



Waveney Wetland SSSIs

Nutrient Modelling Summary

Date: October 2026

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Introduction

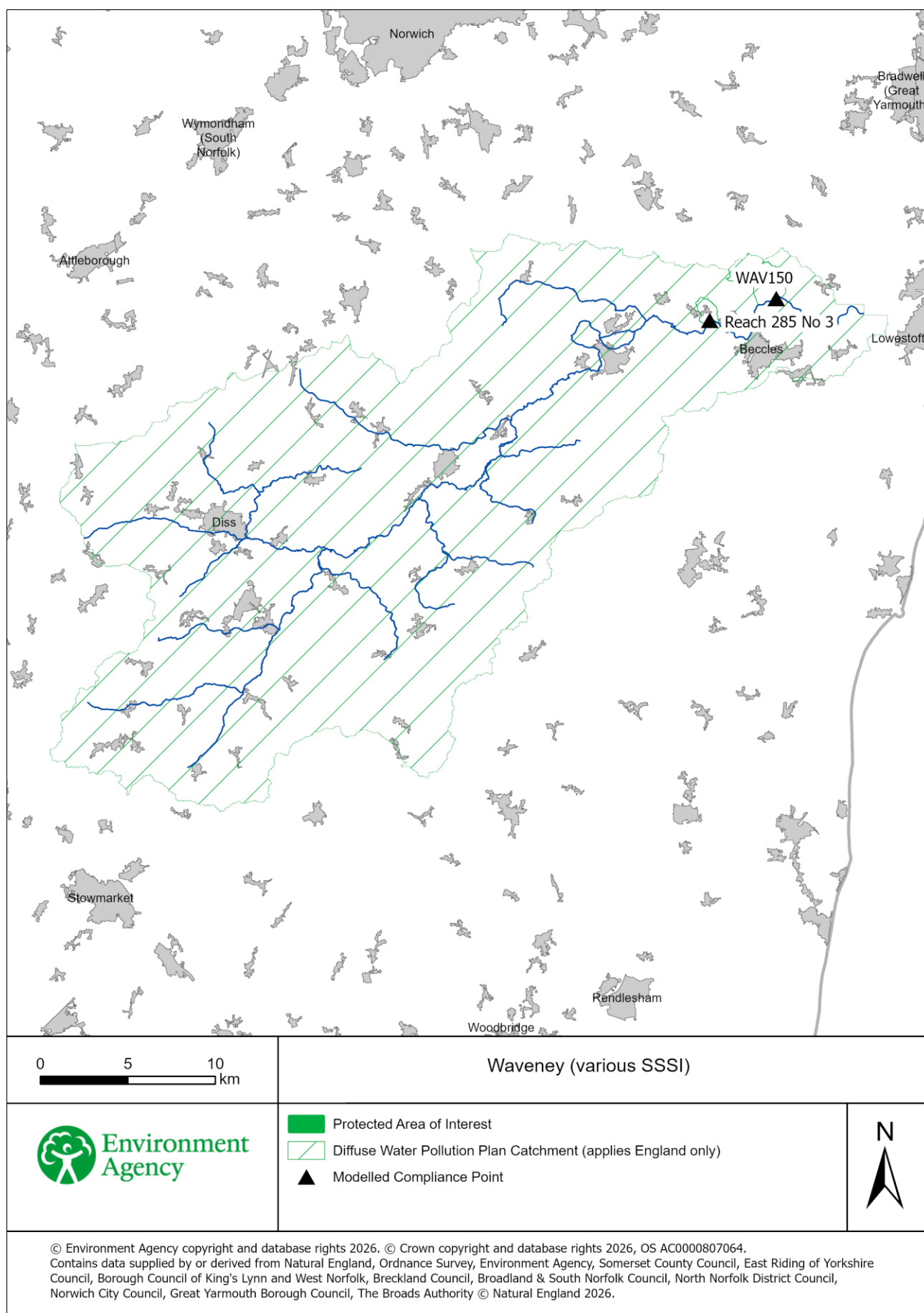
This document provides summary outputs from the Environment Agency's water quality modelling for water dependant Site of Special Scientific Interests (SSSIs) in the Waveney catchment, specifically Geldeston Meadows SSSI and Stanley and Alder Carr SSSI, both part of the Broads Special Area of Conservation (SAC) (Map 1). We provide source apportionment information and data to show the scale of reductions needed to achieve protected area water quality targets. Our outputs will help those working on Diffuse Water Pollution Plans (DWPPs) and site restoration. We aim to support a general understanding of the catchment rather than give the level of detail needed to inform specific on-the-ground measures. Our detailed methodology is described in [Catchment statistics for nutrient pollution in protected areas](#).

We applied the total phosphorus Common Standards Monitoring Guidance (CSMG) target applicable to Geldeston Meadows SSSI and Stanley and Alder Carr SSSI when assessing the modelled river phosphate at the modelled assessment points (Map 1). This is a precautionary approach, not only because phosphate is a fraction of total phosphorus but because the SSSIs are only in connectivity with the river under flood conditions when there is more dilution. Natural England and the Environment Agency agree the CSMG targets for water dependent protected areas and publish them on the [Catchment Data Explorer](#).

Alongside Simcat SAGIS models, we used the Farmscoper v5 decision support tool and applied the revised polluter pays principle methodology (v0.17) used during PR24 planning to define the sector share of the targets for the point and diffuse sectors.

Our outputs highlight the dominant nutrient sources under a range of scenarios, including future estimates based on planned water company investment up to 31 March 2030 (AMP8) and the wider implementation of rural land use measures.

We have not incorporated additional nutrient contributions from any future development and growth including housing. Any additional future nutrient load will be assessed through the planning process led by the Local Planning Authority or through our permitting process.



Map 1. River Waveney catchment and with modelled assessment points highlighted.

Models used

We used the Price Review (PR) PR19 and the PR24 [Simcat SAGIS models](#) for this work alongside [Farmscoper v5](#). Simcat SAGIS (Source Apportionment Geographical Information System) integrates ArcGIS-based digital information management and visualisation with SIMCAT (Simulated Catchment), the Environment Agency's water quality model. Farmscoper is a decision support tool that can be used to assess diffuse agricultural pollutant loads and quantify the impacts of farm mitigation methods on these pollutants.

The PR19 Simcat SAGIS model is calibrated to 2010 to 2012 data, following nationally agreed model build and calibration standards across UKWIR (UK Water Industry Research). Outputs from this model are used to establish the sector share of the protected site target under the revised polluter pays principle. Similarly, the PR24 Simcat SAGIS model is calibrated to 2014 to 2020 data, following UKWIR agreed model build and calibration standards.

The calibration process optimises the agreement between measured and simulated values through reasonable and systematic adjustments to model parameters and input data. We adjust the inputs where there is least confidence, those representing diffuse sources of pollution. The associated project overview document details the datasets included in the models. To assess confidence in the models, we compare the measured and simulated values. While Simcat SAGIS provides a robust framework for decision-making in wastewater investment, we have less certainty in the diffuse load estimates. As a result, we have lower confidence when using the models to assess the outcomes of measures that target diffuse sources, including those used here and in the DWPPs.

Farmscoper has undergone external peer review (Gooday et al., 2014), and the component models and methods used within Farmscoper have been published in the external literature. The assumptions, methods and resulting conclusions are therefore based on sound scientific principles. Farmscoper was developed as an advisory tool to aid policy makers. Farmscoper is now used more extensively and for a wider range of purposes than originally intended, therefore the consequences of assumptions and other uncertainties in Farmscoper outputs need to be considered when decision-making and users need to understand the assumptions, uncertainty, and limitations at the relevant scale of interest.

We used Farmscoper v5 to assess diffuse agricultural pollutant loads and to quantify the impacts of farm scale mitigation methods for a range of scenarios. This applies the agricultural planning assumptions for RBMP cycle 3 for land management measures ([Environment Agency, 2022](#)), as well as information from Defra project WT1594 ([Defra, 2019a](#)) We present outputs for two Farmscoper scenarios in this report to provide estimates of the reduction in nutrient losses from 'full regulation' and 'theoretical maximum' uptake rates in agricultural mitigation measures (Table 2).

Scenarios

The modelling scenarios (Table 1) evaluate the effectiveness of nutrient reductions in point and diffuse sources to meet protected site targets and the diffuse sector share of those targets. In the 2030 Full Regulation and 2030 Theoretical Maximum scenario we have applied the Farmscoper v5 reductions (Table 2) to the rural land use sector inputs. We have based the point sector measures on the AMP8 water industry national environment programme agreed in December 2024 ([PR24 WINEP](#)).

Table 1: Summary description of the point and diffuse measures represented in the Simcat SAGIS Scenarios modelled.

Scenario	Point Sector Measures	Diffuse Sector Measures	Model
Actual (2014 to 2020)*	Observed discharge flow and quality (2014 to 2019). Where not available, defaults used.	Current activities as represented post model calibration.	PR24 Calibration
2030 Optimistic	Water company AMP8 quality permit limits incorporated where applicable**	Current activities as represented post model calibration.	PR24 Calibration
2030 At Permit	All discharges represented at permitted flow and quality values up to and including AMP8**	Current activities as represented post model calibration.	PR24 At Permit
2030 Full Regulation	All discharges represented at permitted flow and quality values up to and including AMP8**	Rural land use inputs reduced by Full Regulation values from Farmscoper v5 (Table 2).	PR24 At Permit
2030 Theoretical Maximum	All discharges represented at permitted flow and quality values up to and including AMP8**	Rural land use inputs reduced by Theoretical Maximum values from Farmscoper v5 (Table 2).	PR24 At Permit

*Previously referred to as the 'recent' scenario.

**Does not include any discharge flow increases that may be required to support growth.

Table 2: Percentage phosphate reductions applied to the rural land use sector in the Simcat SAGIS Scenarios, values produced through Farmscoper v5 modelling.

Scenario	Description	Phosphate
Full Regulation	100% uptake of Regulatory measures, 25% uptake of Farming Rules for Water 'reasonable' Regulatory measures and 'current' uptake of voluntary measures.	10%
Theoretical Maximum	100% uptake of all measures in Farmscoper v5.	29%

Waveney sites modelled outputs

We estimate the phosphate catchment input load source apportionment to be 29% point source and 71% diffuse source in the Actual (2014 to 2020) scenario. Rural land use (65%) dominates the diffuse sector (Tables 3 and 4). When we apply the Full Regulation and Theoretical Maximum reductions to the rural land use sector, the contribution from the rural land use sector falls from 68% in the 2030 At Permit scenario to 65% and 59% respectively.

At Geldeston Meadows the baseline (2009) sector share of the protected site target is estimated to be 41% diffuse and 59% point (Table 5). This means the diffuse sector share of the target is 0.041mg/l and the point sector share is 0.059mg/l. The estimated diffuse sector concentration in the Actual (2014 to 2020) scenario exceeds the diffuse sector share (Table 5). Diffuse concentrations need to reduce by an estimated 35% for the diffuse sector share of the target to be met. The point sector concentration is estimated to be below the point sector share of the target. This means that the total reduction in concentrations estimated to meet the CSMG target is just 3% overall.

The 2030 Optimistic scenario estimates the concentrations after the implementation of AMP8 water company investment in the calibration model. Under this scenario the site target (0.1mg/l OP) is estimated to be met in the river (Table 5).

At Stanley and Alder Carr we estimate the baseline (2009) sector share of the protected site target to be 43% diffuse and 57% point (Table 6). This gives a diffuse sector share of 0.043mg/l and a point sector share of 0.057mg/l. In all scenarios the overall CSMG target (0.1mg/l OP) is estimated to be met due to the point sector concentrations being below the point sector share of the target (Table 6).

Input load source apportionment

Tables 3 and 4 show the estimated phosphate catchment input load source apportionment for each scenario modelled. We have greatest confidence in the point sector loads where monitoring data is available. Confidence reduces where the contribution from the sector is based on estimates rather than observed data, such as the diffuse sectors. Apportioning the input loads gives an indication of which sector is the dominant nutrient source.

Table 3: Estimated phosphate catchment input load source apportionment at the modelled assessment point for Geldeston Meadows SSSI (Reach 285 No 3).

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	29.5%	64.5%	3.7%	2.3%	0.0%
2030 Optimistic	19.6%	73.6%	4.2%	2.6%	0.0%
2030 At Permit	25.4%	68.2%	3.9%	2.4%	0.0%
2030 Full Regulation	28.0%	65.0%	4.3%	2.7%	0.0%
2030 Theoretical Maximum	32.7%	59.1%	5.1%	3.1%	0.0%

Table 4: Estimated phosphate catchment input load source apportionment at the modelled assessment point for Stanley and Alder Carr SSSI (WAV150).

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	29.5%	64.5%	3.8%	2.3%	0.0%
2030 Optimistic	19.6%	73.5%	4.3%	2.6%	0.0%
2030 At Permit	25.4%	68.2%	4.0%	2.4%	0.0%
2030 Full Regulation	28.0%	64.9%	4.4%	2.7%	0.0%
2030 Theoretical Maximum	32.7%	59.1%	5.1%	3.1%	0.0%

Input concentrations and reductions

The in-river modelled concentrations arise from the catchment input loads, after the influence of river dilution and natural decay processes in the river have been simulated. Tables 5 and 6 show the in-river concentration at the modelled assessment points (Map 1) to be consistent with the revised polluter pays principle methodology (v.0.17) used in the PR24 water company price reviews.

Apportionment by concentration and by load can be different because inputs from different sources tend to occur under different river flow conditions. Inputs from treatment works occur continuously while diffuse source inputs tend to occur under higher river flow conditions where there is greater dilution available in the receiving water. As a result, a kilogram of phosphorus discharged from a treatment works will have a relatively greater impact on in-river concentrations than the equivalent input from diffuse sources.

Table 5: Phosphate sector share alongside modelled concentrations (mg/l) and estimated percentage reductions needed across all scenarios at modelled assessment point for Geldeston Meadows SSSI (Reach 285 No 3).

Scenario and Assessment Metric	Diffuse	Point	Total
Baseline (2009) Sector Share of the target	41%	59%	
Sector share of the target (mg/l)	0.041	0.059	0.100
Actual (2014 to 2020) - modelled sector concentration (mg/l)	0.063	0.040	0.104
Actual (2014 to 2020) - reduction to meet sector share	35%	0%	3%
2030 Optimistic – modelled sector concentration (mg/l)	0.063	0.037	0.100
2030 Optimistic – reduction to meet sector share	35%	0%	0%
2030 At Permit – modelled sector concentration (mg/l)	0.063	0.045	0.108
2030 At Permit – reduction to meet sector share	35%	0%	7%
2030 Full Regulation – modelled sector concentration (mg/l)	0.054	0.045	0.099
2030 Full Regulation – reduction to meet sector share	24%	0%	0%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	0.044	0.045	0.089
2030 Theoretical Maximum – reduction to meet sector share	7%	0%	0%

Table 6: Phosphate sector share alongside modelled concentrations (mg/l) and estimated percentage reductions needed across all scenarios at modelled assessment point for Stanley and Alder Carr SSSI (WAV150).

	Diffuse	Point	Total
Baseline (2009) Sector Share of the target	43%	57%	
Sector share of the target (mg/l)	0.043	0.057	0.100
Actual (2014 to 2020) - modelled sector concentration (mg/l)	0.052	0.031	0.083
Actual (2014 to 2020) - reduction to meet sector share	17%	0%	0%
2030 Optimistic – modelled sector concentration (mg/l)	0.052	0.023	0.075
2030 Optimistic – reduction to meet sector share	17%	0%	0%
2030 At Permit – modelled sector concentration (mg/l)	0.051	0.034	0.108
2030 At Permit – reduction to meet sector share	16%	0%	0%
2030 Full Regulation – modelled sector concentration (mg/l)	0.045	0.034	0.079
2030 Full Regulation – reduction to meet sector share	4%	0%	0%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	0.036	0.034	0.07
2030 Theoretical Maximum – reduction to meet sector share	0%	0%	0%

Input load figures used to calculate source apportionment

Table 7: Estimated phosphate catchment input loads (kg/d) and input load source apportionment after calibration, before in-river processes, at modelled assessment point for Geldeston Meadows SSSI (Reach 285 No 3). These are estimates of total catchment loads and not estimates of the loads entering the Geldeston Meadows SSSI because loads enter the site under high river flow conditions.

Scenario	STW (kg/d)	Intermittents (kg/d)	Industrial (kg/d)	Rural Land Use (kg/d)	Urban (kg/d)	Septic Tanks (kg/d)	Highways (kg/d)	Point (%)	Rural Land Use (%)	Urban (%)	Septic Tanks (%)	Other (%)
Actual (2014 to 2020)	25.700	0.279	0.281	57.430	3.305	2.035	0.000	29.5%	64.5%	3.7%	2.3%	0.0%
2030 Optimistic	14.700	0.279	0.281	57.430	3.305	2.035	0.000	19.6%	73.6%	4.2%	2.6%	0.0%
2030 At Permit	20.830	0.279	0.281	57.430	3.305	2.035	0.000	25.4%	68.2%	3.9%	2.4%	0.0%
2030 Full Regulation	20.830	0.279	0.281	49.610	3.305	2.035	0.000	28.0%	65.0%	4.3%	2.7%	0.0%
2030 Theoretical Maximum	20.830	0.279	0.281	38.630	3.305	2.035	0.000	32.7%	59.1%	5.1%	3.1%	0.0%

Table 8: Estimated phosphate catchment input loads (kg/d) and input load source apportionment after calibration, before in-river processes, at modelled assessment point for Stanley and Alder Carr SSSI (WAV150). These are estimates of total catchment loads and not estimates of the loads entering the Stanley and Alder Carr SSSI because loads enter the site under high river flow conditions.

Scenario	STW (kg/d)	Intermittents (kg/d)	Industrial (kg/d)	Rural Land Use (kg/d)	Urban (kg/d)	Septic Tanks (kg/d)	Highways (kg/d)	Point (%)	Rural Land Use (%)	Urban (%)	Septic Tanks (%)	Other (%)
Actual (2014 to 2020)	25.700	0.313	0.281	57.530	3.357	2.039	0.000	29.5%	64.5%	3.8%	2.3%	0.0%
2030 Optimistic	14.700	0.313	0.281	57.530	3.357	2.039	0.000	19.6%	73.5%	4.3%	2.6%	0.0%
2030 At Permit	20.830	0.313	0.281	57.530	3.357	2.039	0.000	25.4%	68.2%	4.0%	2.4%	0.0%
2030 Full Regulation	20.830	0.313	0.281	49.690	3.357	2.039	0.000	28.0%	64.9%	4.4%	2.7%	0.0%
2030 Theoretical Maximum	20.830	0.313	0.281	38.700	3.357	2.039	0.000	32.7%	59.1%	5.1%	3.1%	0.0%

References

Defra (2019a). A national scale assessment of current and future actions to reduce diffuse pollution of water by agriculture. [Report by ADAS for Defra project WT1594](#): 1-47.

Environment Agency (2022). Water quality: what 3 future environmental land management schemes can achieve by 2027. [Water quality: what 3 future environmental land management schemes can achieve by 2027](#).

Gooday, R. D., Anthony, S.G., Chadwick, D.R., Newell-Price, P., Harris, D., Duethmann, D., Fish, R., and A. L. a. W. Collins, M. (2014). Modelling the cost-effectiveness of mitigation methods for multiple pollutants at farm scale. [Science of the Total Environment](#) (468-469): 1198-1209.

List of abbreviations

ADAS – UK-based independent agricultural and environmental consultancy, previously National Agricultural Advisory Service (NAAS).

AMP8 WINEP – Asset Management Plan 8 (2025 – 2030) Water Industry National Environment Programme - [Water industry national environment programme \(WINEP\) methodology - GOV.UK](#)

CSMG – Common Standards Monitoring Guidance – includes guidance on the appropriate standards and targets for designated sites [Common Standards Monitoring Guidance for Freshwater Habitats | JNCC Resource Hub](#)

DWPP – Diffuse Water Pollution Plan

NEAP-N – ADAS model providing annual 1 km grid loadings of nitrate.

PR – [Price Review https://www.ofwat.gov.uk/regulated-companies/price-review/](https://www.ofwat.gov.uk/regulated-companies/price-review/)

PSYCHIC – ADAS model providing annual 1 km grid loadings of Phosphate.

SAC – Special Area of Conservation

SAGIS – Source Apportionment Geographical Information System

SPA – Special Protection Area

SSSI – Site of Special Scientific Interest

UKWIR – United Kingdom Water Industry Research

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