Nutrient Neutrality Assessment

Site at Underbrow Farmhouse, Welton, Carlisle, Cumbria CA5 7HW

SPB Environmental Consultancy Limited.

This report has been prepared by SPB Environmental Consultancy with all reasonable skill, care and diligence, within the terms of the Contract with the Client. The purpose of this report is to identify possible mitigation measures to achieve nutrient neutrality. It Is not to determine site conditions or site areas required suitable for a suggested mitigation option or the legal and financial implications of a suggested mitigation option to achieve nutrient neutrality. Additional expertise is likely to be required using guidelines set out in BRE 365 along with identification of possible flooded areas and following BS 6297:2007 Code of practice for design and installation of drainage fields for use in wastewater treatment. Additionally expertise should be sought to clarify compliance with the EA 'General binding rules for small sewage discharges (SSDs) with effect from 2023'.

Summary

Natural England has issued advice outlining the need to consider the nutrients impacts of any new plans and projects on internationally protected Habitats Sites, and whether mitigation is needed to protect sites from additional nutrient pollution. This falls under Natural England's statutory duties and is part of a coordinated cross departmental response by government, supported by Defra.

A planning application is being submitted for the development one property at Underbrow Farmhouse, Welton, Carlisle, Cumbria CA5 7HW. In response to Natural England's advice a nutrient budget was calculated for the stated property using the Nutrient Neutrality Methodology supplied by Natural England. This resulted in a load of 0.19 kg/TP per year and therefore a likely impact of Phosphorus loadings into the River Eden SAC via surface and subsurface flow paths.

Therefore, options were considered to mitigate against the generated Phosphorus and the planting of 5 apple trees is proposed at the discharge point.

Introduction

Excessive nutrients and increasingly phosphorus enrichment to streams and lakes is a significant problem throughout the world, Burke et (2003). Natural England has issued advice to relevant local authorities to consider the impacts of nutrients from any new plans or projects. This falls under Natural England's statutory duties and is part of a cross departmental response by government. One way to address this uncertainty in nutrient impacts is for new developments to achieve nutrient neutrality. Nutrient neutrality is a means of ensuring that development does not add to existing nutrient burdens and this provides certainty that the whole of the scheme is deliverable in line with the requirements of the Habitats Regulations. As part this assessment a nutrient calculation is calculated for the individual property using a nutrient calculator. If a positive number is generated than a mitigation strategy is required to alleviate the excess nutrients.

Nutrient neutral calculations

Nutrient neutral calculations were undertaken for the construction of one property at Underbrow Farmhouse, Welton, Carlisle, Cumbria CA57 HW. An average occupancy of 2.2 was used as advised by the methodology and a water usage of 120l per day per person again as advised. The client has confirmed the proposed property is greater than 30m from the mains waste connection and therefore, the waste water from the property is to be treated by its own biological package treatment with a performance value supplied by the List of Certified Small Wastewater Treatment Systems Up to 50P, British Water.

The PTP will be owned and maintained by the applicants. Management, and maintenance of the PTPs will follow manufacturer's instructions. Regular servicing will take place as part of the manufacturer's maintenance schedule by qualified personal. Both the certification, management and maintenance instructions are shown in Appendix 1 for the biological package treatment plant to be used. Guidance produced by British Water 'A Guide For Users Of Packaged Waste Water Treatments Plants' will also be followed.

This number was inputted into the calculations. The relevant catchment data was inputted along with average rainfall, soil drainage conditions and whether the proposed site is in a Nitrate Vulnerable Zone. The existing site use is mixed. The resulting nutrient excess from the proposed property was calculated at 0.19 kg/TP. Therefore, a mitigation strategy is expected as there is an expected impact on the River Eden SAC through Phosphorus migration into the R Eden SAC via surface and subsurface pathways. The site plan is shown in Appendix 2.

Mitigation Options

A series of mitigation options were considered including reducing agricultural land, installation of a wetland and willow or orchard planting. Due to the inability in reducing agricultural land a section of the field with planted apple trees at the discharge point is suggested.

The planting of willow trees and orchards that are irrigated with waste water to reduce diffuse pollution has been extensively used in the past with recorded success (Elowson 1999; Rosenqvist & Dawson,2005). Wet woodlands were recommended to reduce P levels in work undertaken in the River Camel SAC by Royal Haskoning DHV. Additional work discussed by E. A. Forbes et al, also demonstrated the success of willows in reducing P levels in discharges. Further studies (Werner & McCracken, 2008; Guidi et al 2015) have also demonstrated the success of willows irrigated with waste water in removing TP from waste water. Studies by Yan'an Tong and Fan Hongzhu (2007) also demonstrated P uptake in apple trees.

Evidence in peer reviewed journals discussed above demonstrate the effectiveness of removing TP from waste water. Work by Werner and McCracken (2008) highlight a case study where a 90x 90m grassland area was planted with willow in a 2 x 2m grid. Loadings of $35m^3$/day of waste water was irrigated onto the area with a Phosphorous content of 11.2 mg/l (mean). Subsequent soil analysis showed no elevated P levels from measurements taken pre experiments.

Additional work undertaken by Jordan et al (2022) also show a reduction in TP using willow for bio remediation. In this particular example low flow soluble reactive P (SRP) concentrations were

reduced to the level of upstream concentrations and with no indication of P losses from the irrigated willow field to the upstream site.

Therefore, using peer reviewed evidence from above and in particular Phosphorus accumulation rates in apple trees supplied by Natural England (0.06 kg/TP) we propose to install a wet woodland consisting of apple trees sitting over a drainage field from a package treatment plant for the proposed property to address the TP suggested using the nutrient neutral calculator.

Using the evidence above we propose to plant 5 apple trees in 2 rows spaced at 4.5 metres apart and the trees spaced at 3.6 in each row to alleviate the 0.19 kg/TP per year generated by the new development. This is gained using data supplied by Natural England, Tree Council and also building on work by Yan'an Tong and Fan Hongzhu (2007).

Natural England accept the use of apple trees only when the proposed developments meets certain thresholds described in the Annex F exemption. The criteria which this site meets with the exception of another discharge to ground is within 200m are shown in Appendix 3.

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Conclusion

With the planting of 5 apple trees at the property and new biological package treatment plant then nutrient neutrality is satisfied and no impact on the River Eden SAC from increased P inputs from this development via surface and subsurface flowpaths.

References

Burke, S. P., Heathwaite, A. L. and Preedy, N. P. (2003) Transfer of phosphorus to surface waters. In: Valsami-Jones, E. (Editor) Phosphorus in Environmental Technology. IWA Publishing, UK, 120-146.

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Tree Council. Guidelines for planting apple and pear tree planting and maintenance.

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Appendix 1

Servicing & Maintenance

Ensuring your sewage treatment plant is regularly maintained is necessary to ensure the operational efficiency of your tank and to limit the possibility of any faults occurring.

■ Servicing

This should be conducted by a professional wastewater treatment servicing agent as a matter of course at least once a year. Failure to do this could impact the performance of your wastewater treatment plant and void your warranty.

Your chosen servicing agent will provide you with information on what is carried out during an annual service.

Please ask your servicing company to view the service document and ask them to run through this with you. Please record servicing in the schedule document on the next page.

■ Monthly User Check

1. If you see an error message or the alarm sounds contact your servicing agent.
2. Visually check the tank and surrounding componentry for signs of damage/leakages or anything which appears incorrect.

The control panel allows a professional servicing agent to set numerous parameters to suit your individual needs.

The control panel is not designed to be operated by the end user unless switching on the holiday mode. Once the plant is configured, the menus within the panel should only be accessed, if necessary, by a professional wastewater treatment servicing agent.

Prüfinstitut für Abwassertechnik GmbH

PERFORMANCE RESULTS

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EN 12566-3
Small wastewater treatment systems for up to 50 PT

Small wastewater treatment system one2clean
SBR plant in one two-zone polypropylene tank

Test report PIA2014-216B14.01.e

Nominal organic daily load*	0.27	kg/d	
Nominal hydraulic daily load	0.75	m^3/d	
Material	polypropylene		
Treatment efficiency (nominal sequences)		Efficiency	Effluent
	COD	94.2 %	43 mg/l
	BOD_5	98.0 %	7 mg/l
	SS	96.3 %	14 mg/l
	NH_4-N**	98.3 %	0.5 mg/l
	N_{tot}**	87.0 %	7.9 mg/l
	P_{tot}	80.2 %	1.6 mg/l
Electrical consumption	0.63	kWh/d	

*at a test influent of ≥ 300 mg/l BOD_5 (mean)
**determined for temperatures ≥ 12°C in the bioreactor

Performance tested by

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This document replaces neither the declaration of performance nor the CE marking

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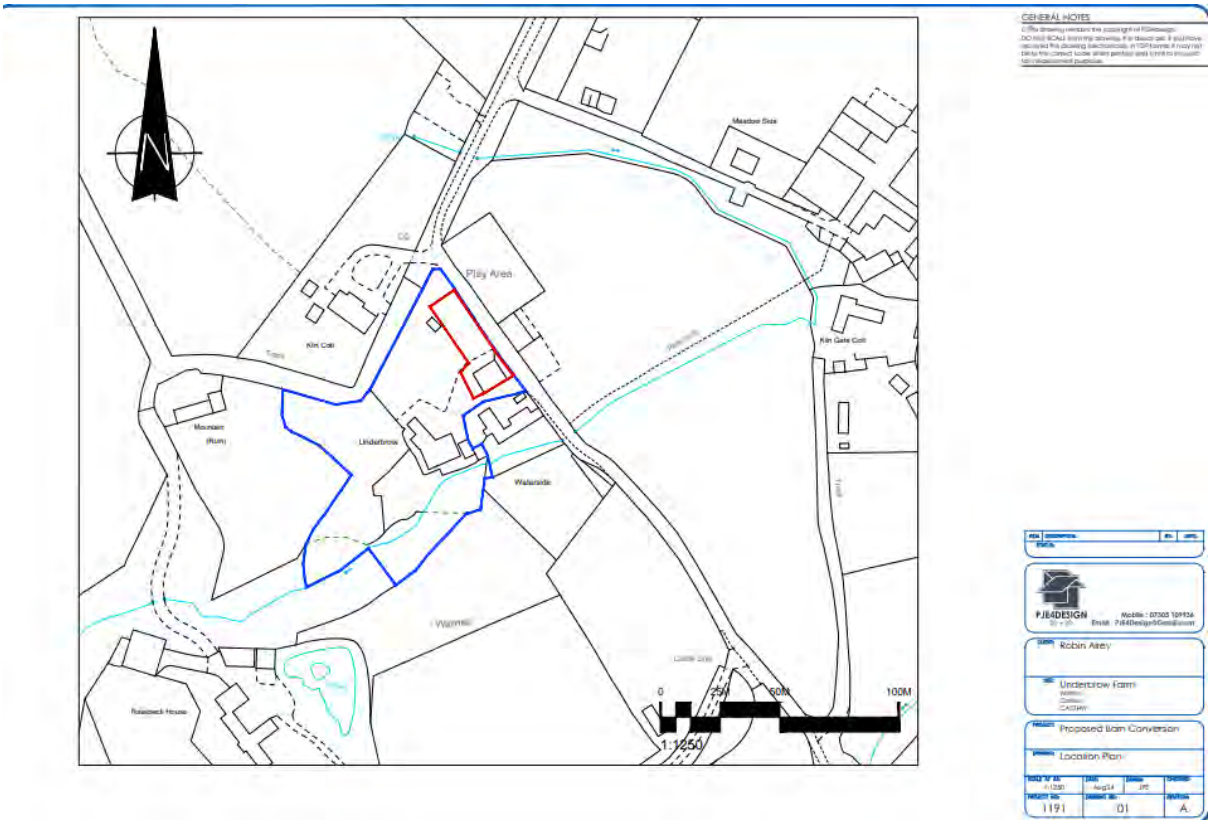
Appendix 2 Site plan



Appendix 3

Natural England accept the use of apple trees only when the proposed developments meets certain threshold described in Annex F exemption.

Proposed thresholds

The proposed thresholds are for a number of key limiting factors that inhibit Phosphorus transfer into the environment. These cover both the hydrology and the relative source of Phosphorus and its proximity to other discharges. Overall small discharges to ground i.e. less than 2m3 /day that are within the surface or groundwater catchment of a designated site will present a low risk that the phosphorus will have a significant effect on the designated site where certain conditions are met:

Additional thresholds are

a) The drainage field is more than 50m from the designated site boundary (or sensitive interest feature)

b) The drainage field is more than 40m from any surface water feature e.g. ditch, drain, watercourse, and;

c) The drainage field in an area with a slope no greater than 15% , and;

d) The drainage field is in an area where the high water table groundwater depth is at least 2m below the surface at all times and;

e) The drainage field will not be subject to significant flooding, e.g. it is not in flood zone 2 or 3 and;

f) 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, soil/geology type and its ability for P sorption/mineralisation or presence of conditions would cause remobilisation phosphorus, presence of mineshafts, etc and;

g) To ensure that there is no significant in combination effect, the discharge to ground should be at least 200m from any other discharge to ground .

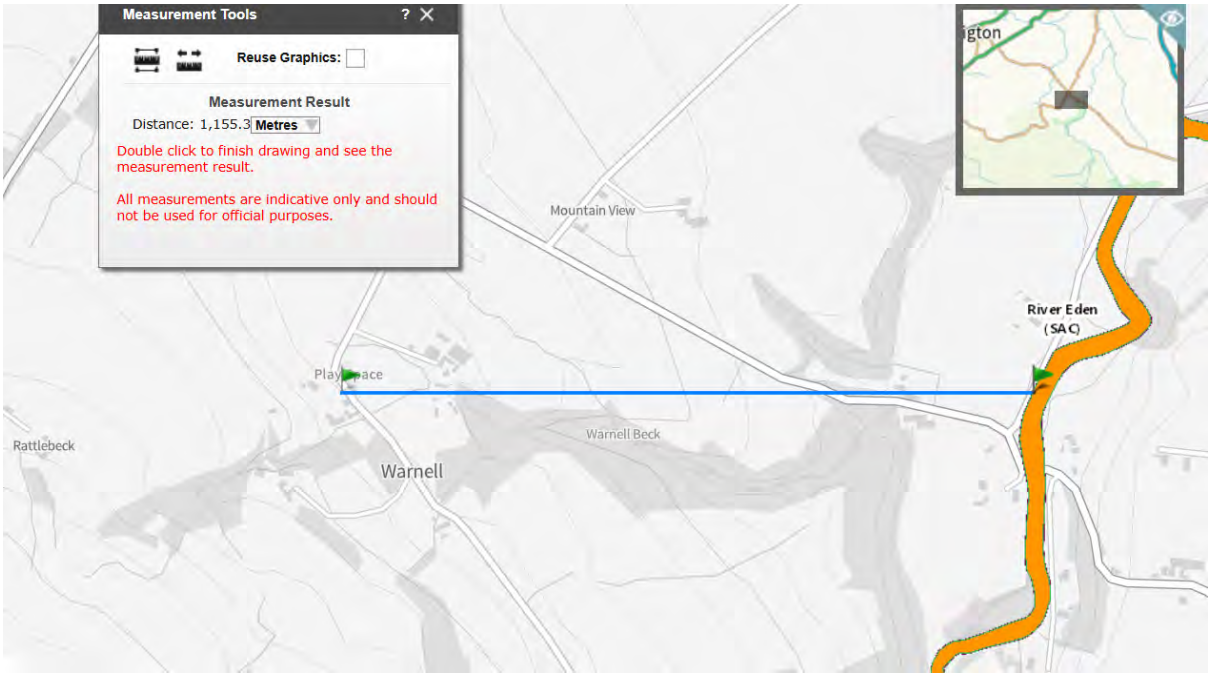
It is anticipated that the discharge will be below 2m3 per day using the standard assumption of each person uses 120 l/day. The additional thresholds will be addressed below individually.

Thresholds applicable to the site.

Thresholds that are presented by Natural England will now be addressed below in order of sequence

as they appear.

Criteria A distance to sensitive feature R. Eden Sac and the nearest watercourse



Criteria B The drainage field is more than 40m from any surface water feature e.g. ditch, drain, watercourse

Criteria C The drainage field in an area with a slope no greater than 15% ,

Criteria D Groundwater is at a depth greater than 2m. Location of adjacent boreholes with BGS log showing no water strike at 4m depth.

Criteria E The drainage field will not be subject to significant flooding, e.g. it is not in flood zone 2 or 3

The site is within a Flood Zone 1

Criteria F

The underlying geology is Pennine Coal Measures Group - Mudstone, siltstone and sandstone. Sedimentary bedrock formed between 319 and 308 million years ago during the Carboniferous period. The heterogeneity of the rocks will prohibit the transport of phosphorus and no mine shafts are indicated under the drainage field.

Criteria G

There is an existing discharge at the adjacent property which is within 200m of the proposed discharge location of nearest houses on septic tank is shown below. The drainage field is marked at 51m from the proposed drainage field well below 200m. But sufficient to meet the General Binding Rules.