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Phosphate Neutrality – Proof of Concept

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1.0 Introduction

This report aims to establish a proof on concept for use of a wetland at the site address to phosphate neutrality requirements.

We have been engaged by a developer to establish whether a constructed wetland scheme is a concept that Natural Resources Wales would support as statutory consultees for a Wrexham County Borough Council.

The scheme is for 10 residential dwellings. There is 1 pre-existing dwelling. Scheme is for 9 additional dwellings.

There is a mains sewers that runs within 300 meters of the site, and as such therefore there is a presumption that the development will be required to connect to mains sewer. The local works has a consent limit of 1.0mg/l for Phosphate.

2.0 Natural England

We have consulted Natural Resources Wales with regards to this concept and they have agreed that it could be a viable solution provided we can supply evidence of its validity.

3.0 Background

Recent CJEU Dutch Nitrogen case law relating to impacts of nutrient laden water impacting on sensitive ecological sites, has highlighted a requirement to mitigate against effluent out flows.

Wrexham Borough Council explain the situation:

“Natural Resources Wales (NRW) has published new targets to reduce river phosphate levels in special areas of conservation (SAC) across Wales. This may affect certain developments and planning applications.”

Relating to the River Dee SAC:

“The River Dee is designated as a SAC, and the majority of Wrexham County Borough is located within its catchment. The river is currently failing against NRW's targets.”

4.0 Site Budget (Source)

Wrexham Borough Council are yet to release a budget calculator for Phosphate. However, for purpose of this report we can make a very close estimation using a calculator from elsewhere.

Southwest Environmental have used numerous calculators, from Cornwall, Devon, Somerset, Pembrokeshire, Carmarthenshire, Cumbria and Hampshire. They all work on a similar basis.

We have used the Carmarthenshire calculator in this instances to make our estimations. We have included this **Appendix 1**.



We propose to reduce water consumption at site via the use of grey water recycling, this will reduce (proportionately) load on the sewage treatment works. Many system claim to save 25 litres per person per day. We have applied a 20% precautionary buffer to this figure with a 20 litre per person saving applied in the calculator. Using a 100 litres per day figure for the CCC Calculator.

5.0 Sewers (Pathway)

The Lavister WWTW sewage works (53.118873 -2.933603) serving the site is has a consent limit of 1mg/l¹.

Lavister Work used its Combined Sewer Overflow for 2121 hours in the most recent annual reporting period. There are 8760 hours in one year.

There is also 2 no. pumping station between site and the work. Both of these assets also record regular spills².

6.0 River Dee (Receptor)

The River Dee SAC is the receptor. Please see section 3.0 for details.

7.0 Mitigation

In order to provide 0.5kg TP/year mitigation it is proposed to create a wetland within applicant owned land to the north of the application site.

In Cornwall and Somerset calculators developed by Royal Haskoning, wetland can be used for both off site and on site mitigation.

On site mitigation would require that foul water from the site flows through and is treated by the wetland. No such physical link is required for an off-site wetland.

The phosphate captured by off-site wetlands, can come from numerous sources. In this instance we propose to capture atmospheric phosphorous.

7.1 Deposition Rate

There are various documents that contain information relating to Atmospheric deposition.

7.1.1 Review of phosphorus pollution in Anglian River Basin District

This May 2012 Environment Agency Document³, indicates that 3.62% of Phosphorous load in rivers comes from background sources.

¹ <https://www.flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/FCC/FCC031-Phosphate-Strategy.pdf>

² <https://www.dwrcymru.com/en/our-services/wastewater/river-water-quality/combined-storm-overflow#:~:text=Unfortunately%2C%20this%20isn't%20possible,ago%20during%20the%20Victorian%20times.>



7.1.2 Atmospheric Phosphorus Deposition UK

Environmental Science: Processes & Impacts published this Accepted Manuscript⁴, which has been through the Royal Society of Chemistry peer review process and has been accepted for publication. It contains many reference values in the form a literature review. Median of 20 published studies was 0.063 g / m² or **0.630kg/ha**.

7.2 Banking Rate

Natural systems such as wetland have a banking rate. This is their capacity to store otherwise free bio-available phosphorous.

Studies show a wide variance in removal rates of Phosphates, ranging from 1 to 41 kg/ha/yr. We have observed the flowing references in scientific literature:

- 7.4 kg/ha/yr Reddy & DeBusk, 1987
- 41 kg/ha/yr Karin Johannesson 2008
- 2.6 kg/ha/yr Johnston 1991
- 8 kg/ha/yr Somerset Phosphate Budget Calculator

The main maintenance requirements are weeding, annual cutting of the reeds and general grounds-care around the system. Where grazing animals are present then fences must be maintained in order to keep them out.

Wetland would provide ample banking for Atmospheric Phosphate.

8.0 Conclusions

Provided the applicant can provide 0.8ha of wetland, this should bank 0.5kg/year of atmospheric phosphate.



APPENDIX 1

Budget Calculator

Stage 1 - additional nutrient loading from wastewater

Instructions

User Inputs required

Date of first occupancy:	12/12/2022
Average occupancy rate:	2.3
Water usage (litres/person/day):	100
Development Proposal (dwellings/units):	10
Wastewater treatment works:	Septic Tank user defined
Wastewater treatment works P permit (mg TP/litre):	Please enter value in cell to the right: 1

Additional population	23 persons
Wastewater by development	2300 litres/day
Annual wastewater TP load	0.84 kg TP/yr

Stage 2 - phosphorus loading from existing land use

Instructions

User Inputs required

Soil drainage type:	Slightly impeded drainage
Annual average rainfall (mm):	1,400.1 - 1,600

Existing Land Use Type(s)	Area (ha)	Annual phosphorus nutrient export (kg TP/year)
Mixed	0.65	0.42
Residential land	0.69	2.07
Woodland	0.37	0.01
Total:	1.71	2.50

Stage 3 - phosphorus loading from new land use

[Instructions](#)

User Inputs required

New Land Use Type(s)	Area (ha)	Annual phosphorus nutrient export (kg TP/year)
Water	0.65	0.00
Residential land	0.69	2.07
Woodland	0.37	0.01
Total:	1.71	2.08

Stage 4 - final budget

Instructions

Calculated Outputs

P loading to WwTW: 0.84
 Net P loading from land use change: -0.42
 P budget: 0.42
 P budget + 20% buffer: 0.50

The total annual phosphorus load to mitigate is: 0.5 kg TP/year



APPENDIX 2

Plans

Approx Wetland Area

