfavourable condition. Thus, new developments that increase the number of overnight stays and subsequently increase the production of wastewater and associated nutrient (phosphorous) inputs to National sites may not be legally consented, unless suitable mitigation of the additional nutrient load is secured.

Because new housing developments in the River Lugg catchment will contribute additional wastewater and phosphorous to the Lugg, Herefordshire Council are facing limitations on granting planning permission to new housing developments in the Lugg catchment. In order to grant planning permission for new housing developments, these plans or projects will need to pass an HRA that shows the development will be "phosphorous neutral", i.e. a mitigation scheme is in place that offsets any net increase in phosphorous from the new development. To understand the amount of mitigation required for a new development, a phosphorous budget is required. The phosphorous budget for a new development will provide an amount in kg per year (kg/yr) that requires mitigation. The sections below provide a non-technical summary of the methodology that has been developed in order to calculate robust phosphorous budgets to support development in Herefordshire.

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[1] Joined Cases C-293/17 and C-294/17 Coöperatie Mobilisation for the Environment UA and Others v College van gedeputeerde staten van Limburg and Other

2. The Herefordshire Council Phosphate Budget Methodology

Following the Dutch Nitrogen Cases, Natural England provided a methodology for calculating phosphorous budgets for new developments within the River Great Stour catchment in Kent. Working with Herefordshire Council and in consultation with Natural England, Ricardo Energy and Environment (Ricardo) have adapted this methodology to the local Herefordshire context. The methodology has also incorporated changes in line with ongoing work by Ricardo for Natural England that is developing national guidance on the calculation of nutrient budgets. The methodology follows the stages for calculating a phosphorous budget detailed by Natural England for the Stour catchment and the Stodmarsh SAC. The phosphorous budget calculations comprise the following four stages:

1. The increase in phosphorous loading to National sites that result from the increase in wastewater from a new development, which is based on population increase, water use and nutrient concentrations in discharges from wastewater treatment works (WwTW) or package treatment plants/septic tanks.
2. The phosphorous export from the past and present land use of the development site.
3. The phosphorous export from the future mix of land use, e.g. urban land, greenspace etc., on the development site, including onsite mitigation.
4. Calculation of the net change in phosphorous loading to a designated site, i.e. the phosphorous budget, which includes the addition of a 20% precautionary buffer.

Each of these stages require various inputs that go into the calculation of the phosphorous budget. The data inputs required and the rationales behind their selection are described in detail in the Herefordshire Council Interim Phosphate Delivery Plan Stage 1 report. The subsections below provide a summary of each input and where possible the input value is provided. However, it should be noted that for various inputs, the value is variable depending on location.

2.1. Stage 1: Calculate additional phosphorus load from the development

2.1.1. Step 1: Calculate additional population

The additional population caused by a new residential development will result in more people producing wastewater with its associated phosphorous load. This in turn creates the "pathway to impact" from new development on the River Wye SAC. Natural England recommends using the average occupancy rate of 2.4 persons per household as calculated by the Office for National Statistics (ONS). This average occupancy rate is derived from the 2011 Census. Assessment of the 2011 Census data for Herefordshire showed that the county had an average occupancy rate of 2.3. This value is also used by Herefordshire Council for planning purposes and by Welsh Water to plan for population growth. This indicates there is sufficient evidence to support the use of a locally relevant occupancy figure of 2.3 in Herefordshire.

It should be noted that the methodology assumes that all residential developments are creating new housing stock that will be filled by inward migration or internal population growth within the Herefordshire Council authority area. The use of an occupancy rate lower than 2.3 due to internal migration within Herefordshire would need to be assessed on a case-by-case basis and supported by sufficient evidence. Similarly, if a development is comprised of a majority of one-bedroom flats or is a non-typical residential development, such as a retirement home or student accommodation, it will likely have an average occupancy lower than 2.3. In these cases, a value lower than 2.3 could be proposed but this would need to be assessed on a case-by-case basis dependant on the mix of dwelling sizes within a development.

2.1.2. Step 2: Water usage per person

The second step in the nutrient budget calculations accounts for per person water use in the new development, ergo the additional flow of wastewater that will be draining to a wastewater treatment works (WwTW) and thus increasing the flow and associated phosphorous load from a WwTW.

Herefordshire Council have adopted the 110 litres per person per day (l/p/d) water efficiency standard as a policy (Policy SD3) in their Local Plan and thus it will be a planning condition of new developments in the Wye SAC catchment. In line with recent guidance from Natural England, where water efficiency standards of 110 l/p/d have been adopted as local policy, the phosphorous budget methodology should use an input value of 120 l/p/d. This is designed to account for people changing water efficient fittings to less efficient fittings after a development is occupied. The Herefordshire phosphorous budget methodology agrees with this precautionary approach to estimating per person water use as there are studies that indicate water efficiency measures are rarely kept in place *in all cases* after they have been implemented.

2.1.3. Step 3: P load in treated effluent exiting WwTWs or package treatment plants/septic tanks

Developments that are too far from a mains sewer to connect to it without unfeasible engineering requirements can be fitted with a package treatment plant (PTP) or septic tank (ST) to provide onsite wastewater treatment. Developments that connect to mains sewerage will discharge their wastewater to a WwTW. The concentration of phosphorous in the effluent that is discharged from a WwTW or PTP/ST is multiplied by the volume of additional wastewater being generated by the new development (Steps 1 and 2 of Stage 1) in order to get the "load" of additional phosphorous being generated by the development. Phosphorous load is expressed in units of kg/yr.

It should be noted that for developments that are not being connected to mains sewerage, only PTPs are allowed to discharge directly to a watercourse. However, both PTPs and STs can discharge to a drainage field. Assuming a drainage field is designed correctly, it can retain the majority of the phosphorous in effluent from a PTP or ST. Natural England has provided guidance that a small discharge of less than 2 m^3/day from an ST or PTP that is discharging to a drainage field will result in a development being phosphorous neutral if it meets the following criteria:

- The drainage field is more than 50 m from the designated site boundary (or sensitive interest feature) **and**;
- The drainage field is more than 40 m from any surface water feature e.g. ditch, drain, watercourse, **and**;
- The drainage field in an area with a slope no greater than 15%, **and**;
- The drainage field is in an area where the high-water table groundwater depth is at least 2 m below the surface at all times **and**;
- The drainage field will not be subject to significant flooding, e.g. it is not in flood zone 2 or 3 **and**;
- There are no other known factors which would expedite the transport of phosphorus for example fissured geology, insufficient soil below the drainage pipes, known sewer flooding, conditions in the soil/geology that would cause remobilisation phosphorus, presence of mineshafts, etc **and**;
- To ensure that there is no significant in combination effect, the discharge to ground should be at least 200 m from any other discharge to ground.

If *all* the above criteria can be met for a package treatment plant or septic tank, Natural England suggest that there is currently no further requirement for an HRA to determine nutrient neutrality for the development. Meeting these criteria will have to be determined on a site-by-site basis and it is noted that the competent authority (Herefordshire Council) will need to determine whether they agree with the above criteria in terms of providing the certainty that phosphorous discharge to a drainage field from a PTP or ST or will remove the pathway to impact on the River Wye SAC.

Getting phosphorous concentrations and loads for WwTWs

For new developments with mains sewer drainage to a WwTW, the concentration of phosphorous in WwTW effluent discharges to the River Wye SAC is primarily contingent on whether the WwTW has a permit limit for phosphorous on its discharge, i.e. whether the Environment Agency has imposed a maximum concentration of phosphorous allowed in the WwTW discharge. If a new development is connecting to a WwTW with has a phosphorous permit limit, this value is used as input to Step 3. The WwTWs that have phosphorous permit limits and discharge to the River Wye within the Herefordshire Council authority area are shown in Table 2.1. Some of the WwTWs listed in Table 2.1 currently do not have phosphorous permit limits but are being upgraded to have a phosphorous permit limit between now and 2025.

Table 2.1: WwTW within the Herefordshire Council area and River Wye SAC catchment, their current phosphorous consent limit and proposed phosphorous consent limits that will be implemented by 2025.

WwTW	Sub-Catchment of Wye SAC WwTW discharges to	Current P limit (mg P/l)	Proposed P limit (mg P/l) by 2025
Eign	Upper Wye	1	0.4
Hereford (Rotherwas)	Upper Wye	1	0.4
Kingstone & Madley	Upper Wye		2
Leominster Worcester Road	Lugg	1	0.5
Bromyard	Lugg	1	1
Moreton-on-Lugg	Lugg	1	1
Kington	Lugg	1	1
Weobley	Lugg		1.5
Pontrilas	Lower Wye		1.8
Lower Cleeve (New)	Lower Wye		2

If the WwTW a development is connecting to doesn't have a phosphorous permit limit, then a default value of 5 mg total phosphorous (TP)/l should be used. This value is based on data provided by Welsh Water and will be subject to periodic review as more data to support or alter this value becomes available. For developments that are connecting to WwTWs that are being upgraded to have phosphorous permit limits by 2025, or where the permit limit is being tightened, a phosphorous budget should be calculated for the period prior to 2025 when the development will occupied using a Stage 1, Step 3 input value of 5 mg TP/l. A second budget calculated for the period post-2025 should be calculated with the lower Stage 1, Step 3 value as listed in Table 2.1. An example of a two-stage nutrient budget should be completed as follows:

- A development with a lifespan of 80 years is completed on the 01/01/2022 and will discharge, for example, to the Eign WwTW with a permit limit of 1 mg P/l, changing to 0.4 mg P/l in 2025.
- A four-year budget from 2022-2025 using the Eign WwTW P permit of 1 mg P/l is calculated and short-term measures can be used to mitigate this load.
- A 76-year budget using the lower limit of 0.4 mg P/l should be calculated with different, long-term mitigation measures able to be applied to achieve nutrient neutrality in perpetuity.

The phosphorous concentrations, including those which are changing in 2025 and an ability to incorporate these changes, have been written into the 'Phosphate Budget Calculator' tool that accompanies the Herefordshire Council Interim Delivery Plan Stage 1 report.

Getting phosphorous concentrations and loads for PTPs or STs

If a development is being fitted with a PTP or ST, the effluent concentration for input into the Stage 1, Step 3 phosphorous budget calculations should ideally be determined from manufacturer specifications that will provide a concentration of phosphorous in the effluent from the PTP or ST. This reported concentration should be verifiable by testing of the PTP/ST effluent by an independent organisation other than the PTP/ST manufacturer. If the PTP or ST being used does not provide a phosphorous concentration in its specifications, default values taken from the literature of 9.7 mg P/l for PTPs or 11.6

mg P/l STs should be used. It should be noted there are PTPs available that can achieve very low concentrations of phosphorous in their effluent and these should be used to avoid having to provide more mitigation to make a development phosphorous neutral.

2.1.4. Worked example of Stage 1

Table 2.2: Worked example of Stage 1 nutrient budget calculation. A theoretical new development of 1000 dwellings with an average occupancy of 2.3 persons per household is discharging to a WwTW that has a 1.5 mg TP/l limit.

Step	Value	Unit	Explanation
Development Proposal	1000	Residential dwellings	The number of new dwellings.
Step 1 (additional population)	2300	Persons	2.3 x 2500 = 5750
Step 2 (wastewater volume)	276,000	litres/day	2300 persons x 120 litres = 276,000 litres (If necessary, subtract volume from displaced population).
Step 3 (receiving WwTW TP discharge)	1.35	mg TP/l	90% of 1.5 mg TP/l
Step 4 (TP discharged after WwTW treated)	372,600	mg TP/day	Step 2 x Step 3 = 1.35 mg TP/l x 276,000 = 372,600
Convert mg/TP to kg/TP	0.37	kg TP/day	Divide by 1,000,000
Convert kg/TP/day to kg/TP/year	136.09	kg TP/year	Multiply by 365.25 days

2.2. Stage 2: Calculate existing P load from current land use

All land uses/land covers result in a certain quantity of phosphorous export to river systems, e.g. the Rivers Wye and Lugg. Prior to development, a development site will either be in agricultural use or be an urban site with a potential range of land uses. Stage 2 of the phosphorous budget methodology assesses the phosphorous export from the land use(s) on the pre-development site. This phosphorous export from current land use is offset against the new phosphorous load that will be output by the development site post-development.

2.2.1. Phosphorous export from agricultural land use

If a development site is currently in agricultural use, the phosphorous export associated with the type of agriculture on a farm will need to be ascertained. The phosphorous export from a particular type of farming is determined by a complex range of factors. However, tools exist that can provide estimates of the likely export of phosphorous from given type of farm. For the purpose of the Herefordshire Council phosphorous budget methodology, a modelling exercise using Farmscoper[2] was conducted for the Herefordshire Council authority area. Farmscoper was used to model phosphorous export from different farm types in the three Operational Catchments of the River Wye that have areas within the Herefordshire Council authority area. Operational Catchments define the catchments of smaller tributary rivers within the "Management Catchments" of larger rivers. The relevant Operational Catchments in the Herefordshire Council authority area are the Arrow, Lugg and Frome, the Monnow,

[2] Farmscoper is an industry standard tool for assessing the export of diffuse pollution, including phosphorous, from farms.

and the Wye Operational Catchment. These catchments are part of the larger River Wye Management Catchment. For each these catchments, the Farmscoper tool provides estimates of phosphorous export for nine farm types:

- Cereals
- General Cropping
- Horticulture
- Pig
- Poultry
- Dairy
- LFA
- Lowland
- Mixed

Each farm type has a range of estimates of phosphorous export that depend on the rainfall and soil drainage characteristics of the farm. Instructions on how to determine the Operational Catchment, rainfall and soil drainage characteristics for a development site are included in the 'Phosphate Budget Calculator' tool. Selection of the farm type and associated variables in the tool, along with the area of the development site (in hectares) that is currently occupied by this farm type, will calculate the annual phosphorous export from current agricultural land use on a development site. This can be used as input to Stage 2 of the phosphorous budget methodology.

2.2.2. Phosphorous export from urban land uses

Development sites in urban areas may comprise a mix of land uses. For the purpose of calculating a phosphorous budget for a development site, these land uses are classified as follows:

- Residential
- Commercial/industrial
- Open urban land
- Greenspace, e.g. parks or other green infrastructure managed for recreation
- Community food growing, e.g. allotments

For phosphorous export from residential, commercial/industrial or open urban land, an approach that combines an estimate of the annual surface runoff that is generated by rainfall on the development site and the average concentration of phosphorous in this runoff is used. This approach provides an annual load of phosphorous in kg/yr that is exported from the development site. An approach to getting the average annual rainfall for a development site is detailed in the 'Phosphate Budget Calculator' tool and the rainfall value is used automatically in the tool to calculate the phosphorous export from either residential, commercial/industrial or open urban land.

Phosphorous export for greenspace uses an assumption that the majority of the phosphorous inputs to greenspace are from pet waste. These inputs are likely to be accounted for in the phosphorous export value calculated for residential land, as the number of pets in an area is a function of the number of people living in that area, not the presence of greenspace. In order to avoid double counting of inputs of phosphorous from pet waste that are accounted for in the calculation of phosphorous export from residential areas, greenspace areas are assumed to export phosphorous at the background concentration of natural land, which is estimated at 0.02 kg P/ha. This approach to setting the phosphorous export value for greenspace was agreed in close consultation with Natural England.

Community food growing spaces such as allotments will have a phosphorous export rate that is likely to be most similar to certain types of agriculture. There is limited information available in the scientific literature on likely phosphorous export rates from community food growing. As such, the phosphorous export rate used in the nutrient budget calculations uses the General Cropping farm type from the Farmscoper modelling detailed in Section 2.2.1. This farm type was selected as the closest arable farm type to the mixed fruit and vegetable crops typical of community food growing. It was also assumed that the free draining soil would be typical of community food growing as drained soils tend to be found predominantly in commercial agricultural settings. Thus, the phosphorous export rate for areas of community food growing is determined by the average rainfall for a development site, as this is the only characteristic out farm type, soil drainage and rainfall that is free to vary between development sites.

2.2.3. Worked example of Stage 2

Table 2.3: Worked example of Stage 2 of the nutrient budget calculations. The theoretical development site is currently in agricultural use for cereals and dairy farming.

Step	Value	Unit	Explanation
Pre-development site type	Agricultural	NA	The development site is currently agricultural land.
Development site Operational Catchment	Arrow, Lugg and Frome	NA	The development site is in the Arrow, Lugg and Frome Operational Catchment.
Soil drainage type	Slightly impeded drainage	NA	The soil drainage, which has a large impact on phosphorous export, is classed as slightly impeded.
Annual average rainfall	700.1-750	mm	The average annual rainfall band for the development site. Again, this has a large impact on agricultural phosphorous export. Wetter sites will have greater export.
Farm types on the development site	Cereals and Dairy	NA	The development site is currently a farm with an area used for cereals farming and an area used for dairy farming
Area of cereals farming	3	Hectares	The area of the farm used for cereals farming is multiplied by an export value for the above combination of soil drainage and rainfall
Phosphorous export from cereals farming	3.16	kg TP/year	The annual phosphorous export from the area of the development site currently used for cereals farming.
Area of dairy farming	5	Hectares	The area of the farm used for dairy farming is multiplied by an export value for the above combination of soil drainage and rainfall.
Phosphorous export from dairy farming	7.7	kg TP/year	The annual phosphorous export from the area of the development site currently used for dairy farming.
Total phosphorous export from the pre-development site	**10.86**	kg TP/year	The sum of the phosphorous export from the cereals and dairy farming areas. This current phosphorous export from the site is offset against the new phosphorous export that the development will create.

2.3. Stage 3: Calculate the phosphorous load from future land use

Post-development, a development site will be either 100% urban land or a mix of urban land use and greenspaces and/or community food growing. The purpose of Stage 3 of the nutrient budget calculations is to account for the future phosphorous losses from the mix of new land uses on the development site. The inputs required for the Stage 3 calculations are the same as those determined for urban land uses in Stage 2 (see Section 2.2.2 above). Stage 3 will output a total amount of phosphorous that will be generated by the land uses on the development site post-development.

2.3.1. Worked example of Stage 3

Table 2.4: Worked example of Stage 3 of the nutrient budget calculations. The theoretical development site is currently in agricultural use for cereals and dairy farming.

Step	Value	Unit	Explanation
Annual average rainfall	700.1-750	mm	The average annual rainfall band for the development site. This determines the phosphorous export from urban land uses. Wetter sites will have greater export.
Urban land uses on the development site	Residential and Greenspace	NA	The development site will incorporate both residential areas and greenspace.
Area of residential urban land	6.5	Hectares	6.5 ha of the development site will be covered with housing.
Phosphorous export urban land	9.66	kg TP/year	The annual phosphorous export from the area of the development site that will be residential post-development.
Area of greenspace	1.5	Hectares	The development site will have 1.5 ha of greenspace.
Phosphorous export from dairy farming	0.03	kg TP/year	The annual phosphorous export from the area of the development site that will be greenspace post-development.
Total phosphorous export from the pre-development site	**9.69**	kg TP/year	The sum of the phosphorous export from the residential and greenspace areas.

2.4. Stage 4: Calculate the phosphorous budget and add the precautionary buffer.

The final stage of the phosphorous budget calculations calculates the phosphorus budget for the development. This is the result of the net difference between the new phosphorus load from wastewater (Stage 1), the phosphorous load from existing land use(s) on the development site (Stage 2) and the new land uses on the development site (Stage 3). If this net difference is a positive number, then the new development will result in a surplus of phosphorous input to the River Wye SAC compared to the current amount coming from the development site. This surplus is the amount of phosphorous that needs to be mitigated. If the net difference is a negative number, then the development is already nutrient neutral and does not require mitigation. It should be noted that it is highly unlikely that new developments will be nutrient neutral without requiring mitigation.

If the nutrient budget shows that a surplus of phosphorous will be input to the River Wye SAC as a result of the development, then the phosphorous budget output is increased by a “precautionary buffer” of 20%. This precautionary buffer is designed to account for the various uncertainties that underpin the inputs to the nutrient budget calculations, in line with the precautionary principle that underpins HRAs.

2.4.1. Worked example of Stage 4

Table 2.5: Worked example of Stage 4 of the phosphorous budget calculations, showing how the outputs from Stages 1-3 of the phosphorous budget are combined to determine the final phosphorous budget for a development.

Step	Value	Unit	Explanation
Step 1 – New phosphorus load from the development's wastewater	136.09	kg P/year	This is the output from Stage 1 – see Table 2.2.
Step 2 – subtract the phosphorous export calculated in Stage 2 from the output for Stage 1	136.09 - 10.86 = 125.23	kg P/year	This step offsets the current phosphorous export from land uses on the development site (see Table 2.3) against the new phosphorous load from the development's wastewater.
Step 3 – add the new phosphorous load from the development sites future land use from Stage 3	125.23 + 9.69 = 134.92	kg P/year	This step adds the future phosphorous export from land uses on the development site (see Table 2.4) to the output from Step 2. **This is the phosphorous budget for the development**
Step 4 – add precautionary 20% buffer	134.92 x 1.2 = 161.90	kg P/year	As the output of Step 3 above zero, the 20% precautionary buffer is applied.
Phosphorus budget with 20% buffer	**161.90 kg P/year to be mitigated**		