



Yare Broads and Marshes SSSI

Nutrient Modelling Summary

Date: October 2026

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

Published by:

Environment Agency
Horizon House, Deanery Road,
Bristol BS1 5AH

www.gov.uk/environment-agency

© Environment Agency 2026

All rights reserved. This document may be reproduced with prior permission of the Environment Agency.

Further copies of this report are available from our publications catalogue: www.gov.uk/government/publications or our National Customer Contact Centre: 03708 506 506

Email: enquiries@environment-agency.gov.uk

Contents

Introduction	4
Models used	6
Scenarios.....	7
Yare Broads and Marshes SSSI modelled outputs	8
Input load source apportionment	8
Input concentrations and reductions.....	9
Input load figures used to calculate source apportionment.....	12
References	13
List of abbreviations.....	13
Would you like to find out more about us or your environment?	14
incident hotline.....	14
floodline	14
Environment first.....	14

Introduction

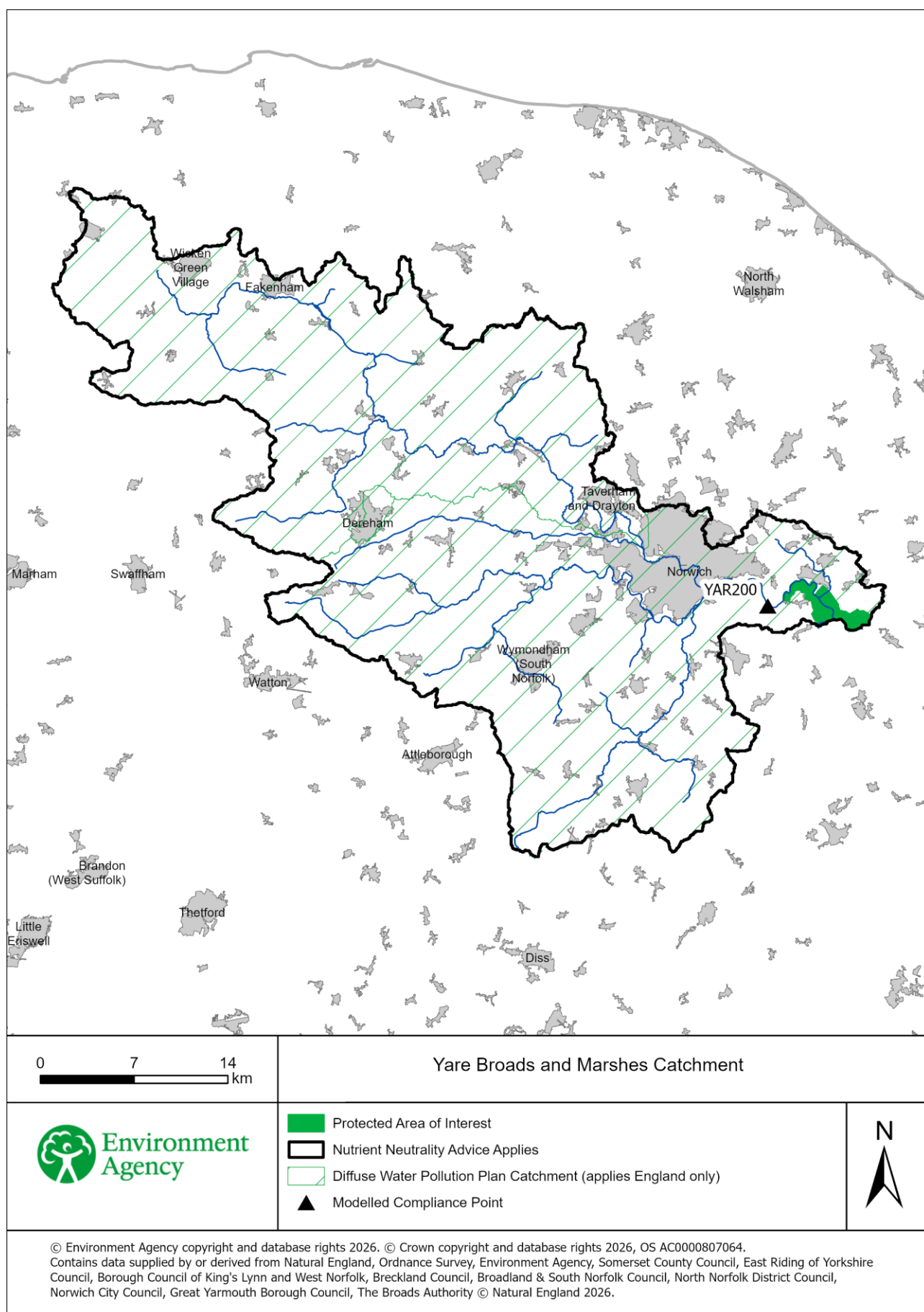
This document provides summary outputs from the Environment Agency's water quality modelling for the Yare Broads and Marshes Site of Special Scientific Interest (SSSI), part of the Broads Special Area of Conservation (SAC) (Map 1). We provide catchment-scale source apportionment information and maps showing the scale of reductions needed to achieve protected area water quality targets. Our outputs will help those working on Diffuse Water Pollution Plans (DWPPs), designing or co-ordinating nutrient mitigation schemes, and working on 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 converted the total phosphorus Common Standards Monitoring Guidance (CSMG) target applicable to the Yare Broads and Marshes SSSI to a phosphate target to assess the modelled river phosphate at the modelled assessment point (Map 1). Natural England and the Environment Agency agree these targets for water dependent protected areas and publish them on the [Catchment Data Explorer](#). We used the total nitrogen lake Water Framework Directive target when assessing the river nitrate modelled results. The Water Framework Directive total nitrogen target is tighter than the CSMG target.

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 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. Yare Broads and Marshes catchment with protected area highlighted and catchment where Natural England nutrient neutrality advice applies shown. Modelled assessment point 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 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 (Tables 2 and 3) 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: Phosphate and nitrate percentage reductions applied to the rural land use sector in the Simcat SAGIS scenarios for the Yare Broads and Marshes catchment, values produced through Farmscoper v5 modelling.

Scenario	Description	Phosphate	Nitrate
Full Regulation	100% uptake of Regulatory measures, 25% uptake of Farming Rules for Water 'reasonable' Regulatory measures and 'current' uptake of voluntary measures.	11%	6%
Theoretical Maximum	100% uptake of all measures in Farmscoper v5.	34%	18%

Yare Broads and Marshes SSSI modelled outputs

We estimate the phosphate catchment input load source apportionment to be 46% point source and 54% diffuse source in the Actual (2014 to 2020) scenario. Rural land use (41%) and urban sources (13%) dominate the diffuse sector (Table 3). The source apportionment changes incrementally under the subsequent scenarios. 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 51% in the 2030 At Permit scenario to 47% and 40% respectively.

For the nitrate catchment input load source apportionment, we estimate point sources to be 20% and diffuse sources 80% in the Actual (2014 to 2020) scenario. Rural land use sources (75%) dominate the diffuse sector (Table 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 83% in the 2030 At Permit scenario to 82% and 80% respectively (Table 4).

We estimate the baseline (2009) sector share of the phosphate protected site target to be 50% diffuse and 50% point. This gives a sector share of 0.01mg/l for both the point and diffuse sectors (Table 5). The estimated phosphate concentrations at modelled assessment point YAR200 in the Actual (2014 to 2020) scenario exceed the sector share (Table 5). For the sector share to be met, the diffuse sector concentrations need to reduce by an estimated 80% and point sector concentrations by 88%. With both the Full Regulation and Theoretical Maximum reductions applied to the rural land use sector, the residual reductions needed to meet the diffuse sector share remain high at 78% and 73% respectively (Table 5).

We estimate the baseline (2009) sector share of the protected site total nitrogen target to also be 50% diffuse and 50% point (based on nitrate concentrations). This gives a sector share of 0.535mg/l for both sectors (Table 6). The estimated nitrate sector concentrations in the Actual (2014 to 2020) scenario exceed the sector share (Table 6). For the sector share to be met, the diffuse sector concentrations need to reduce by an estimated 86% and point sector concentrations by 83%. With both the Full Regulation and Theoretical Maximum reductions applied to the rural land use sector, the residual reductions needed to meet the diffuse sector share are 86% and 84% respectively (Table 6).

Input load source apportionment

Tables 3 and 4 show the estimated catchment input load source apportionment figures for each scenario modelled for both phosphate and nitrate. 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 catchment phosphate input load source apportionment at YAR200.

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	45.5%	40.5%	12.7%	1.2%	0.1%
2030 Optimistic	28.0%	53.6%	16.8%	1.5%	0.1%
2030 At Permit	31.8%	50.7%	15.9%	1.5%	0.1%
2030 Full Regulation	34.3%	46.9%	17.2%	1.6%	0.1%
2030 Theoretical Maximum	38.9%	39.7%	19.5%	1.8%	0.1%

Table 4: Estimated catchment nitrate input load source apportionment at YAR200.

Scenario	Point Sources	Rural Land Use	Urban	Septic Tanks	Other
Actual (2014 to 2020)	20.1%	74.7%	1.0%	0.1%	4.0%
2030 Optimistic	9.6%	84.6%	1.2%	0.1%	4.6%
2030 At Permit	11.1%	83.2%	1.2%	0.1%	4.5%
2030 Full Regulation	11.6%	82.4%	1.2%	0.1%	4.7%
2030 Theoretical Maximum	13.2%	80.1%	1.4%	0.1%	5.3%

Input concentrations and reductions

The in-river modelled concentrations arise from the input catchment 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 concentrations at modelled assessment point YAR200 (Map 1) to be consistent with the revised polluter pays principle methodology (v0.17) 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 (converted from total phosphorus) alongside modelled concentrations (mg/l) and estimated percentage reductions across all scenarios at modelled assessment point YAR200.

	Diffuse	Point	Total
Baseline (2009) Sector Share of the target at YAR200	50%	50%	100%
Catchment average sector share of the target (mg/l)	0.010	0.010	0.020
Actual (2014 to 2020) - modelled sector concentration (mg/l)	0.051	0.086	0.137
Actual (2014 to 2020) - reduction to meet sector share	80%	88%	85%
2030 Optimistic – modelled sector concentration (mg/l)	0.051	0.040	0.090
2030 Optimistic – reduction to meet sector share	80%	75%	78%
2030 At Permit – modelled sector concentration (mg/l)	0.050	0.046	0.095
2030 At Permit – reduction to meet sector share	80%	78%	79%
2030 Full Regulation – modelled sector concentration (mg/l)	0.045	0.046	0.090
2030 Full Regulation – reduction to meet sector share	78%	78%	78%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	0.037	0.046	0.083
2030 Theoretical Maximum – reduction to meet sector share	73%	78%	76%

Table 6: Total nitrogen sector targets alongside modelled nitrate concentrations (mg/l) and estimated percentage reductions needed for the targets to be met across all scenarios.

	Diffuse	Point	Total
Baseline (2009) Sector Share of the target at YAR200	50%	50%	100%
Catchment average sector share of the target (mg/l)	0.535	0.535	1.070
Actual (2014 to 2020) - modelled sector concentration (mg/l)	3.904	3.122	7.026
Actual (2014 to 2020) - reduction to meet sector share	86%	83%	85%
2030 Optimistic – modelled sector concentration (mg/l)	3.903	1.268	5.170
2030 Optimistic – reduction to meet sector share	86%	58%	79%
2030 At Permit – modelled sector concentration (mg/l)	3.828	1.437	5.265
2030 At Permit – reduction to meet sector share	86%	63%	80%
2030 Full Regulation – modelled sector concentration (mg/l)	3.708	1.437	5.145
2030 Full Regulation – reduction to meet sector share	86%	63%	79%
2030 Theoretical Maximum – modelled sector concentration (mg/l)	3.382	1.437	4.819
2030 Theoretical Maximum – reduction to meet sector share	84%	63%	78%

Input load figures used to calculate source apportionment

Table 7: Estimated phosphate input catchment loads (kg/d) and input load source apportionment after calibration, before in-river processes, at modelled assessment point YAR200 (Map 1). These are estimates of total catchment loads and not estimates of loads entering the Yare Broad and Marshes protected area because loads enter the site under high river flow and/ or pumped 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)	66.5	0.9	1.4	61.25	19.20	1.75	0.14	45.5%	40.5%	12.7%	1.2%	0.1%
2030 Optimistic	29.7	0.9	1.4	61.25	19.20	1.75	0.14	28.0%	53.6%	16.8%	1.5%	0.1%
2030 At Permit	36.1	0.9	1.4	61.25	19.20	1.75	0.14	31.8%	50.7%	15.9%	1.5%	0.1%
2030 Full Regulation	36.1	0.9	1.4	52.45	19.20	1.75	0.14	34.3%	46.9%	17.2%	1.6%	0.1%
2030 Theoretical Maximum	36.1	0.9	1.4	39.13	19.20	1.75	0.14	38.9%	39.7%	19.5%	1.8%	0.1%

Table 8: Estimated nitrate input catchment loads (kg/d) and input load source apportionment after calibration, before in-river processes, at modelled assessment point YAR200 (Map 1). These are estimates of total catchment loads and not estimates of loads entering the Yare Broad and Marshes protected area because loads enter the site under high river flow and/ or pumped 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)	Atmospheric Deposition (kg/d)	Point (%)	Rural Land Use (%)	Urban (%)	Septic Tanks (%)	Other (%)
Actual (2014 to 2020)	2125.6	0.9	1.7	7891	110	6.04	0.37	425.70	20.1%	74.7%	1.0%	0.1%	4.0%
2030 Optimistic	890.8	0.9	1.7	7891	110	6.04	0.37	425.70	9.6%	84.6%	1.2%	0.1%	4.6%
2030 At Permit	1052.6	0.9	1.7	7891	110	6.04	0.37	425.70	11.1%	83.2%	1.2%	0.1%	4.5%
2030 Full Regulation	1052.6	0.9	1.7	7891	110	6.04	0.37	425.70	11.6%	82.4%	1.2%	0.1%	4.7%
2030 Theoretical Maximum	1052.6	0.9	1.7	7891	110	6.04	0.37	425.70	13.2%	80.1%	1.4%	0.1%	5.3%

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

Would you like to find out more about us or your environment?

Then call us on

03708 506 506 (Monday to Friday, 8am to 6pm)

Email: enquiries@environment-agency.gov.uk

Or visit our website

www.gov.uk/environment-agency

incident hotline

0800 807060 **(24 hours)**

floodline

0345 988 1188 **(24 hours)**

Find out about call charges (<https://www.gov.uk/call-charges>)

Environment first

Are you viewing this onscreen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle.