REPORT

Small scale discharges of phosphorus: Low risk mapping

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1 Introduction

1.1 Overview

Natural England have previously agreed interim guidelines with Local Planning Authorities regarding small scale thresholds within the hydrological catchments of areas subject to nutrient neutrality guidance. The guidance relates to small discharges from Package Treatment Plants (PTPs) and Septic Tanks (STs) and it states that where all of the requirements of pre-defined conditions are met, a PTP / ST will not have a likely significant effect on the designated site from phosphorus. The small scale thresholds only applies to phosphorus and not nitrogen, which is a more mobile nutrient.

1.2 Legal context

The Waddenzee case[1] established that where a project or plan is “likely to have a significant effect” on a designated site then an Appropriate Assessment (AA) must be carried out. The test of a Likely Significant Effect (LSE) is a low threshold and requires the competent authority to conduct a screening exercise to assess whether a project or plan is likely to have a significant effect on a designated site. The case law has established that where LSE cannot be excluded then the project or plan will have a significant effect on the site concerned. Where there is any doubt to the absence of significant effect (i.e. there is not absolute certainty) then under the precautionary principle, an AA must be carried out.

Any site-specific rationale or thresholds to demonstrate the insignificance of effects would need to ensure that the risk of LSE (alone or in combination) can be excluded. Where evidence is not currently available or it is uncertain, it would be more appropriate to take the plan or project through to AA for further consideration.

A conclusion of no LSE could be reached and therefore no AA would be necessary, if despite there being a pathway for additional phosphorus contributions, these will clearly be insignificant alone or in combination. The thresholds for insignificant contributions are detailed in **Section 1.4.**

1.3 Environmental context

PTPs and STs that discharge to ground via a drainage field should pose little threat to the environment, because much of the phosphorus discharged is removed from the effluent as it percolates through the soil. Phosphorus (P) is removed through sorption to soil particles within the aerated soil zone. How much phosphorus is removed within the aerated soil zone will depend on the soil type and the soil phosphorus characteristics, pH, texture, and the hydraulic loading rate. P sorption can be reversed and P desorption can occur in certain conditions (e.g. due to a change in redox conditions) (Lusk et al., 2017).

For the drainage field to work effectively, the drainage field needs to have acceptable year-round percolation rates which will be influenced by the soil type. If the soils drain too quickly or too slowly, effective phosphorus removal will not take place. In addition, if infiltration rates are lower than the loading rate of the effluent into the drainage field then hydraulic failure can occur which results in the effluent being discharged over the soil surface. Therefore, correct design of the system is important.

The Building Regulations (2015) set out design and construction standards for septic tanks, package treatment plants and drainage fields. In relation to drainage fields, they include the need for a percolation test, a method for how this should be undertaken and the minimum and maximum percolation values (Vp)

[1] *European Court of Justice case of Waddenzee (Case C-127/02)*

which ensure that the drainage field effectively removes pollutants. This is then used to calculate the size of the drainage field required for the size of the household it will be serving.

Evidence has shown that it is the aerated soil zone of the drainage field which provides the function of removing the phosphorus from the effluent before it enters a receiving waterbody (surface or groundwater). Enhanced connectivity to a water body, which bypasses the removal process, has the potential to contribute to phosphorus pollution of designates sites. Therefore, it will be important that the drainage field is sited far enough away from any watercourse, ditch, drain, etc, as well as not in a location where the groundwater is high enough for it to come into connection with this aerated zone. In addition, seasonal flooding can wash out the contents of the tanks. Slope also affects the way the drainage field functions, with steeper slopes having a higher risk of run off (May et al., 2016).

There is also some evidence that density (i.e. number) of these types of systems in an area also has a bearing on the risk of pollution. In general, lower densities of tanks tend to cause less contamination of downstream water bodies.

1.4 Aim of this report

This report provides further information on Natural England’s thresholds for small scale discharges and how these were derived (**Section 2**), and presents a small discharge low risk zone map which can be used to meet most of the conditions (**Section 3**). It is, however, important to note that site specific information is required to supplement the mapping to confirm that all of the requirements are met.

2 Thresholds for insignificant levels of phosphorus discharges to ground from septic tanks or package treatment plants

2.1 Evidence base

The low risk zone mapping was built using the methodology developed by May et al. (2016). Further information on the justification for the proposed threshold is provided in this section.

May et al. (2016) assigned risk categories which indicate the likelihood of a PTP / ST to cause P pollution problems. A PTP / ST that falls within the low risk category is unlikely to cause P pollution problems, and as such, no LSE can be concluded and the plan or project can be excluded from an AA. Therefore, the thresholds that define 'low' risk within May et al. (2016) were used to define the thresholds presented in **Section 1.4.**

2.1.1 Unsewered discharges

The guidance only relates to small sewage discharge such as PTPs or STs. Sewered developments provide a direct pathway for increased nutrient contributions and there is not enough certainty that additional phosphorus contribution will be insignificant alone or in combination.

2.1.2 Discharge rate

The thresholds only apply to small discharges of less than $2m^3$/day (2,000 litres/day). This limit is based on the General Binding Rules (Environment Agency, 2015) which limits discharges to ground over $2m^3$ in volume (rule 1). Discharges of greater than $2m^3$ must connect to the public foul sewer where it is reasonable to do so or must apply for a permit.

Furthermore, $2m^3$/day is a representative size for the majority of the septic tanks investigated within May et al. (2015), from which most of the thresholds are based.

2.1.3 Discharges to ground

Discharges directly to water are considered to be 'high' risk under the risk categories developed by May et a. (2016) and as such would never fall within the low risk category. However, discharges to ground are considered to be low risk, due to the likely sorption effects of soil on phosphorus (see **Section 1.3**).

2.1.4 Proximity to designated site

May et al. (2015) found that at distances of greater than 50m from a water feature the risk of causing P pollution is very low. Therefore, 50m is considered to be an appropriate buffer around the water-dependent designated sites.

2.1.5 Proximity to watercourse

May et al. (2015) measured the impact to water features at 10m intervals surrounding a PTP / ST. Measurable impacts were recorded at a distance of up to 30m from the source, a weak impact from some sources up to 40m and no impact beyond 50m. Therefore, distances between 40 - 50m were assigned a low risk category (**Table 1**).

Table 1: Risk categories assigned to buffer zones surrounding water features, based on the results of May et al. (2015). (Edited from May et al. (2016))

Distance to water (m)	Risk category	Justification
0 - 20	High	Most PTPs / STs had an impact on soil and porewater P
20 - 40	Moderate	Some PTPs / STs had an impact on soil and porewater P
40 - 50	Low	No PTPs / STs had an impact on soil and porewater P

2.1.6 Slope

May et al. (2016) assigned a risk category to slope values were based on an equation published by Haggard et al. (2005), which describes the relationship between slope and percentage runoff. It is assumed that, on steeper slopes with higher runoff values, PTP / STs discharges would be more likely to result in P laden runoff than on shallower slopes, as suggested by Canter & Knox (1985). The values were grouped into low, moderate and high categories on a relatively arbitrary basis. A slope of 15% or less was defined as low risk (**Table 2**).

Table 2: Slope and risk category assigned (Edited from May et al. (2016))

Slope (%)	Slope risk category
>25	High
15 – 25	Moderate
0 - 15	Low

2.1.7 Depth to high water table

May et al. (2016) assigned risk categories for the depth to the high water table having taken into account the findings of May et al. (2015) and the recommendations of Canter and Knox (1985). May et al. (2015) reported high P concentrations in the upper 1m of soil in a soakaway, moderate levels of P in the soil at 1-2m depth, and very low levels of P in the soil at >2m depth (**Table 3**). From this it was concluded that P moving vertically through the soil column would only reach groundwater if the water table impinged on these upper soil layers.

Table 3: Depth to groundwater risk categories (Edited from May et al. (2016))

Groundwater depth (m)	Risk category	Justification
0 – 1.0	High	High P levels recorded in soil soakaway at this depth (May et al. 2015)
1.0 – 2.0	Moderate	Moderate P levels recorded in soil soakaway at this depth (May et al. 2015)
2.0 - >2.5	Low	Low P levels recorded in soil soakaway at this depth (May et al. 2015)

2.1.8 Significant flooding

Reductions in the P retention capacity of drainage fields may occur if soils become temporarily waterlogged during local flood events. As such, it is considered that a location within flood zone 2 or 3 could contribute significant phosphorus loads to the designated site.

2.1.9 Other discharges to ground

A distance of 200m is based on the findings of May et al. (2015) which found no phosphorus signal at distances greater than 50m from the source. In order for two drainage fields areas not to overlap they need to be at least 100m apart. A safety factor of two is then applied to ensure that in the long term, there will be the certainty that the effective drainage field phosphorus retention areas do not overlap. This also ensures that the maximum density of these systems is no more than one for every 4ha (or 25 per km^2), as identified in May et al. (2015).

2.1.10 Percolation test

The thresholds are consistent with the Building Regulations (2015) which state that drainage field disposal should only be used when percolation test indicate average values of Vp of between 12 and 100. Values of less than 12 are deemed to allow untreated effluent to percolate into the ground too quickly for adequate treatment to occur and values greater than 100 are deemed to provide inefficient soakage that may lead to surface ponding.

2.2 Thresholds for small scale discharges

The thresholds proposed by May et al. (2016) on the basis of the evidence presented in **Section 2.1** only apply to small discharges from PTPs or STs of less than $2m^3$/day directly to ground. Discharges that exceed the flow rate or are direct to a watercourse would not meet the thresholds.

Small discharges will present a low risk that the phosphorus will have a significant effect on the designated site where certain conditions are met:

a) The drainage field is more than 50m from the designated site boundary (or sensitive interest feature); and
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, conditions in the soil/geology that 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; and
h) For the proposed location of the drainage field, the percolation test has been performed with results lying within the Building Regulations (2015) required range of an average Vp value between 12 and 100.

3 Low risk zone mapping

A small sewage discharge low risk zone map has been created for the River Wensum SAC and The Broads SAC which are subject to nutrient neutrality guidance. The mapping defines the areas which meet the requirements of conditions **a**, **b**, **c**, **d**, **e** and **g**. Conditions **f** and **h** require site specific information and cannot be modelled via GIS.

A risk zone layer was provided by Natural England (Hornby & Hill, 2017) which can be used to assess conditions **b**, **c** and **d**. The Natural England supplied risk zone layer considers proximity to watercourse, depth to high water table and slope and combines them in to a final low risk layer across England. Water features were derived through Ordnance Survey VectorMap District and transitional waters (e.g. estuaries) were buffered and mosaicked into the dataset. The depth to high water was purchased from GeoSmart and the slope was estimated from a 20m resolution DTM. For further details on data processing and scoring technique please refer to the document: "UC1431 - Technical document: Construction of the Small Sewage Discharge Risk Zone map of England" which can be requested from Natural England.

The areas of slope less than 15% (condition **c**) was developed further using Environment Agency slope 2m DTM dataset. This provides a much more detailed assessment than the 20m dataset used within the Natural England risk zone layer and provides greater certainty that condition **c** will be met.

Table 4 provides details on the sources of datasets used to create the small sewage discharge low risk zone map.

Table 4: *Data sources*

Threshold condition	Description	Source
a)	50m from the designated site boundary	Designated site boundaries from Natural England Open Data Geoportal.
b)	40m from any surface water feature	Hornby & Hill, 2017
c)	Slope no greater than 15%	Hornby & Hill, 2017 Environment Agency Lidar slope 2m DTM dataset
d)	High-water groundwater table at least 2m below the surface	Hornby & Hill, 2017
e)	Not in flood zone 2 or 3	Flood zone boundaries from Environment Agency
g)	200m from other discharges to ground	Point locations provided by The Rivers Trust – Consented discharges to controlled waters. The data was extracted from the Environment Agency's public register in March 2021 and republished by The Rivers Trust.
Wastewater catchments	Wastewater catchments draining in to the surface water catchment	Wastewater catchments provided by Anglian Water and republished by Royal HaskoningDHV to define the treatment works draining in to the surface water catchments.

National scale datasets have been used which represent the best available evidence for the development of the map. However, there are some limitations on the accuracy of national scale data. Therefore, it would be prudent for developers to undertake due diligence when determining if a development meets the requirements of the conditions, using local knowledge and site-specific information. An example of this would be the identification of localised ditches which are unlikely to be recorded on national scale surface water mapping.

3.1 Interpreting the map

Any PTP or ST with a discharge of less than 2m^3/day that is to ground that is situated within the low risk zone will meet requirements of conditions **a**, **b**, **c**, **d**, **e** and **g** (**Figure 1**). Areas outside of the low risk zone will not meet one or more of the conditions set out in **Section 4**.

In order to meet all of the conditions, the PTP / ST must also meet the requirements of conditions **f** and **h** which require site specific information. If conditions **a** to **h** are all met, this represents a low risk that phosphorus will reach the designated site, and not zero risk. There will be further processes of dilution and attenuation between the drainage field and the site, which will provide further reduction and the current evidence would suggest that the scale of any inputs from these sources would not be significant. Where best available evidence indicates that these conditions are met, Natural England can advise if, in its view, a conclusion of no LSE alone and in combination for phosphorus can be reached in these circumstances. In this case, no phosphorus mitigation will be required as a result of the proposed development. However, **nitrogen mitigation** will still be required.

Where uncertainty remains so that LSE cannot be ruled out, or where evidence exists that there is a risk of phosphorus from small discharges to ground causing a significant effect to a designated site (e.g. from SAGIS modelling or monitoring investigations), then LSE cannot be ruled out and, an AA should be undertaken.

For developments which allow for increases in the number of people that will be served by an existing discharge to a drainage field (and is compliant with condition **a** to **h**), it will be important to consider whether the existing system has sufficient capacity in its design to accommodate the increase, without increasing the risk of pollution.

In order for a PTP / ST to be accepted, it is expected that a technical report would need to be submitted which shows the location of the PTP / ST within the low risk zone and any supporting evidence to demonstrate conditions f and h are met.

The PTP / ST must also be able to achieve the appropriate Building Regulations requirements. The building regulations state that a connection to the foul sewer should be considered to be potentially feasible where the distance from the development site to the sewer is less than the number of properties multiplied by 30m. In addition to Planning Permission and Building Regulation approval, an Environmental Permit from the Environment Agency may also be required.

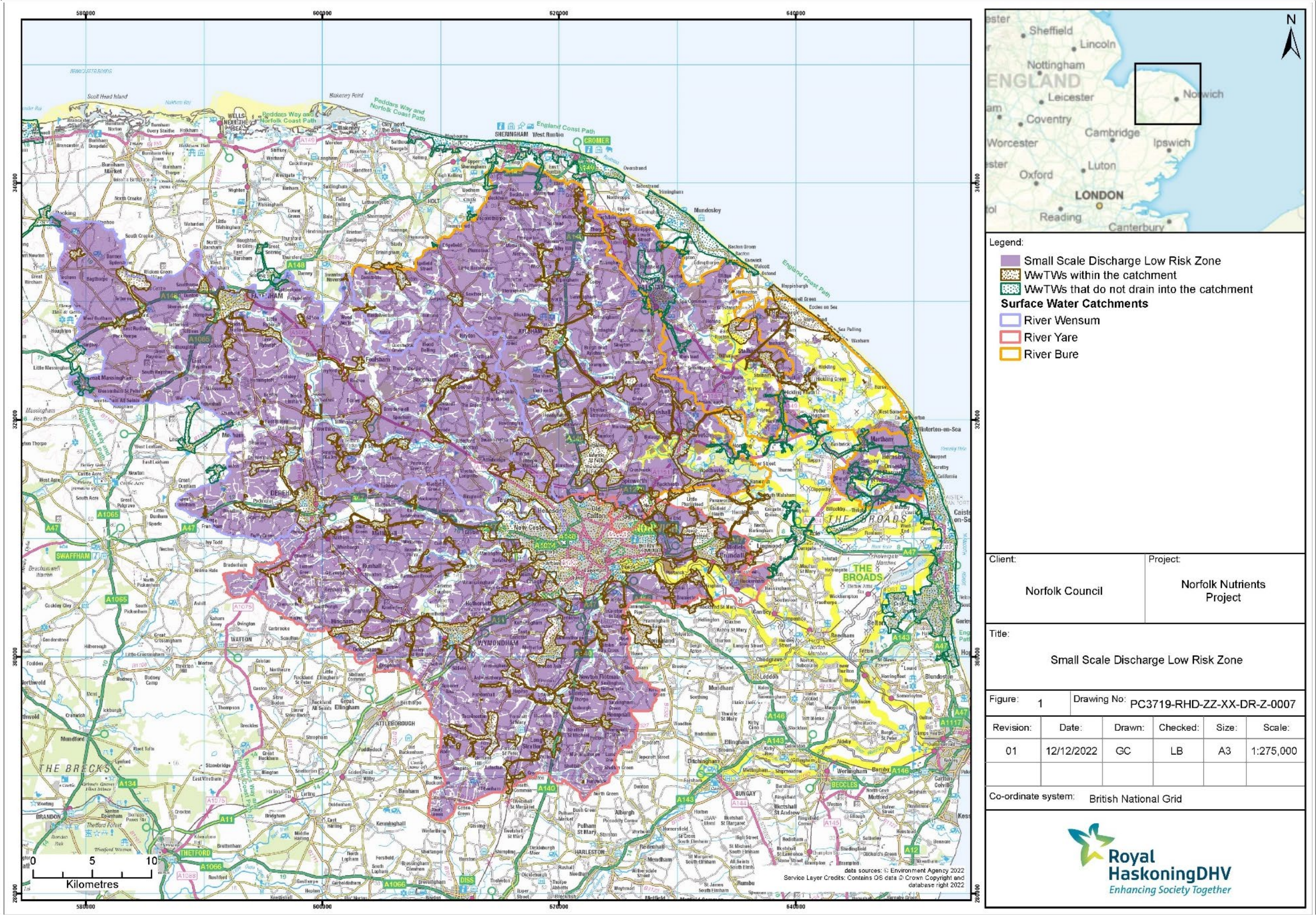

***Figure 1:** Small scale discharges low risk map*

4 Conclusions

A small sewage discharge low risk zone map has been created which follows interim guidelines agreed with Natural England on small scale thresholds in Somerset and Cornwall (Natural England, *pers. comm.*, 2022). Where all of the conditions (**a** to **h**) are met then Natural England can advise that, in its view, a conclusion of no LSE alone and in combination for phosphorus can be reached in these circumstances. The map defines the areas which fall within the low risk zone where all of the requirements of conditions **a**, **b**, **c**, **d**, **e** and **g** are met. Conditions **f** and **h** require site specific information and when provided alongside the mapping can be used to demonstrate that all the required conditions are met.

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