



# Water Quality Stocktake

Project report

Office for Environmental Protection

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# Glossary

Acronym	Definition
ADI	Acceptable Daily Intake
AMR	Antimicrobial Resistance
BDB	Biocides Delivery Boards
BEIS	Department for Business, Energy & Industrial Strategy (note now replaced by the Department for Energy Security and Net Zero, Department for Science, Innovation and Technology, and Department for Business and Trade)
BPR	Biocidal Products Regulation
CEC	Chemicals of Emerging Concern
CIP	Chemical Investigations Programme
CIPP	Chemical and Industrial Pollution Policy team (Northern Ireland)
CLP	Classification, Labelling and Packaging
CMR	Carcinogenic, mutagenic or toxic to reproduction
COPR	The Control of Pesticides Regulation
CSO	Combined Sewer Overflow
DAERA	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)
Defra	Department for the Environment Food and Rural Affairs
Dfi	Department for Infrastructure (Northern Ireland)
DIPA	Diisopropanolamine
DMEL	Derived Minimal Effect Level
DNEL	Derived No-Effect Level
DrWPA	Drinking Water Protected Areas
DWI	Drinking Water Inspectorate
DWSP	Drinking Water Safety Plan
DWPP	Diffuse Water Pollution Plan
EA	Environment Agency
ECHA	European Chemicals Agency
ECP	Expert Committee on Pesticides
EDC	Endocrine Disrupting Chemical
EFSA	European Food Safety Authority
e-NGO	Environmental non-governmental organisation
EQS	Environmental Quality Standard
EU	European Union
GC-MS	Gas Chromatography Mass Spectrometry
HRA	Habitats Regulations Assessment
HSE	Health and Safety Executive
JAGDAG	Joint Agencies Groundwater Directive Advisory Group

Acronym	Definition
LC-MS	Liquid Chromatography-Mass Spectrometry
LOD	Limit of Detection
NGO	Non-governmental organisation
NIEA	Northern Ireland Environment Agency
NSAID	Non-steroidal anti-inflammatory drug
NVZ	Nitrate Vulnerable Zones
OEP	Office for Environmental Protection
OPFR	Organophosphorus flame retardant
ORNEC	Operations that require Natural England's consent
PAH	Polycyclic Aromatic Hydrocarbon
PARC	Partnership for the Assessment of Risk from Chemicals
PBT	Persistent, bioaccumulative and toxic
PBDE	Polybrominated diphenyl ether
PC	Price Control
PCC	Personal Care Products
PDB	Pesticides Delivery Board
PEWS	Prioritisation and Early Warning System
PFAS	Per- and polyfluoroalkyl substances
PIC	Prior Informed Consent Regulation
PNEC	Predicted No Effect Concentration
POP	Persistent Organic Pollutant
PPP	Plant Protection Product
PRIF	Expert Committee on Pesticides Residues in Food
RBD	River Basin District
RBMP	River Basin Management Plan
REACH	Registration, Evaluation, Authorisation and restriction of Chemicals
RIS2	Road Investment Strategy
RMOA	Regulatory management option analysis
RSS	Really Simple Syndication
SAC	Special Area of Conservation
SAGIS	Source Apportionment Geographic Information System
SGZ	Safeguard Zones
SIP	Site Improvement Plan
SPA	Special Protection Area
SRP	Soluble Reactive Phosphorus
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Urban Drainage Systems



Acronym	Definition
SVHC	Substances of Very High Concern
TDI	Tolerable Daily Intake
UKCGG	UK Chemicals Governance Group
UWWTR	Urban Wastewater Treatment Regulations
VAM	Views about Management
VMD	Veterinary Medicines Directorate
vPvB	Very persistent and very bioaccumulative
WFD	Water Framework Directive
WHO	World Health Organisation
WIMS	Water Information Management System
WINEP	Water Industry National Environment Programme
WwTW	Wastewater Treatment Works

# Summary

This project provides a comprehensive resource on water quality challenges facing England and Northern Ireland by identifying emerging substances of concern, identifying critical knowledge gaps and proposing key recommendations. This project forms part of the wider Office for Environmental Protection (OEP) 'Project Belisama' study on the water environment in England and Northern Ireland. The project consisted of three broad areas of study:

- A **water quality stocktake** encompassing a comprehensive literature review to identify relevant emerging water environment pollutants and the preparation of factsheets for those of greatest concern.
- A **risk assessment** for prioritised pollutants.
- A **critical review of water quality delivery plans** for England and Northern Ireland (e.g. River Basin Management Plans (RBMPs)), evaluating their effectiveness and range of action.

## *Water quality stocktake*

The stocktake started with the compilation of a longlist of 195 pollutants of potential concern, following a comprehensive review. This was then narrowed down to a shortlist of 74 substances, following a screening process. The screening process considered several aspects, including:

- The number of times a pollutant was identified in a review of literature and reports.
- Pollutants that show regular exceedance of Environment Agency (EA) screening criteria.
- The priority scoring in the EA's Prioritisation and Early Warning System (PEWS).
- Hazard profile, e.g. whether a pollutant is a carcinogen or endocrine disrupting chemical (EDC).
- Fate and behaviour characteristics, e.g. if a substance is 'persistent, mobile and toxic'
- The most recent European Union (EU) Water Framework Directive (WFD) Watch List.

Following the screening, detailed factsheets were produced for 25 pollutants or categories of pollutant (including emerging and "new insight" pollutants). The factsheets reported information on pollutants' primary sources, ecological & human health impacts, and relevant legislation. Factsheets were also prepared for nine established pollutants, including phosphorus, nitrogen, selected metals and per- and polyfluoroalkyl substances (PFAS).

## *Risk assessment*

Prioritised pollutants were taken forward for more detailed consideration by risk assessment to determine the extent, magnitude and future evolution of the risks posed to the aquatic environments of England and Northern Ireland. Substances were selected to ensure that there was a representative for different categories of pollutant, namely, pharmaceuticals, personal care products, industrial chemicals, EDCs, and on the basis of specific concerns highlighted in the factsheets. The seven substances selected for risk assessment and the rationale for their selection are set out below:

- 1,4-dioxane – industrial chemical, assigned highest priority under the EA PEWS review, potentially carcinogenic to humans and undergoing assessment for being persistent, bioaccumulative and toxic (PBT).
- Bisphenol A – industrial chemical with many uses and confirmed EDC, classified as a Priority Substance under the EU WFD.
- Carbamazepine – pharmaceutical, highlighted in PEWS and prioritised in an EA assessment of pharmaceuticals due to regular detection in monitoring programmes.
- Climbazole – used in personal care products, representative of the azole class of fungicides and undergoing assessment in the EU as a potential EDC.
- Diclofenac – pharmaceutical, representative of the non-steroidal anti-inflammatory drugs (NSAIDs) class of medicines, widely detected and included on the WFD Watch List.
- Fipronil – veterinary medicine (insecticide), classified as very toxic and widely detected in English waters.
- Galaxolide – used extensively in personal care products as a fragrance (synthetic musk), is classified as very toxic and is undergoing assessment in the EU as PBT and as a potential EDC.

The risk assessment considered the following:



- The spatial context, defined as 'localised' (specific sources only in certain areas of the countries), 'widespread' (pollution observed in most surface water bodies, often resulting from discharge in effluent from Wastewater Treatment Works (WwTWs)), or 'ubiquitous' (pollutant detected in nearly all water samples, including those taken from groundwater – aquatic pollutants with this characteristic are usually persistent and mobile).
- The current risk, defined as: 'low' if all (or nearly all) measurements are well below the assessment criteria; 'moderate' if measured concentrations are just below the assessment criteria for environment or human health, or if there are a small number of exceedances; 'high' if there was an appreciable number of exceedances; and 'very high' if a very high level of exceedances occurred and/or the nature of the hazard (e.g. potential exposure to a carcinogen in drinking water).
- Evolution of risk, with the direction of potential future risk assigned as 'improvement', 'no change' or 'deterioration' based on the likelihood of concentrations in the aquatic environment either declining, remaining static or increasing in the short to medium term.
- The quality of evidence, whereby the reliability and robustness of the risk assessment is determined to be 'very good', 'good', 'moderate' or 'poor' depending on the quality of evidence. This considered the extent of monitoring data (including whether it is available for a specific country) and how well the potential impacts of the pollutant have been characterised (including the robustness of the available assessment criteria).

The above criteria were combined to assign an overall risk to each substance. The assessment indicated that 1,4-dioxane and fipronil are likely to present a very high risk to the aquatic environment in England and Northern Ireland. Galaxolide and bisphenol A pose high risks in both countries. The pharmaceutical diclofenac presents a high risk in England, but a low risk in Northern Ireland. Climbazole and carbamazepine present a moderate risk in England and Northern Ireland.

#### *Review of plans*

The review of delivery plans indicated that, in England, plans with regards to nutrients are comprehensive, particularly for protected areas. In catchments not designated as protected areas, measures tended to be more generic and primarily rely on ensuring compliance within the legislation aimed at reducing the impact of nutrient loads on the water environment from the agricultural sector. With regards to metals, although specific waterbodies affected by metal pollution have been identified, there does not appear to be a clear strategy or prioritised programme of schemes to address the pollution.

The EA's process for developing regulatory measures to address emerging substances is robust and underpinned by a strong evidence-base; however, the EA have indicated that in some cases, there are not sufficient resources (primarily staff) to implement all the measures that they have identified. In Northern Ireland, delivery plans are largely focused on nutrients and target both agricultural and wastewater sources. Measures are often generic and catchment-specific measures are not frequently considered. Staff resourcing issues in the Northern Ireland Environment Agency meant that we received limited information on emerging pollutants.

#### *Recommendations*

The key recommendations arising from this work are listed below, which we envisage would be undertaken largely by the EA and Department for Environment, Food and Rural Affairs (Defra).

- Explore options to make sources of information on emerging chemicals (e.g. the EA Water Information Management System (WIMS) and UK REACH databases) more user-friendly and accessible to non-specialists.
- Create a wider overarching database on emerging chemicals. This would need to be regularly updated to respond to the fast pace of technological and scientific developments in this area.
- Expand the factsheet repository produced for this project to include other chemicals.
- Improve the monitoring of emerging pollutants, especially those identified as highest priority.
- Create a publicly-available 'signposting document', explaining how the different water quality delivery plans are inter-linked.
- Delivery plans, in particular the RBMPs, should present more detail of proposed measures at, for example, catchment or waterbody scale.
- Make the measures listed in delivery plans SMART (Specific, Measurable, Achievable, Realistic and Timely), incorporating clear information on the delivery lead and how the effectiveness of measures will be evaluated, tracked and recorded.

# 1. Introduction & overall approach

The UK Government's 25-year Environment Plan highlights the need for early identification of chemicals of concern, so that effective intervention can be undertaken prior to damage being caused to the environment, wildlife or human health. This project aims to bring together the latest scientific understanding on chemicals in the water environment, in view of the fast pace of developments in the field of environmental chemistry. The overall aim was not to repeat work that has been done under the auspices of the Water Framework Directive (WFD), but rather, to synthesise the latest technical knowledge to identify key gaps in knowledge, and provide recommendations for future work to improve our understanding of water quality issues. This project, therefore, focuses primarily on emerging substances or those for which significant new insights have become available. The work forms part of a wider study undertaken by the Office for Environmental Protection (OEP) on the water environment. We note that there is heightened public interest in, and awareness of, emerging pollutants in the water environment. With this in mind, we endeavour to provide a useful reference for regulators, stakeholders and the wider public on this important topical area.

We followed a stepped overall approach for this work, dividing the study into three broad tasks: (1) a water quality stocktake, (2) a risk assessment, and (3) a review of existing plans (see Figure 1-1). In more detail this entailed the following:

- Water quality stocktake
  - We undertook a comprehensive review to identify key pollutants of concern, dividing them into emerging pollutants, those with key new insights, and established pollutants.
  - Based on the review, we identified a long list of pollutants, in some cases grouping substances together.
  - We then focused on emerging substances or those with significant new insights, so not to duplicate existing work on established pollutants. We developed factsheets for emerging and new insight substances. For completeness, we also developed factsheets for nine key established pollutants.
- Risk assessment
  - From the list of emerging pollutants, we identified seven pollutants of greatest concern. These were then subjected to a detailed risk assessment.
- We finally reviewed existing plans dealing with water quality (nutrients and emerging/new insights pollutants) across England and Northern Ireland, critically, evaluating their effectiveness and range of action.

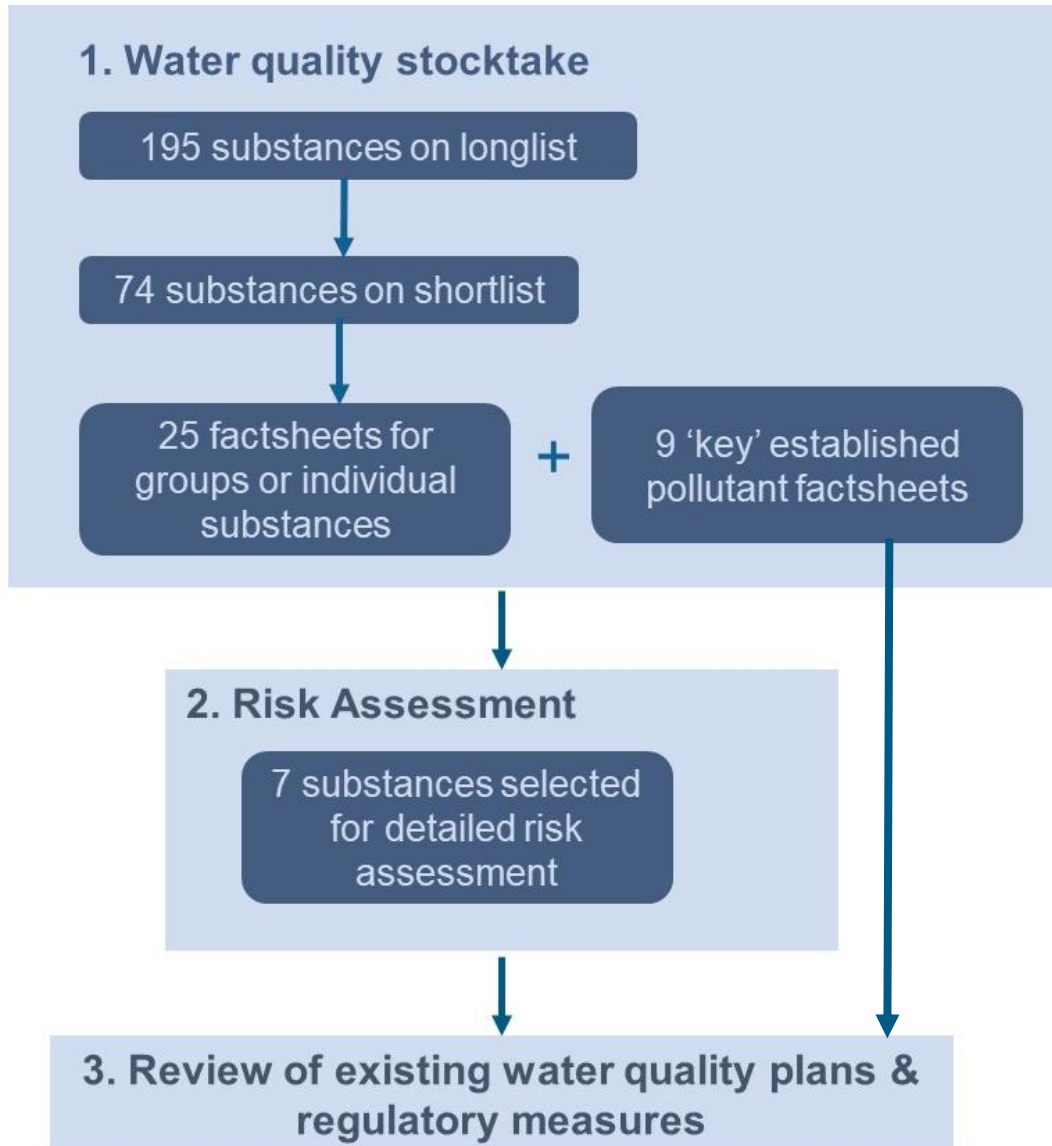


Figure 1-1 - Overall project approach

## 2. Water quality stocktake

### 2.1. Approach

The overarching aim of the water quality stocktake task was to undertake a comprehensive stocktake of aquatic pollutants in England and Northern Ireland. The review initially considered a wide range of pollutants as a baseline longlist which was then narrowed down to focus on a list of key emerging pollutants, current pollutants with significant new knowledge, and new water quality pressures, factors or trends to address.

#### Compilation of a longlist of pollutants

A comprehensive review of water quality pollutants in England and Northern Ireland was conducted by assessing scientific literature and reports produced by UK regulators, the water industry, and non-governmental organisations (NGOs), as well as utilising the project team's extensive knowledge of this subject.

The main sources of relevant literature were the Web of Science and Google Scholar, using various combinations of the key search terms (detailed in Table 2-1). Searches were conducted in December 2022 – January 2023.

**Table 2-1 - Key search terms included within the literature search**

emerging	pollutant	hazard	England
new	substance	health risk	Northern Ireland
new insights	chemical	environmental risk	United Kingdom
	antimicrobial	human health	Great Britain
	biocide (pesticide, herbicide)		
	pharmaceutical		
	metals		
	flame retardants		

Other literature sources included reports by UK regulators, the water industry and NGOs, namely:

- The Environment Agency's (EA) Prioritisation and Early Warning System (PEWS) decision logs.
- The priorities considered for the 2022-2023 UK REACH work programme<sup>1</sup>.
- Pollutants identified in the River Basin Management Plans: Challenges for the Water Environment<sup>2</sup>.
- The EA draft pharmaceutical report – 'Review of Monitoring Data and Selection of Pharmaceuticals and Medically Related Substances for Further Analysis'.
- UK Water Industry Research (UKWIR) urban runoff and atmospheric deposition (2022).

The lists of pollutants identified in the reviews were combined then cross-referenced against:

- The substances listed in the Environmental Quality Standards (EQS) daughter Directive (2013/39/EU) which are transposed for the UK in (1) the Water Environment (Water Framework Directive) (England and Wales) (Amendment) Directions 2015<sup>3</sup>, and (2) The Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015<sup>4</sup>. These standards are implemented in the UK through (1) the Water Environment (WFD) (England and Wales) Regulations (2017)<sup>5</sup>, and (2) the Water Environment (WFD) Regulations (Northern Ireland) (2017)<sup>6</sup> (based on the EU WFD Directive 2000/60/EC7).
- Substances included in the UK water industry's Chemical Investigations Programme (CIP)<sup>8</sup>.
- Substances included in PEWS, and the respective priority classification.

### Production of a shortlist of pollutants

When producing the shortlist the aim was to identify emerging pollutants or pollutants with significant new insights included in the longlist that pose the greatest potential risk to the aquatic environment or to human health via the aquatic environment in England and Northern Ireland. It also aimed to group individual pollutants, where appropriate, and to capture a fair representation of pollutants from the main categories/sources of high concern (biocides, pharmaceuticals, industrial chemicals, personal care products, plant protection products, veterinary medicines, and endocrine disrupting chemicals). Pollutants covered by the WFD Regulations in England and Northern Ireland (i.e., those with EQS) were not considered to be 'emerging' but could still be considered for the shortlist if there were 'significant new insights' that imply environmental standards could be modified as a consequence.

Several aspects were considered when deriving the shortlist, including:

- The number of times a pollutant was identified in the review of literature and reports.
- Pollutants that show regular exceedance of EA screening criteria (e.g. EQS (where available) or predicted no effect concentrations (PNECs)).

<sup>1</sup> [Rationale for prioritising substances in the UK REACH work programme, 2022 to 2023 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/collections/river-basin-planning-challenges-for-the-water-environment)

<sup>2</sup> <https://www.gov.uk/government/collections/river-basin-planning-challenges-for-the-water-environment>

<sup>3</sup> The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/ukksi/2015/1623/resources>

<sup>4</sup> The Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2015/45/made>

<sup>5</sup> The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/ukksi/2017/407/made>

<sup>6</sup> The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2017/81/contents/made>

<sup>7</sup> DIRECTIVE 2008/105/EC of the European parliament and of the council. Available at: [untitled \(europa.eu\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0105)

<sup>8</sup> <https://ukwir.org/chemical-investigations-programme-EIR-Database>

- The priority scoring in PEWS – specifically focussing on substances that had been ranked as Priority 1 (high risk, high certainty) or Priority 2 (high risk, low certainty) based on an assessment of the available exposure and hazard information.
- The hazard profile, e.g. carcinogens and endocrine disrupting chemicals.
- Fate and behaviour characteristic, e.g. 'persistent, mobile and toxic'.
- Consideration was also given to the most recent EU WFD Watch List (2022)<sup>9</sup>, if the substances had already been identified as part of this review as being relevant to England or Northern Ireland.

Decisions on the final shortlist were made based on discussions within the project team following the above criteria and in consultation with the OEP, the EA and the Northern Ireland Environment Agency (NIEA).

194 substances were identified on the longlist, of which 74 substances classed as 'emerging' or with 'significant new insights' and were taken forward to the shortlist. Many of the substances could be grouped together, resulting in a total of 25 factsheets (nine individual substances and 16 groups, Table 2-2).

Additionally, nine 'key established pollutants' were selected, representing seven individual substances and two groups, covering a total of 21 substances (see Table 2-3).

**Table 2-2 - Shortlist pollutants and pollutants categories selected as 'emerging pollutants' or those with 'significant new insights'.**

Category name / pollutant name	Example pollutants within category	Classification
Azole compounds	climbazole metconazole penconazole prochloraz tebucanazole	Pesticide/fungicide Personal care products
Alkylphenols	nonylphenol octylphenol 4-tert butylphenol 2,4,6-tri-tert-butylphenol 4-sec-butyl-2,6-di-tert-butylphenol	Industrial chemicals Endocrine Disrupting Chemicals (EDCs)
Antibiotics in the $\beta$ -lactam family	amoxicillin sodium ampicillin sodium cloxacillin	Pharmaceutical Veterinary medicines
Bisphenol A and related substances	bisphenol A bisphenol F bisphenol S tetrabromobisphenol-A (TBBPA)	Industrial chemicals EDCs
Carbamazepine	n/a	Pharmaceutical
Cypermethrin	n/a	Biocide
Fipronil	n/a	Insecticide
Fluoxetine (Prozac or Oxactin)	n/a	Pharmaceutical
Halogenated solvents	trichloroethylene/trichloroethene tetrachloroethylene/tetrachloroethene bromodichloromethane	Industrial chemicals

<sup>9</sup> [Selection of substances for the 4th Watch List under the Water Framework Directive - Publications Office of the EU \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&plugin=1)

Category name / pollutant name	Example pollutants within category	Classification
	chlorodibromomethane	
Imidacloprid	n/a	Insecticide
Industrial UVs	UV-320 UV-326 UV-328 UV-350	Industrial chemicals
Macrolide antibiotics	azithromycin clarithromycin erythromycin	Pharmaceuticals Veterinary medicines
Microplastics	primary microplastics secondary microplastics	Particulates
Non-steroidal anti-inflammatory drugs (NSAIDs)	naproxen diclofenac Ibuprofen	Pharmaceuticals
Organophosphorus flame retardants	tris(2-chloro-1-methylethyl) phosphate (TCPP) trixylyl phosphate (TXP) tris(2-choroethyl) phosphate (TCEP) triphenyl phosphate (TPP) tris[2-chloro-1-(chloromethyl)ethyl] phosphate (TDCP) triethyl phosphate (TEP) tripropyl phosphate (TPrP)	Industrial chemicals
Other antibiotics	ciprofloxacin sulfamethoxazole trimethoprim tetracycline	Pharmaceutical Veterinary medicines
Polycyclic aromatic hydrocarbons (PAHs)	benzo(a)pyrene (B[a]P) chrysene benzo[a]anthracene benzo[b]fluoranthene pyrene fluroanthene benzo(ghi)perylene	Industrial chemicals
Parabens - alkyl esters of p-hydroxybenzoic acid	methyl paraben ethyl paraben propyl paraben butyl paraben	Personal care products EDCs
Polycyclic musks	galaxolide tonalide	Personal care products
Propranolol	n/a	Pharmaceutical
Phthalate esters	diethylhexyl phthalate (DEHP) dibutyl phthalate (DBP)	Industrial chemicals EDCs



Category name / pollutant name	Example pollutants within category	Classification
	benzylbutyl phthalate (BBP) diisobutyl phthalate (DIBP)	
Tri-allate	n/a	Plant protection product - pesticide
Triclocarbon	n/a	Pharmaceutical
UV filters (sunscreen)	octocrylene 4-methylbenzylidene camphor oxybenzone homosalate	Personal care products
1-4 dioxane	n/a	Industrial chemicals

**Table 2-3 - Shortlist pollutants and pollutants categories selected as 'key established pollutants'**

Category name / pollutant name	Example pollutants within category	Classification
Nitrogen	n/a	Nutrient
Phosphorous	n/a	Nutrient
Copper	n/a	Metal
Lead	n/a	Metal
Mercury	n/a	Metal
Nickel	n/a	Metal
Zinc	n/a	Metal
PFAS (per- and poly-fluoroalkyl substances)	PFOS PFOA PFNA PFDA PFBS PFHxS PFHxA	Industrial chemicals
Polybrominated diphenyl ethers (PBDEs)	BDE 28 BDE 47 BDE 99 BDE100 BDE 153 BDE 154 BDE 209	Industrial chemicals Potential EDCs

## 2.2. Factsheets summary

### 2.2.1. Purpose of the factsheets

The aim of the factsheets was to provide an objective summary of the key pollutants of concern identified from the research. The factsheets are intended to enhance the understanding of water quality pressures, and

support prioritisation of resources to the areas that matter most. The factsheets contain essential information, presented in a simple and effective format.

The water quality factsheets were produced in February and March 2023. The field of emerging pollutants is ever evolving, and information included within the factsheets may become outdated as new information becomes available. In cases where groups of pollutants are discussed, the information included within each category was only provided for the example pollutants where information was readily available.

For a detailed description of the core information and key references included within each category in the factsheets, and a glossary of acronyms and technical language used within the factsheets, please refer to Appendix B (Notes on Factsheets).

The below sections provide a summary of some of the key categories of information included in each factsheet:

- The current level of legislation/action in place for each pollutant
- The data availability and quality of evidence for each pollutant
- Key evidence gaps identified across the factsheets

### 2.2.2. Current level of legislation/action

The factsheets detailed the key legislation or actions relating to pollutant groups or members of the pollutant group. In some cases there are numerous pieces of national and international legislation for a given substance. This section within the factsheets primarily considered several principle laws, regulations, measures and actions, (summarised in Table 2-4), however this list is not exhaustive. In many cases the lack of legislation reflects the emerging nature of the pollutants covered by the factsheets. The key legislations considered are:

#### 1. EQS as part of the WFD

The WFD at EU level (Directive 2000/60/EC)<sup>10</sup>, and the EQS daughter directive (Directive 2008/105/EC) are transposed into English and Northern Irish law by the Water Environment (WFD) (England and Wales) Regulations (2017)<sup>11</sup> and The Water Environment (WFD) Regulations (Northern Ireland) (2017)<sup>12</sup>. EQS values are detailed in EU Directive 2013/39/EU<sup>13</sup> which is transposed through the Water Environment (Water Framework Directive) (England and Wales) (Amendment) Directions 2015<sup>14</sup>, and the Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015<sup>15</sup>. At the time of writing (May 2023), there is general alignment between the EU EQS values and those included in the WFD Regulations for England and Wales and Northern Ireland. However, the direction of EQS development in England and Wales and Northern Ireland may differ from that of the EU in future.

Since leaving the EU, the development and application of new EQS in England and Wales operates independently from the EU. Correspondence with the EA (12 Jan 2023) indicate that they are awaiting direction from Department for Environment, Food and Rural Affairs (Defra) regarding the approach to be taken post WFD (i.e. will the government make their own decisions regarding the list of priority substances and associated EQS). The EA has funding to work on the derivation of EQS for some pollutants (e.g., for PAHs, erythromycin and imidacloprid). The EU are also working on EQS development for several new Priority/Priority Hazardous Substances and the EA will consider and build on work done by the EU for the pollutants covered by the current funding.

The Water (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 ensures that the Water Framework Directive (as transposed in 2017) continue to operate in Northern Ireland following the departure of the UK from

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<sup>10</sup> DIRECTIVE 2008/105/EC of the European parliament and of the council. Available at: [untitled \(europa.eu\)](#)

<sup>11</sup> The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2017/407/made>

<sup>12</sup> The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2017/81/contents/made>

<sup>13</sup> Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0039>

<sup>14</sup> The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2015/1623/resources>

<sup>15</sup> The Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2015/45/made>



the EU<sup>16</sup>. For this reason there are differences between EQS for England/Wales and Northern Ireland. Decisions still need to be made in Ireland regarding the approach to EQS guidance post-Brexit. There are currently three options under consideration in Northern Ireland (1) to continue to align with the EU replicating the changes they make; (2) To align with the UKs approach, and (3) To implement a bespoke Northern Ireland approach (set their own EQS) (based on correspondence on 7<sup>th</sup> Feb 2023).

## 2. The Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

REACH aims to address the production and use of chemical substances and their potential environmental and human health effects (Regulation EC 1907/2006<sup>17</sup>). Under the EU (Withdrawal) Act 2018, the EU REACH Regulation was brought into UK law on 1 January 2021 and is known as UK REACH (The REACH (Amendment) Regulations 2023 (draft)<sup>18</sup>). The regulation applies to the majority of chemical substances that are manufactured or imported into the UK. UK REACH and the EU REACH regulations operate independently from each other, therefore decisions as part of EU REACH (made since the UKs departure from the EU) are not automatically reflected in UK REACH. Under the terms of the Northern Ireland Protocol, EU REACH continues to apply in Northern Ireland, whereas UK REACH applies to England, Wales and Scotland.

## 3. Drinking water limits

Drinking water limits are defined by the UK Drinking Water Standards and Regulations (Drinking water Inspectorate)<sup>19</sup> under the Water Supply (Water Quality) Regulations 2016 (England and Wales)<sup>20</sup> and the Water Supply (Water Quality) Regulations 2017 (Northern Ireland)<sup>21</sup>.

## 4. Pollutants identified in one of the European Union (EU) Water Framework Directive (WFD) Watch Lists

Since leaving the EU, there is no direct regulatory consequence of something being on the watchlist for England/Wales. However, the EA lists 'bilateral exchange and collaboration' in PARC (Partnership for the Assessment of Risk from Chemicals)<sup>22</sup> as one of the sources of information feeding into PEWS. PARC is Co-funded by the EU and may allow consideration of watch list chemicals into PEWS.

In contrast, the Water (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 ensures that the Water Framework Directive (as transposed in 2017) continue to operate in Northern Ireland following the departure of the UK from the EU<sup>16</sup>. This means that the NIEA should monitor pollutants on the watchlist to determine the risk they pose to the aquatic environment and whether EU EQS should be set for them.

## 5. Other legislation

For example relating Food limits defined by the European Food Safety Authority (EFSA) or approved active Plant Protection Products (PPP).

### 2.2.3. Monitoring data availability

Routine monitoring is not conducted for most of the emerging pollutants included within the factsheets as they are typically unregulated. However, concentrations of emerging pollutants in surface and groundwater bodies and in wastewater treatment works (WwTW) influent and effluent (in England) is often conducted by the EA's Liquid chromatography-mass spectrometry (LC-MS) and gas chromatography-mass spectrometry (GC-MS) screening programme and/or the CIP. Nevertheless, the number of samples, frequency of sampling and type of water body sampled varies greatly by pollutant. Some pollutants covered in the factsheets (such as the  $\beta$ -lactam antibiotics, some organophosphorus flame retardants, most of the phalate esters and galaxolide), are not included in any of the monitoring programmes that were investigated as part of this review. Data availability

<sup>16</sup> [Water Framework Directive | Department of Agriculture, Environment and Rural Affairs \(daera-ni.gov.uk\)](https://www.daera-ni.gov.uk/articles/water-framework-directive) <https://www.daera-ni.gov.uk/articles/water-framework-directive>

<sup>17</sup> Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). Available at: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32006R1907>

<sup>18</sup> The REACH (Amendment) Regulations 2023 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/ukdsi/2023/9780348247329>

<sup>19</sup> Drinking Water Standards and Regulations - Drinking Water Inspectorate (dwi.gov.uk). Available at: <https://www.dwi.gov.uk/drinking-water-standards-and-regulations/>

<sup>20</sup> The Water Supply (Water Quality) Regulations 2016 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/ukdsi/2016/614/contents>

<sup>21</sup> The Water Supply (Water Quality) Regulations (Northern Ireland) 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2017/212/made>

<sup>22</sup> [Partnership for the Assessment of Risks from Chemicals | Parc \(eu-parc.eu\)](https://www.eu-parc.eu)

per pollutant is summarised in Table 2-4 and a summary of the different monitoring programmes considered in the factsheets is described below:

### 1. Routine monitoring by the EA or NIEA

Routine monitoring is driven by WFD Legislation<sup>11,12</sup>, and is typically only done for Priority Substances included within the 2015 Directions<sup>14,15</sup>.

### 2. The EA's LC-MS and GC-MS screening programme

The EA's LC-MS and GC-MS screening programme provides semi-quantitative concentrations for a significant number of regulated and un-regulated pollutants in a range of surface and groundwater bodies in England. Data is available through [data.gov.uk](https://data.gov.uk)<sup>23</sup>.

Whilst the NIEA do not conduct routine monitoring for many of the emerging pollutants, they have indicated that methods are being developed for a number of emerging pollutants, specifically pharmaceuticals (based on correspondence on the 7<sup>th</sup> Feb 2023).

### 3. The CIP

The CIP is the UK water industry's response to current and emerging legislation on trace chemical substances in the water environment. It brings together the 10 large water and wastewater companies in England and Wales with regulators (Defra, the EA and Natural Resources Wales) to investigate a range of chemical substances, often contained in many domestic products, that find their way into sewage and biosolids and reach rivers and streams; who or what is responsible for them getting there in the first place; and what can be done to reduce concentrations, if needed. Many of these chemicals – including metals, fire retardants and biocides, hydrocarbons, pharmaceuticals, hormones and personal care products – have the potential to be present in both untreated and treated effluent.

To help to address this challenge, a programme of chemical investigations has been part of the water industry's national environment programme (WINEP) since AMP5. Through the WINEP, the 10 water and wastewater companies in England and Wales have funded a 15+ year programme of work as follows:

CIP1 (£25 million) 2010 – 2015: Determined the sources/pathways of chemicals getting into rivers via WwTWs and characterised treated wastewater in terms of these chemicals.

CIP2 (£140 million) 2015 – 2020: 600 WwTWs were prioritised for further investigation to better understand the potential scale of the challenge. Technology trials at WwTWs were also carried out to determine potential solutions to remove trace chemical substances before treated wastewater is released into rivers.

CIP3 (£25 million) 2020 – 2022: Focussed on investigating gaps in knowledge arising from CIP1 and CIP2, particularly around microplastics and understanding anti-microbial resistance in current wastewater treatment processes.

The CIP4 programme of investigations is currently in its planning stage, and will be delivered over the period 2025-2028. The CIP4 programme of investigations has a broad scope and will include: source control measures for PFOS, the treatment capability of wetlands for chemicals, the impact of sludge spreading on chemicals in groundwater, continued focus on emerging substances that may enter the environment from WwTWs; investigations into endocrine disrupting chemicals, Antimicrobial Resistance (AMR) etc.

Further information can be found at: [Sign up and access the Chemical investigations programme Data access portal \(ukwir.org\)](https://www.ukwir.org)

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<sup>23</sup> Water quality monitoring data GC-MS and LC-MS semi-quantitative screen - data.gov.uk. Available at: <https://www.data.gov.uk/dataset/0c63b33e-0e34-45bb-a779-16a8c3a4b3f7/water-quality-monitoring-data-gc-ms-and-lc-ms-semi-quantitative-screen>



#### Table 2-4 - Overview of key legislations/ actions and data availability of each pollutant

Legislation/actions covers (1) inclusion in one of the European Union (EU) WFD Watch List; (2) WFD regulations within the EU, England and Northern Ireland (NI); (3) Registration under the REACH in the EU and United Kingdom (UK); (4) Limits for drinking water; (5) Limits for food; (6) Other legislation. Data availability covers (1) Routine monitoring in England and Wales by the EA and in Northern Ireland by the NIEA; (2) CIP; and (3) The EA's LC-MS and GC-MS screening programme (England). [X = yes, ~ = in progress/development].



Pollutant details			Legislation								Monitoring data availability			
Pollutant group	Pollutants within group	CAS number	EU WFD Watch List	Water Framework Directive (WFD)			REACH		Drinking water limit	Other	Routine monitoring			LC-MS/GC-MS
				EU	England	NI	EU	UK			EA	NIEA	CIP	
<b>Emerging pollutants/ Pollutants with significant new insights</b>														
<i>β-lactam antibiotics</i>	Amoxicillin	26787-78-0	X (2020)				X							
	Ampicillin	69-53-4					X							
	Cloxacillin	61-72-3												
<i>Macrolide antibiotics</i>	Azithromycin	83905-01-5	X (2015, 2018)	X (draft)			X						X	X
	Clarithromycin	81103-11-9	X (2015, 2018)	X (draft)									X	X
	Erythromycin	114-07-8	X (2015, 2018)	X (draft)	~		X						X	X
<i>Other antibiotics</i>	Ciprofloxacin	85721-33-1	X (2015, 2018)										X	X
	Tetracycline	60-54-8					X							X
	Trimethoprim	738-70-5	X (2020)										X	X
	Sulfamethoxazole	723-46-6	X (2020)										X	X
<i>NSAIDs</i>	Diclofenac	15307-86-5	X (2015)	X									X	X
	Ibuprofen	15687-27-1											X	X
	Naproxen	22204-53-1											X	X
<i>Carbamazepine</i>	Carbamazepine	298-46-41		X (draft)									X	X
<i>Propranolol</i>	Propranolol	525-66-6											X	X
Pollutant group	Pollutants within group	CAS number	EU WFD Watch List	EU	England	NI	EU	UK	Drinking water limit	Other	EA	NIEA	CIP	LC-MS/GC-MS
<i>Fluoxetine</i>	Fluoxetine	54910-89-3											X	X
<i>Azoles</i>	Prochloraz	67747-09-5	X (2020)						X	X <sup>24</sup>	X	X	X	X
	Metconazole	125116-23-6	X (2020)						X	X <sup>24</sup>		X	X	X
	Climbazole	38083-17-9											X	X



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<sup>24</sup> Approved active Plant Protection Product



	Penconazole	66246-88-6	X (2020)							X	X <sup>24</sup>		X	X	X
	Tebuconazole	107534-96-3	X (2020)							X	X <sup>24,25</sup>		X	X	X
<i>Tri-allate</i>	Tri-allate	2303-17-5	X (2015)		X	X				X	X <sup>26</sup>	X		X	X
<i>Cypermethrin</i>	Cypermethrin	52315-07-8		X (draft)	X						X <sup>24,26</sup>	X	X	X	X
<i>Fipronil</i>	Fipronil		X (2022)								X <sup>25,27</sup>			X	X
<i>Imidacloprid</i>	Imidacloprid	138261-41-3	X (2015, 2018)	X (draft)	~						X <sup>25,27</sup>			X	X
<i>Microplastics</i>	Microplastics	n/a													
<i>1,4-Dioxane</i>	1,4-Dioxane	123-91-1					X	X						X	X
<i>Organophosphorus flame retardants (OPFRs)</i>	TCP	13674-84-5					X								
	TXP	25155-23-1					X	X			X <sup>28</sup>				X
	TCEP	115-96-8					X	X			X <sup>28</sup>				
	TPP	115-86-6					X						X	X	
	TDCPP	13674-87-8					X				X <sup>28</sup>				
	TEP	78-40-0					X								
	TPrP	513-08-6													
<b>Pollutant group</b>	<b>Pollutants within group</b>	<b>CAS number</b>	<b>EU WFD Watch List</b>	<b>EU</b>	<b>England</b>	<b>NI</b>	<b>EU</b>	<b>UK</b>	<b>Drinking water limit</b>	<b>Other</b>	<b>EA</b>	<b>NIEA</b>	<b>CIP</b>	<b>LC-MS/GC-MS</b>	
<i>Alkylphenols</i>	Nonylphenol	25154-52-3		X	X	X	X	X		X <sup>29</sup>	X		X		
	Octylphenol	1806-26-4		X	X	X				X <sup>29</sup>	X		X		
	4-tert-Octylphenol	140-66-9					X	X					X		
	4-tert butylphenol	98-54-4	X				X	X					X		
	2,4,6-tri-tert-butylphenol	732-26-3												X	
	4-sec-butyl-2,6-di-tert-butylphenol	17540-75-9													
<i>Bisphenol A and related substances</i>	Bisphenol A (BPA)	80-05-7		X (draft)			X	X	X				X	X	
	Bisphenol F (BPF)	620-92-8 & 1333-16-0												X	
	Bisphenol S (BPS)	80-09-1					X	X					X	X	



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<sup>25</sup> Approved active under the Biocidal Products Regulation (BPR Regulation (EU) 528/2012).

<sup>26</sup> Covered by the Control of Pesticides Regulations (COPR) - one of the laws that controls biocides in Great Britain (GB) and Northern Ireland to make sure that when they are used properly, they do not harm people, pets or the wider environment.

<sup>27</sup> Covered by the Prior Informed Consent Regulation (PIC, Regulation (EU) 649/2012) administers the import and export of certain hazardous chemicals and places obligations on companies who wish to export these chemicals to non-EU countries.

<sup>28</sup> Regulation on cosmetic products (restricted)

<sup>29</sup> Banned under the UK Plant Protection Products Regulation (PPPR, 2011) (<https://www.legislation.gov.uk/ukSI/2011/2131/contents/made>)



	TBBPA	79-94-7					X							
<i>Parabens</i>	Methyl paraben	99-76-3											X	X
	Ethyl paraben	120-47-8											X	X
	Propyl paraben	94-13-3											X	X
	Butyl paraben	94-26-8					X	X						X
<i>Phthalate esters</i>	DEHP	117-81-7		X	X	X	X	X					X	X
	DBP	84-74-2					X	X						
	BBP	85-68-7					X	X						
	DIBP	84-69-5					X	X						
<i>Polycyclic Musk</i>	Galaxolide	1222-05-5								X <sup>28</sup>				
	Tonalide	21145-77-7, 1506-02-1											X	
<b>Pollutant group</b>	<b>Pollutants within group</b>	<b>CAS number</b>	<b>EU WFD Watch List</b>	<b>EU</b>	<b>England</b>	<b>NI</b>	<b>EU</b>	<b>UK</b>	<b>Drinking water limit</b>	<b>Other</b>	<b>EA</b>	<b>NIEA</b>	<b>CIP</b>	<b>LC-MS/GC-MS</b>
<i>UV filters</i>	Octocrylene	6197-30-4	X (4th)							X <sup>28</sup>			X	X
	4-methylbenzylidene camphor (4-MBC)	36861-47-9					X			X <sup>28</sup>			X	X
	Oxybenzone	131-57-7	X (4th)				X			X <sup>28</sup>				X
	Homosalate	118-56-9								X <sup>28</sup>			X	X
<i>Industrial UV filters</i>	UV320	3846-71-7	X				X	X						
	UV326													X
	UV328	25973-55-1	X				X	X					X	X
	UV350	36437-37-3	X				X	X						
<i>Halogenated solvents</i>	Trichloroethylene	79-01-6	X	X	X	X			X		X	X	X	X
	Tetrachloroethylene	127-18-4	X	X	X	X			X		X	X	X	X





	Bromodichloro-methane	75-27-4										X	X	X
	Chlorodibromo-methane	124-48-1											X	X
PAHs	Benzo(a)-pyrene	50-32-8		X	X	X	X		X		X	X	X	X
	Chrysene	218-01-9											X	X
	Benzo(a)-anthracene	56-55-3											X	X
	Benzo(b)-fluoranthene	205-99-2		X	X	X			X		X	X		X
	Pyrene	129-00-0											X	X
	Fluoranthene	206-44-0		X	X	X							X	X
	Benzo(ghi)-perylene	191-24-2		X	X	X	X		X		X	X	X	X
Pollutant	Pollutants	CAS number	Watch List	EU	England	NI	EU	UK	DEW	Other	EA	NIEA	CIP	LC/GC MS
<b>Key established pollutants</b>														
Nitrogen	Nitrogen	n/a		X	X	X			X	X <sup>30</sup>	X	X	X	
Phosphorous	Phosphorous	n/a		X	X	X				X <sup>31</sup>	X	X	X	
Copper	Copper	7440-50-8	X	X	X	X			X	X <sup>24,25</sup>	X	X	X	
Lead	Lead	7439-92-1		X	X	X	X	X	X		X	X	X	
Mercury	Mercury	7439-97-6		X	X	X	X	X	X		X	X	X	
Nickel	Nickel	7440-02-0		X	X	X	X	X	X		X	X	X	
Zinc	Zinc	7440-66-6		X	X	X				X <sup>32</sup>	X	X	X	
PDBEs	BDE 28	41318-75-6		X	X	X					X	X	X	
	BDE 47	5436-43-1		X	X	X					X	X	X	
	BDE 99	60348-60-9		X	X	X					X	X	X	
	BDE 100	189084-64-8		X	X	X					X	X	X	
	BDE 153	68631-49-2		X	X	X					X	X	X	
	BDE 154	207122-15-4									X	X	X	
	BDE 209	1163-19-5					X	X						



PFAS	PFAS	n/a					X	X	X	X <sup>33</sup>				
	PFOS	1763-23-1		X	X	X					X	X	X	X
	PFOA	335-67-1		X (draft)	X	?					X	X	X	X
	PFNA	375-95-1					X	X						X
	PFDA	335-76-2					X	X						X
	PFBS	375-73-5		X (draft)				X						X
	PFHxS	355-46-4		X (draft)			X	X						X
	PFHxA	307-24-4					X							X

<sup>30</sup> [The Nitrate Pollution Prevention Regulations 2015 \(legislation.gov.uk\)](#); [The Nutrient Action Programme Regulations \(Northern Ireland\) 2019 \(legislation.gov.uk\)](#); [The Urban Waste Water Treatment \(England and Wales\) Regulations 1994 \(legislation.gov.uk\)](#); [The Urban Waste Water Treatment Regulations \(Northern Ireland\) 2007 \(legislation.gov.uk\)](#)

<sup>31</sup> [The Conservation of Habitats and Species Regulations 2017 \(legislation.gov.uk\)](#); [The Conservation \(Natural Habitats, etc.\) \(Amendment\) \(Northern Ireland\) \(EU Exit\) Regulations 2019 \(legislation.gov.uk\)](#)

<sup>32</sup> Some zinc compounds are approved actives under BPR and PPP.

<sup>33</sup> Food limits defined by EFSA.

## 2.2.4. Summary of evidence gaps

The factsheets include a section detailing the gaps in knowledge identified by others or that have been identified from this review. There were several key themes common to many of the pollutants, summarised below:

### Understanding the source of pollutants

- More research is needed to assess the contribution from combined sewer overflows (CSOs) as a source of pharmaceuticals in river waters<sup>34</sup>.
- Further research is required to better understand the source of cypermethrin to inform appropriate application of legislation and mitigation measures.
- Studies could be carried out to improve the understanding of the emissions and risks of azoles in England and Northern Ireland. A more detailed review should be undertaken of the monitoring data for azoles used as PPPs and which have been shown to exceed assessment criteria, i.e. prochloraz and tebuconazole. Such a review could determine the frequency and location of these exceedances in order to examine the extent of any risk to the aquatic environment in England and how this relates to crop application.
- Further work could be conducted to better understand the sources, exposure pathways and risks of bisphenols in the aquatic environment. This work should include all substances that potentially degrade to recognised endocrine disrupting active bisphenols (such as BPA).
- It is estimated that >100 individual PFAS are in use within the UK, however little is understood about their use, the quantities available in the UK market, or their presence in imported goods<sup>35</sup>.
- There are also gaps in our understanding of the release of PFAS from goods throughout their life cycle. For example, leaching of PFAS during recycling and waste disposal<sup>35</sup>.
- Polymers are not required to be registered under REACH. This is an important gap in knowledge because polymers containing residual PFAS additives or processing aids are a recognised source of PFAS in the environment due to degradation and/or weathering over time. It is not currently possible to estimate the contribution of such polymers to the environmental PFAS<sup>36</sup> load.

### Understanding the role of sediment adsorption

- Future work to understand the sediment properties which determine the sorption capacity of pollutants such as macrolide antibiotics<sup>37</sup>.
- Clarification of the sorption characteristics of organophosphorus flame retardants (OPFRs) to predict their bioavailability and to develop control methods.
- More research is required to better understand the distribution of OPFRs between water, suspended solids and sediment compartments.
- As UV filters are expected to adsorb strongly to sediment; sediment monitoring may be more beneficial than monitoring in surface waters.

### Better understanding the risks of transformation products

- Limited data are available about the ecotoxicity of pharmaceutical by-products of beta-lactam antibiotics and carbamazepine. Identification of the most relevant metabolites and transformation products (as is done for pesticides) will aid risk assessment.
- Knowledge gaps exist on the transformation products of phthalate esters such as DBP, BBP and diisobutyl phthalate (DIBP).
- Knowledge gaps exist on the toxicity and persistence of the environmental transformation products of imidacloprid.
- There is limited information on the degradation products of polycyclic musks.

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<sup>34</sup> Kay et al. (2017). Widespread, routine occurrence of pharmaceuticals in sewage effluent, combined sewer overflows and receiving waters. *Environmental Pollution*, 220, 1447–1455. <https://doi.org/10.1016/j.envpol.2016.10.087>

<sup>35</sup> [Poly- and perfluoroalkyl substances \(PFAS\): sources, pathways and environmental data - report \(publishing.service.gov.uk\)](https://www.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/614442/poly-and-perfluoroalkyl-substances-pfas-sources-pathways-and-environmental-data-report.pdf)

<sup>36</sup> [Chemical Investigations Programme: Volume 3 - Overview of Pilot Plant Investigations \(ukwir.org\)](https://www.ukwir.org/chemical-investigations-programme-volume-3-overview-of-pilot-plant-investigations)

<sup>37</sup> Hanamoto et al. (2018). The different fate of antibiotics in the Thames River, UK, and the Katsura River, Japan. *Environmental Science and Pollution Research*, 25(2), 1903–1913. <https://doi.org/10.1007/s11356-017-0523-z>

- Comprehensive risk assessments for some metabolites (e.g., diisopropanolamine (DIPA) from tri-allate) are lacking.
- There are data gaps for 1,2,4-triazole, a common metabolite of the azole fungicides commonly used as PPPs (e.g. tebuconazole). 1,2,4-triazole is less persistent than the parent fungicides but it is significantly more mobile in the environment, giving it the potential to contaminate surface waters to a greater degree than its parent compounds. It has also been shown to be reprotoxic.

### Better understanding the risk to the environment

- We need a better understanding on the combined toxicity of multiple pollutants (specifically pharmaceuticals such as antibiotics) to biological communities.
- Limited data are available about the ecotoxicity of some emerging pollutants, such as amoxicillin and carbamazepine. Future research should prioritise long-term environmentally relevant exposures and investigate the effect on communities and ecosystems, rather than single species approaches<sup>38</sup>.
- Further development of accurate ecological risk assessment models.
- There is a need to improve the quality of ecotoxicology research for propranolol, so that more robust environmental risk assessments may be completed.
- There is a need for further study on the bioaccumulation capability for OPFRs, propranolol and other active pharmaceutical ingredients<sup>39</sup>.
- Some PFAS substances have not been extensively tested, so information about their hazardous properties is limited, posing a significant challenge and potential barrier to effective risk management.

### Better understanding the risk to human health

- Combining laboratory experiments with monitoring and surveillance studies will help to better predict AMR levels in the environment and potential risk to human health, providing support for mitigation strategies<sup>40</sup>.
- The potential combined intake of the tri-allate metabolite DIPA from drinking water and food sources requires further assessment.
- More research is needed into the impact of PAHs within the human body.
- More research is needed to better understand the human health implications of long-term exposure to low concentrations of PFAS, especially in children<sup>41</sup>.

### More research required into endocrine disrupting properties of certain pollutants

- Definitive views should be developed on the endocrine disrupting potential of bisphenols other than those already evaluated (e.g. bisphenol A) which may require additional research or further assessments.
- Both galaxolide and tonalide are currently being assessed in Europe for Endocrine Disrupting Properties, as well as being persistent, bioaccumulative and toxic (PBT) for galaxolide. The outcome of these assessments may affect the conclusions drawn regarding human health effects and future trends.
- The available hazard data identifies concerns for some UV filter substances over endocrine disruption, PBT and very persistent and very bioaccumulative (vPvB) characteristics. However, further data are required to conclude for most of the substances in this group.
- With the exception of butyl paraben, parabens have not been confirmed as EDC, although EU endocrine disruptor assessments are ongoing for methyl paraben and propyl paraben.
- Copper is undergoing an endocrine disruption assessment in the EU; and therefore, further information on the human health effects of copper will be available once this review is complete

<sup>38</sup> da Silva Santos et al. (2018). Chronic effects of carbamazepine on zebrafish: Behavioural, reproductive and biochemical endpoints. *Ecotoxicology and Environmental Safety*, 164, 297–304. <https://doi.org/https://doi.org/10.1016/j.ecoenv.2018.08.01>

<sup>39</sup> Jeong et al. (2016). Bioaccumulation and biotransformation of the beta-blocker propranolol in multigenerational exposure to *Daphnia magna*. *Environmental Pollution*, 216, 811–818. <https://doi.org/https://doi.org/10.1016/j.envpol.2016.06.051>

<sup>40</sup> Borsetto et al. (2021). Impact of sulfamethoxazole on a riverine microbiome. *Water Research*, 201, 117382. <https://doi.org/https://doi.org/10.1016/j.watres.2021.117382>

<sup>41</sup> [Our Current Understanding of the Human Health and Environmental Risks of PFAS | US EPA](#)

## Limited data availability

- No datasets or studies were found assessing the concentration of  $\beta$ -lactam antibiotics degradation products in the surface or groundwaters of England and Northern Ireland.
- More data are required on the geospatial distribution of OPFRs in the UK to better understand their source.
- For alkylphenols there are no monitoring data for 4-sec-butyl-2,6-di-tert-butylphenol in England or Northern Ireland, and no routine monitoring of 4-tert butylphenol or 2,4,6-tri-tert-butylphenol, therefore information on typical exposures is of low confidence.
- There is limited information on the projected changes of fipronil, phthalate ester and imidacloprid emissions and measured concentrations.
- There is no routine monitoring of polycyclic musk substances in either England or Northern Ireland.
- There are little monitoring data available for industrial UV filters.
- Monitoring data are still limited for naproxen compared to other NSAID substances
- Routine monitoring should also include all relevant bisphenols based on a review of toxicological evidence and structural similarities that may indicate endocrine disrupting potential.
- Routine monitoring of UV filters has not been conducted therefore trends over a number of years are difficult to determine, although there are some regulatory screening data and monitoring data from publications are available.
- There is limited information on measured concentrations and the projected changes of paraben emissions.

## EQS development

- PFOA has no EQS despite being monitored by the EA.
- Cypermethrin is not included in the *Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015*<sup>42</sup>, despite being routinely monitored in Northern Ireland.
- Work has recently been completed at EU level to derive EQS values for diclofenac and ibuprofen, and developments should be monitored to see if this is of relevance to the UK.
- Similarly, draft EQS (EU) have been established for azithromycin, clarithromycin, erythromycin, carbamazepine, imidacloprid, PFOA, PFBS and PFHxS, which should be evaluated for relevance to the UK.
- Although there is a riverine standard for ammonia, there are no formal nitrate standards for other nitrogen species in riverine freshwaters under the WFD, such as nitrate (note there is a nitrate standard for lakes).
- An updated EQS is to be derived for copper in the EU, which is likely to be more stringent than the present EQS and it is unknown if this would be applied in England and Northern Ireland.

## Water treatment processes

- The removal behaviours for metabolites of pharmaceutical pollutants also requires further study, especially along with potential influences on metabolic pathways that may exist in biologically operated engineered systems, including constructed wetlands<sup>43</sup>.
- Further research and development into tertiary treatment technologies for antibiotic removal in WWTWs<sup>44</sup>.
- The effect of water treatment processes on the formation of potentially hazardous metabolites (e.g., PBEs N-nitroso-diisopropanolamine from DIPA) is not understood.

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<sup>42</sup> The Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2015/45/made>

<sup>43</sup> [Chemical Investigations Programme: Volume 3 - Overview of Pilot Plant Investigations \(ukwir.org\)](https://www.ukwir.org)

<sup>44</sup> Burke et al. (2016). Occurrence of Antibiotics in Surface and Groundwater of a Drinking Water Catchment Area in Germany. *Water Environment Research*, 88(7), 652–659. <https://doi.org/https://doi.org/10.2175/106143016X14609975746604>

- The fate of BDE-209 within the wastewater treatment process should be investigated, given the high toxicity of the by-product BDE-154
- Although new technologies are available for reducing phosphorus to very low levels at WwTWs, this has only recently been widely tested in the UK.

#### Other mitigation measures

- Uncertainty in modelling mitigation measures and recovery times as recycling of phosphorus in rivers is very complex and difficult to model/account for within water quality models.
- Uncertainty over the effectiveness of mitigation measures for agricultural diffuse losses of phosphorous and challenges associated with scaling up findings from small to large studies.
- Uncertainty over the effectiveness of mitigation measures for non-agricultural diffuse losses of phosphorous.

## 3. Risk assessment

### 3.1. Approach

#### 3.1.1. Selection of pollutants

Selected pollutants from those considered by the factsheets detailed in Section 2 were taken forward for more detailed consideration by risk assessment to determine the extent, magnitude and future evolution of the risks posed to the aquatic environments of England and Northern Ireland. Substances were selected to ensure that there was a representative for each category of pollutant (i.e. pharmaceuticals, personal care products, industrial chemicals and EDCs) and on the basis of specific concerns highlighted in the factsheets. The seven individual substances selected for risk assessment and the reasons for their selection are outlined below:

- 1,4-dioxane – industrial chemical; assigned highest priority under EA PEWS review, potentially carcinogenic to humans and undergoing assessment for being PBT.
- Bisphenol A – industrial chemical with many uses and confirmed EDC; classified as a Priority Substance under the EU WFD.
- Carbamazepine – pharmaceutical; highlighted in PEWS and prioritised in an EA assessment of pharmaceuticals<sup>45</sup> due to regular detection in monitoring programmes.
- Climbazole – used in personal care products; representative of azole class of fungicides and undergoing assessment in the EU as potential EDC.
- Diclofenac – pharmaceutical; representative of NSAIDs class of medicines, widely detected and included on WFD Watch List.
- Fipronil – veterinary medicine (insecticide); classified as very toxic to aquatic environment and widely detected in English waters.
- Galaxolide – used extensively in personal care products as fragrance (synthetic musk); classified as very toxic to aquatic environment and undergoing assessment in the EU as PBT or vPvB and as potential EDC.

#### 3.1.2. Risk assessment criteria

The risk assessments initially consider the characteristics of the pollutant that influence its environmental fate, including the degree to which it is likely to remain dissolved in water or partition to particulate matter and organic matter; a higher degree of ‘hydrophobicity’ (repulsion to water) makes a substance more likely to partition to solid matter and be found in sediment. Pollutants with a lower tendency to partition to sediment or soil are termed ‘mobile’ and have much greater potential to impact groundwater and are less likely to be removed by partitioning to sludge during sewage treatment.

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<sup>45</sup> EA (2020) Review of Monitoring Data and Selection of Pharmaceutical and Medically Related Substances for Further Analysis [Draft Report provided by Environment Agency]

The risk assessment is based on a categorisation approach (akin to RAG rating) and uses a range of criteria to assign an overall risk (methodology detailed below). Based on combined consideration of all the criteria the overall risk rating for a pollutant is described as ‘low’, ‘moderate’, ‘high’ or ‘very high’.

#### Spatial context

Readily available monitoring data for measurements of the selected pollutants in England and Northern Ireland were reviewed and mapped to assess the extent of coverage by monitoring programmes to determine whether sufficient data are available to reveal spatial trends, i.e. the extent of pollution across the two countries, whether pollution levels are relatively uniform or if there are hotspots of highly elevated concentrations. The extent of aquatic pollution was assessed as being either: ‘localised’ (specific sources only in certain areas of the countries); ‘widespread’ (pollution observed in most surface water bodies, often resulting from discharge in effluent from WwTW); or ‘ubiquitous’ (pollutant detected in nearly all water samples, including those taken from groundwater – aquatic pollutants with this characteristic are usually persistent and mobile).

#### Current risk

The current risk to water bodies in England and Northern Ireland was assessed semi-quantitatively by comparing existing monitoring data to available assessment criteria. Environmental risk assessment criteria such as PNECs and EQS were used to assess ecological risk, and drinking water guidelines were used to evaluate the potential risk to human health (noting that potential drinking water sources are being considered rather than drinking water itself). The current risk level was determined to be ‘low’ if all (or nearly all) measurements are well below the assessment criteria; risk was judged to be ‘moderate’ if measured concentration are just below the assessment criteria for environment or human health, or if there are a small number of exceedances; ‘high’ risk is based on there being an appreciable number of exceedances; and ‘very high’ on the basis of a high level of exceedances and also on the nature of the hazard (e.g. potential exposure to a carcinogen in drinking water). If monitoring data were not available for either England or Northern Ireland expert judgement was applied to determine whether it would appropriate to read across the existing information from one country to another.

#### Evolution of risk

The direction of potential future risk was assigned as ‘improvement’, ‘no change’ or ‘deterioration’ based on the likelihood of concentrations in the aquatic environment either declining, remaining static or increasing in the short to medium term. There is an absence of long-term monitoring data for most pollutants so assessment of this criterion is largely qualitative and based on expert knowledge regarding the potential for changes in the market of the substances considered, or the potential impact of legislative actions, e.g. assignment under REACH as a Substance of Very High Concern (SVHC) would likely lead to withdrawal from use or restriction to only low concentrations being permitted in products, which would lead to a reduction in releases to the aquatic environment.

#### Quality of the evidence

The reliability and robustness of the risk assessment is determined to be ‘very good’, ‘good’, ‘moderate’ or ‘poor’ depending on the quality of evidence in terms of the extent of monitoring data (including whether it is available for a specific country) and how well the potential impacts of the pollutant have been characterised, including the robustness of the available assessment criteria.

## 3.2. Risk assessment summary

Risk assessments for the seven selected pollutants are included in Appendix C. A summary of the risk assessment findings is provided in Table 3-1. Note that risk management (which would include consideration of measures to address the risks below) is considered to be outside the scope of this work.

**Table 3-1 - Results of risk assessment for selected water pollutants**

Pollutant	Spatial context	Current risk	Evolution of risk	Quality of evidence	Overall risk rating
1,4-dioxane	Ubiquitous	Very high	No change (potentially impacted by ongoing regulatory evaluation)	Moderate (England) Poor (Northern Ireland)	Very high



Pollutant	Spatial context	Current risk	Evolution of risk	Quality of evidence	Overall risk rating
Bisphenol A	Widespread	High	No change	Good (England) Poor (Northern Ireland)	High
Carbamazepine	(Widespread to) Ubiquitous	Moderate	No change	Moderate (England) Poor (Northern Ireland)	Moderate
Climbazole	Widespread	Low	No change (potentially impacted by ongoing regulatory evaluation)	Poor (Northern Ireland) Poor to Moderate (England)	Moderate
Diclofenac	Widespread	High (England) Low (Northern Ireland)	No change	Good	High (England) Low (Northern Ireland)
Fipronil	Widespread	Very high	No change	Good (England) Poor (Northern Ireland)	Very high
Galaxolide	Widespread	Moderate	No change (potentially impacted by ongoing regulatory evaluation)	Poor	High

1,4-dioxane is deemed to be represent a 'very high' risk to water bodies in England and Northern Ireland based on very extensive pollution of both surface waters and groundwaters, persistence and it is a potential human carcinogen that exceeds the World Health Organisation (WHO) drinking water quality guideline at a high proportion of groundwater sites monitored in England. This pollutant's properties and behaviour in the environment mean that it is able to move a large distance from where it was originally released and because it takes many years to breakdown in groundwater there is the potential for concentrations to increase over time. Monitoring data have only been collected relatively recently and it is recommended that monitoring is expanded with a focus on water bodies extracted for drinking water. Assessment should also be made of the degree to which this substance is removed by drinking water treatment technologies used in England and Northern Ireland.

A 'high' risk level is assigned to bisphenol A on the basis that it is a confirmed EDC with widespread pollution of surface water and groundwater and the existence of hotspots of highly elevated concentrations that exceed environmental and drinking water quality guidelines. Groundwater data for England are limited and no data for groundwater or surface water are available for Northern Ireland. Extensive and routine monitoring is recommended for surface water and groundwater, specifically that abstracted for drinking water.

A risk rating of 'moderate' is concluded for carbamazepine based on the apparently ubiquitous presence of this pharmaceutical in surface water and groundwater in England, combined with the overwhelming majority of concentrations being lower than the assessment criteria, thus indicating an absence of risk to aquatic organisms. However, the persistence of this compound means that it has the potential to increase in concentration in water bodies such as groundwater.



Climbazole is ranked as a 'moderate' risk based on the relatively low concentrations measured in English water bodies, i.e. all measured concentrations are lower than the currently available assessment criteria. However, climbazole has a potentially significant impact (endocrine disrupting effects on aquatic organisms) that has not yet been fully evaluated and the outcome of the ongoing EU assessment will affect the overall risk rating, making it higher or lower, depending on UK endorsement of the opinion. The outcome of the endocrine disruption assessment for climbazole will influence recommendations and determine the need to take any future actions.

A 'high' risk level is assigned to diclofenac in England based on widespread pollution and the high proportion of measurements in English rivers exceeding the proposed EU WFD EQS, indicating a high risk of ecological impact. The risk level appears to be much lower for Northern Ireland, where all measured concentration in surface water except one are lower than the EQS. Concern over the potential impact of diclofenac is supported by its previous inclusion on the WFD Watch List and there is the potential for interaction with other related pharmaceuticals discharged in wastewater treatment effluents. It is recommended that an assessment be made of the apparent discrepancy in risk levels between England and Northern Ireland, which could reflect differences in the use of this medicine or how sampling programmes have been conducted.

An overall risk of 'very high' is concluded for fipronil based on widespread pollution and the large number of samples measured in English water bodies exceeding the currently available assessment criteria for environmental risk. This finding is supported by the inclusion of fipronil on the WFD Watch List. Additionally, risks to human health via drinking water have not been fully characterised and require more investigation. There are deficiencies in the monitoring dataset for fipronil as, while there is a reasonable amount of recent water monitoring data for England, there are none for Northern Ireland and there are no data for sediment from either country (fipronil is predicted to partition to sediment). It is recommended that monitoring programmes are undertaken to address these data gaps.

Galaxolide was concluded to present a 'high' risk based on concentrations measured at some locations in English water bodies being considerably higher than the currently available assessment criteria, indicating an unacceptable level of risk at these locations. Additionally, galaxolide may be an EDC and is also being evaluated under EU REACH for PBT properties. The outcome of these assessments will affect the overall risk rating, influence recommendations and determine the need to take any future actions. The risk rating of 'high' is also influenced by the limited amount of water monitoring data for England, the absence of data for Northern Ireland, and the lack of data on sediment concentration from either country; it is recommended that monitoring programmes are undertaken to address these data gaps. Due to its chemical properties, galaxolide has the potential to accumulate in sediment so measurements are required to determine whether this is accumulating in the environment.

## 4. Review of delivery plans and regulatory measures

### 4.1. Approach

The aim of this task was to identify and review the delivery plans or programmes of measures which have been developed to address a set of selected pollutants. These pollutants have been separated into two groups: established pollutants and emerging pollutants. Established pollutants are those that are considered to be significant in terms of contributing to failures of waterbodies in England and Northern Ireland to meet their statutory objectives. The pollutants covered were:

- Phosphorus;
- Nitrogen; and
- Metals (Copper (Cu), Zinc (Zn), Lead (Pb), Nickel (Ni) and Mercury (Hg)).

The group of emerging substances that were the subject of the risk assessment in Task 3, as well PBDEs and PFAS were used as a sample set of pollutants to review and assess how measures have been developed by regulatory agencies to address emerging pollutants.

### 4.2. Established pollutants

The delivery plans which have been developed for each pollutant were identified. A request was made to the EA and NIEA to supply:

- River Basin Management Plan (RBMP) measures to address the following pressures: nutrients, chemicals in the water environment, pollution from abandoned mines and pollution from contaminated land;
- A sample of plans to deliver protected area objectives;
- As sample of any other plans (more detailed than RBMP measures) to address the pressures listed above.

In addition, a search was made to identify any other publicly available plans or relevant information sources on measures to address the established pollutants.

The information on measures, and a sample of these plans were assessed against criteria agreed with the OEP to determine the adequacy of these plans. The aim of this review was to assess and document the characteristics of each plan rather than to carry out an in-depth assessment of the quality of the plans, which is beyond the scope of this project. The plans that apply to England and to Northern Ireland have been reviewed separately.

#### 4.2.1. Plans in England

Table 4-1 summarises the plans that have been reviewed, presents an overview of each plan and provides information on which substances the measures in the plan aim to address.

Table 4-2 provides an assessment of a sample of each of the plans which contain measures to address nutrients; followed by Table 4-3, which provides an assessment of a sample of each of the plans which contain measures to address metals.

**Table 4-1- Summary of plans in England**  
Summary of the plan (and plan owner)

	Nitrogen	Phosphorus	Metals
<p><b>2022 updated River Basin Management Plans (RBMPs) for eight River Basin Districts (RBDs) in England (Environment Agency)</b></p> <p>The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 seek to establish an integrated approach to the protection and sustainable use of the water environment. They require the:</p> <ul style="list-style-type: none"> <li>preparation and publication of RBMPs</li> <li>setting of environmental objectives for groundwater and surface waters (including estuaries and coastal waters)</li> <li>devising and implementing of programmes of measures to meet those objectives.</li> </ul> <p>The RBMPs for the seven RBDs that are wholly in England and three cross border RBDs, were updated in 2022. The plans set out legally binding locally specific environmental objectives that underpin water regulation and planning activities.</p> <p>The plans set out the current health of the water environment through an assessment of waterbody status – comprising ecological status and chemical status for surface water bodies. Waterbody status is classified on a scale from High – Good – Moderate – Poor – Bad.</p> <p>The plans also set out environmental objectives for the waterbodies in the RBDs. Many of the objectives are locally specific, and apply to individual waterbodies or parts of the water environment.</p> <p>The WFD objectives covered by the plans include:</p> <ul style="list-style-type: none"> <li>preventing deterioration of the status of surface waters and groundwater;</li> <li>achieving objectives and standards for protected areas;</li> <li>aiming to achieve good ecological status (or good ecological potential for artificial and heavily modified waterbodies) for all surface water bodies;</li> <li>reversing any significant and sustained upward trends in pollutant concentrations in groundwater;</li> <li>aiming progressively to reduce pollution from priority substances and aiming to cease or phase-out discharges, emissions and losses of priority hazardous substances into surface waters;</li> <li>preventing or limiting the entry of pollutants to groundwater; and</li> <li>reversing any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater.</li> </ul> <p>The plans set out <b>summary programmes of measures</b> that are required to prevent deterioration of waterbody status and to achieve the individual objectives set for each waterbody. The summary programmes of measures refer in some instances to more detailed measures that are set out in a range of other sources. We have reviewed the following sources which are referred to in the summary programmes of measures, and are most likely to contain measures to address the established pollutants:</p> <ul style="list-style-type: none"> <li>The <b>Water Industry National Environment Programme (WNEP; Environment Agency)</b></li> <li>The <b>Highways England Strategic Road Investment Strategy (RIS2) 2020-2025 (National Highways<sup>46</sup>)</b></li> <li><b>Defra abandoned metals mines programme.</b></li> </ul> <p>There are many areas where the water environment is especially valued for its uses or sensitive to particular pressures such as nutrients. These areas include rare wildlife habitats, bathing waters, shellfish waters and areas where drinking water is abstracted. Under the WFD these areas are known as Protected Areas and their uses or sensitivity are given particular legal protection. Protected areas are a priority for action to make sure they achieve their objectives and protect the benefits they provide. In addition to the national summary programmes of measures, there are separate plans which give details of the measures and actions that are needed to meet Protected Area objectives. For the purposes of this study we have reviewed the measures to protect the following Protected Areas<sup>47</sup>:</p> <ul style="list-style-type: none"> <li>Drinking Water Protected Areas (DWPA) (areas identified for the abstraction of water for human consumption);</li> <li>Nutrient-sensitive areas, including areas identified as Nitrate Vulnerable Zones (NVZs) and Sensitive Areas for urban waste water treatment as designated under the Urban Waste Water Treatment Regulations 1994 (UWWTR 1994);</li> <li>Habitats Sites i.e. water-dependent Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) (areas designated for the protection of habitats or species).</li> </ul>	✓	✓	✓
<p><b>Measures and plans to protect sites designated for nature conservation</b></p> <ul style="list-style-type: none"> <li>Sites of Special Scientific Interest (SSSI) designated sites database (Natural England)</li> <li>Site Improvement Plans (SIPs) for England's Natura 2000 Sites (Natural England).</li> <li>Diffuse Water Pollution Plans (Natural England and EA).</li> </ul>	✓	✓	
<p><b>Measures to protect Drinking Water Protected Areas (Environment Agency)</b></p> <p>DWPA safeguard zone action plans.</p>	✓	✓	✓
<p><b>Measures to protect Nutrient Sensitive Areas</b></p> <ul style="list-style-type: none"> <li>Review of rules for farmers and landowners in NVZs (Defra)</li> <li>Review of measures to ensure all relevant discharges from waste water treatment works affecting nutrient sensitive areas (under the UWWTR 1994) have appropriate phosphorus or nitrogen limits.</li> </ul>	✓		

<sup>46</sup> In the summary programmes of measures the measures are listed as being owned by Highways England. This organisation was renamed National Highways in 2021.

<sup>47</sup> Plans for Bathing Waters and Shellfish Water Protected Areas were not reviewed as the focus of these plans is on reducing the concentrations of faecal indicator organisms, rather than nutrients or metals.



**Table 4-2 - Assessment of adequacy of plans in England to address nutrients**

Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions / Gap Analysis
<p><b>River Basin Management Plan summary programmes of measures (Environment Agency)</b></p> <p>Measures in the summary programme of measures are listed as either 'linked to 2027 outcomes', or 'not linked to 2027 outcomes' (see more detail under columns 5 and 6 of this table).</p> <p>Measures that are listed to address N and/or P that are linked to 2027 outcomes include:</p> <p>Water Industry PR19 WINEP wastewater treatment schemes to address P and N (see separate row below)</p> <p>Water Industry AMP PR19 WINEP catchment schemes - e.g. farm nutrient management plans and soil testing, improved farming practice (see separate row below).</p> <p>Measures funded through the EA's Environment Programme and Flood and Coastal Erosion Risk Management (FCERM) capital programme. These are often measures which are aimed at achieving multiple benefits (e.g. natural flood management, with additional nutrient reduction benefits, or river restoration/habitat creation projects which will have additional benefits of reducing nutrient loads).</p> <p>Examples of measures in the summary programme to address N and/or P that are not linked to 2027 outcomes include:</p> <p>General measure: "Regulation of agricultural and rural land (including targeted regulation of protected areas such as NVZs)"</p> <p>Specific voluntary partnership measures (e.g. creation of a constructed wetland to treat phosphate and contribute to conservation targets for a designated site).</p>	<p>River basin management plans: updated 2022 - GOV.UK (www.gov.uk)</p> <p>Measures data for England   Catchment Data Explorer</p>	<p>Statutory. Measures are developed to meet requirements of The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.</p>	<p>The summary programme includes measures to address nutrients from the water industry and agricultural sectors.</p> <p>These are the two main sectors responsible for waterbodies failing to meet their objectives for phosphorus.</p>	<p>The summary programme of measures sets out national scale measures and measures for individual RBDs.</p> <p>Many of the measures are not set out at waterbody scale and do not specify specific catchments or waterbodies where the measure will be implemented.</p> <p>The measures funded through the EA's Environment Programme and FCERM capital programme are generally more specific as to the waterbodies or operational catchments where the measure will be implemented.</p>	<p>The plan does not predict specific outcomes associated with each measure. Measures are listed as 'linked to 2027 outcomes', where funding has been committed or there is an established funding mechanism, and there is confidence about where and when the outcomes will be achieved.</p> <p>Measures are listed as 'not linked to 2027 outcomes' where funding has been committed or there is an established funding mechanism, but where there is currently uncertainty about the specific locations that will benefit from the measures.</p> <p>For all RBDs the majority of the measures listed are 'not linked to 2027 outcomes'.</p>	<p>For all RBDs there are a number of measures listed as 'linked to 2027 outcomes'. This indicates that funding has been committed or there is an established funding mechanism for these measures. However the majority of measures for each RBD are listed as 'not linked to 2027 outcomes', indicating funding has been committed or there is an established funding mechanism, but there is currently uncertainty about the specific locations that will benefit from the measures.</p> <p>Each measure has a named lead delivery organisation.</p>	<p>The EA's water quality monitoring programme could be used to monitor the impact of measures that are delivered. However this monitoring programme is not designed specifically to evaluate the impact of specific measures.</p> <p>The scale of the monitoring programme has reduced significantly over recent years from approximately 10,000 riverine water quality sample points in the year 2,000 to approximately 4,100 sites in 2022, meaning it is more difficult to specifically measure the impact of individual measures.</p>	<p>It is difficult to link the measures to specific catchments or geographical areas.</p> <p>The majority of the measures are listed as 'not linked to 2027 outcomes' meaning there is currently uncertainty about the specific locations that will benefit from the measures. It is therefore difficult to predict the outcomes of the programme of measures.</p> <p>The monitoring programme is not designed specifically to evaluate the impact of individual measures.</p>
<p>The WINEP is a component of each water company's 5 yearly business plan.</p>	<p>Water Industry National Environment</p>	<p>Water companies must deliver the measures that are agreed and funded through their 5 yearly</p>	<p>The measures address pollutant loads from the water</p>	<p>The RBMP is a national plan. The PR19 WINEP lists a detailed set of measures that will be</p>	<p>An environmental outcome is listed for each of the improvement and no</p>	<p>The WINEP measures are funded through the water company</p>	<p>The EA's water quality monitoring programme could be used to monitor</p>	<p>The 5-year periodic review process is not aligned with</p>

Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p>It is the programme of actions water companies need to take to meet statutory environmental obligations, non-statutory environmental requirements or delivery against a water company's statutory functions.</p> <p>The WINEP comprises a set of measures for each water company which are developed and agreed between water companies and the EA.</p> <p>Water companies include the agreed WINEP options in their business plans. As part of the 5 yearly price review process, Ofwat assess the business plans to set the price control determinations.</p> <p>Water companies are then responsible for delivering the schemes and measures and the EA assures the WINEP actions are delivered to the agreed timeframe and environmental obligations are met.</p> <p>The relevant PR19 schemes that relate to nutrient removal are summarised below:</p> <p><b>Water Industry National Environment Programme (PR19) – phosphorus (Environment Agency)</b></p> <p>Water Industry PR19 schemes for phosphorus removal to meet statutory and non-statutory obligations.</p> <p>800 phosphorus removal schemes are listed with a driver to improve or prevent deterioration of status in a WFD waterbody.</p> <p>39 phosphorus removal schemes are listed with a driver to restore or improve the condition of designated sites (SAC, SSSIs).</p> <p>96 phosphorus removal schemes are listed with a driver to meet UWWTR objectives for designated Sensitive Areas (Eutrophic).</p>	<p>Programme - data.gov.uk</p>	<p>Business Plan. The WINEP measures may be designed to meet statutory environmental obligations (arising from a range of primary and secondary legislation (e.g. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, The Urban Waste Water Treatment (England and Wales) Regulations 1994 etc.) non-statutory environmental requirements or delivery against a water company's statutory functions</p>	<p>industry assets (WWTWs, storm overflows). Nutrient loads from privately operated sewage treatment (e.g. septic tanks and private package plants) are not covered by the WINEP.</p>	<p>delivered at water company assets over the period April 2020- March 2025.</p> <p>(The PR24 WINEP will set out a similar programme of measures to those shown listed in the PR19 WINEP. The PR24 measures will be delivered over the period April 2025 – March 2030. As the PR24 WINEP is still being developed, we have focussed on the PR19 WINEP to illustrate the scale of measures that are delivered in each 5-year cycle).</p> <p>Each measure specifies the site (specific water industry asset) where the measure will be implemented.</p>	<p>deterioration measures in the WINEP.</p> <p>The 800 schemes with a driver to improve or prevent deterioration in WFD status are predicted to improve or protect ~6000 km of waterbodies and ~90 km<sup>2</sup> of lake or reservoir.</p> <p>The 39 schemes with a habitats directive or SSSI driver are predicted to restore or improve ~8000 ha of designated sites.</p> <p>The 96 schemes with a UWWTR driver are predicted to improve or protect ~700 km of river.</p> <p>Water quality modelling (e.g. using SAGIS) is used to identify the phosphorus removal measures that are needed to meet the required objectives.</p>	<p>Price Review process and the water companies are responsible for implementing each measure.</p> <p>Each measure has a specified delivery date and water companies and the regulators track delivery of the measures.</p> <p>Delivery of WINEP schemes is one of the indicators used in the EA's annual assessment of the environmental performance of the water companies.</p> <p>Water companies may also have performance commitments associated with delivery of WINEP measures.</p>	<p>the impact of the WINEP measures that are delivered.</p> <p>However this monitoring programme is not designed specifically to evaluate the impact of WINEP measures, and the scale of the monitoring programme has reduced significantly over recent years, meaning it is more difficult to specifically measure the impact of individual measures.</p>	<p>the 6 yearly RBMP cycle.</p>
<p><b>Water Industry National Environment Programme (PR19) – nitrogen (Environment Agency)</b></p>	<p>Water Industry National Environment Programme - data.gov.uk</p>	<p>Water companies must deliver the measures that are agreed and funded through their 5 yearly Business Plan. The WINEP measures may be</p>	<p>The measures address pollutant loads from the water industry assets (WWTWs, storm overflows). Nutrient loads from privately operated sewage treatment</p>	<p>The RBMP is a national plan. The PR19 WINEP lists a detailed set of measures that will be delivered at water company assets over</p>	<p>An environmental outcome is listed for each of the improvements and no deterioration</p>	<p>The WINEP measures are funded through the water company Price Review process and the</p>	<p>The EA's water quality monitoring programme could be used to monitor the impact of the</p>	<p>The 5-year periodic review process is not aligned with the 6 yearly RBMP cycle.</p>



Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p>Water Industry PR19 WINEP schemes for ammonia and nitrate removal to meet statutory and non-statutory obligations. 141 ammonia removal schemes at WWTWs are listed with a driver to improve or prevent deterioration of status in a WFD waterbody. 2 nitrogen removal schemes at WWTWs are listed with a driver to meet UWWTR objectives for designated Sensitive Areas (Nitrate).</p>		<p>designed to meet statutory environmental obligations (arising from a range of primary and secondary legislation (e.g. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, The Urban Waste Water Treatment (England and Wales) Regulations 1994 etc.) non-statutory environmental requirements or delivery against a water company's statutory functions.</p>	<p>(e.g. septic tanks and private package plants) are not covered by the WINEP.</p>	<p>the period April 2020- March 2025. (The PR24 WINEP will set out a similar programme of measures to those shown listed in the PR19 WINEP. The PR24 measures will be delivered over the period April 2025- March 2030. As the PR24 WINEP is still being developed, we have focussed on the PR19 WINEP to illustrate the scale of measures that are delivered in each 5-year cycle). Each measure specifies the site (specific water industry asset) where the measure will be implemented.</p>	<p>measures in the WINEP. The 140 schemes with a driver to improve or prevent deterioration in WFD status for ammonia are predicted to improve or protect ~750 km<sup>2</sup> of waterbodies and ~12 km<sup>2</sup> of lake or reservoir. The 2 schemes with a UWWTR driver are predicted to improve or protect ~16 km of river and 33 km<sup>2</sup> of estuary respectively.</p>	<p>water companies are responsible for implementing each measure. Each measure has a specified delivery date and water companies and the regulators track delivery of the measures. Delivery of WINEP schemes is one of the indicators used in the EA's annual assessment of the environmental performance of the water companies. Water companies may also have performance commitments associated with delivery of WINEP measures.</p>	<p>WINEP measures that are delivered. However this monitoring programme is not designed specifically to evaluate the impact of WINEP measures, and the scale of the monitoring programme has reduced significantly over recent years, meaning it is more difficult to specifically measure the impact of individual measures.</p>	
<p><b>Sites of Special Scientific Interest (Natural England)</b> SSSIs are nationally important sites for wildlife and geology. Natural England gathers evidence on the condition of features of interest within SSSIs, alongside evidence on any pressures that may be affecting them. This evidence is obtained through a variety of means including formal monitoring, site checks and use of third-party data. Natural England also define Mechanisms and Actions as a means of defining the steps needed to resolve the highlighted pressure. Landowners have a duty to manage land within a SSSI effectively and appropriately to conserve the special features of the site. Natural England also publish information on "operations that require Natural England's</p>	<p><a href="https://naturalengland.org.uk">Site Search (naturalengland.org.uk)</a> Information on each SSSI, its condition, and the ORNECs and VAMs is available via this search website.</p>	<p>Protected under Wildlife and Countryside Act 1981.</p>	<p>The ORNECs and VAMs include generic measures that are designed to protect the SSSIs from potential harm from nutrients from point and diffuse sources.</p>	<p>Site specific improvement plans are not routinely produced. Natural England identify Mechanisms and Actions as a means of defining the steps needed to resolve any pressures on a site. These mechanisms and actions can be attributed to other organisations as well as Natural England.</p>	<p>N/A – site specific improvement plans not routinely produced.</p>	<p>N/A – site specific improvement plans not routinely produced.</p>	<p>Progress with actions can be ascertained through various means. However there are no specific evaluation programmes. Although Natural England and other statutory nature conservation bodies monitor SSSI features and report on the condition of SSSI units, this is not done on a routine basis and is</p>	<p>N/A</p>

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<p>consent" (ORNECs) and "views about management" (VAMs) to assist landowners in managing the sites.</p> <p>The VAMs provide a fairly generic advice that should be used to protect the site (e.g. "Management should minimise pollution of the river from point and diffuse sources, including discharges of domestic and industrial effluent, run-off from agriculture, forestry and urban land, and accidental pollution from industry and agriculture".</p> <p>Similarly ORNECs list a standard set of operations that require Natural England's consent e.g. stock feeding, application of manure.</p> <p>As such they provide a means of protecting the sites from potentially harmful activities.</p> <p>Site specific management plans are not routinely produced for sites that are designated as a SSSI but have not also been designated as internationally important (see next row).</p>							not designed to track the trend in overall condition assessment for each SSSI.	
<p><b>Site improvement plans (Natural England)</b></p> <p>Some SSSI sites have also been designated as SACs or SPAs under the EU Habitats Directive, and are collectively known as European sites (formerly Natura 2000 sites). SIPs have been developed for all European sites. The plans were developed with the aim of improving those sites that are not yet meeting their conservation objectives and achieving favourable condition. Two example SIPs were reviewed for this study – one for the River Kent SAC and one for the River Lambourn and Kennet Lambourn floodplain. SIPs provide a high-level overview of the issues (both current and predicted) affecting the condition of the site's feature and outlines the priority measures required to improve the condition of the features. It does not cover issues where remedial actions are already in place or ongoing management activities which are required for maintenance.</p>	<p>Natural England Access to Evidence - Site Improvement Plans by River Basin District</p> <p>Example plans for River Kent SAC river Site Improvement Plan: River Kent - SIP194 (naturalengland.org.uk) and the River Lambourn and Kennet -</p>	<p>The Conservation of Habitats and Species Regulations 2017 (legislation covering designation of sites and conservation objectives for the designated sites). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. There is not a statutory requirement to produce a SIPs. However they have been developed with the aim of identifying and implementing the measures that are needed to achieve the conservation objectives at water dependent sites, in order to meet the</p>	<p>The example plan for the river Kent SAC river, states that diffuse water pollution is causing failures in nutrient and suspended solid objectives on some tributaries. Reduced water quality and increased siltation impacts on all life stages of the species interest features.</p> <p>The example plan for the Lambourn states that although significant water quality improvement has been achieved through investment by water companies in sewage treatment works and control of domestic treatment plants by the EA, water pollution remains a significant issue. Both sediment and nutrient input are of concern.</p>	<p>Catchment specific. The measures in the SIP are high level and refer to the Diffuse Water Pollution Plan (DWPP). The DWPP is a more detailed plan associated with the same catchment designed to specifically address diffuse sources of water pollution (see row below).</p>	<p>The plan does not predict outcomes.</p>	<p>Each measure within the Kent SIP has a cost estimate, delivery timescale, mechanism for implementation, a named funding option and a delivery lead body.</p> <p>The measures within the Lambourn SIP generally have a delivery timescale and a delivery lead body. For some measures the funding option states, "not yet determined".</p>	<p>Not known. Many of the measures were due to be delivered over the period 2014-2021 and it is not clear from the plan whether these have now been delivered.</p>	<p>The main gap appears to be availability of data to monitor the effectiveness of the plans. For some measures, uncertainty over funding means the measures may not be implemented. The plan does not predict outcomes.</p>



Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p>The SIP consists of three parts: a summary table, which sets out the priority issues and measures; a detailed actions table, which sets out who needs to do what, when and how much it will cost; and a set of tables containing contextual information and links. Both the SIPs for the River Kent SAC and the River Lambourn SAC include a measure to update and implement the Diffuse Water Pollution Plans (see row below). The Lambourn SIP also sets out a range of additional measures – examples include: Secure source of partnership funding to ensure that advisory visits to farms can continue for foreseeable future. Complete programme of advisory visits and grant funding to address specific pollution sources Secure agreement with local authority highways department to produce action plan to address diffuse pollution from roads, and agree implementation plan.</p>	<p>Lambourn floodplain were reviewed. Site Improvement Plan: River Lambourn and Kennet-Lambourn Floodplain - SIP112 (naturalengland.org.uk)</p>	<p>objectives for protected areas under the WFD regulations.</p>	<p>A diffuse pollution plan is in place and catchment sensitive farming initiative covers the catchment. However, evidence of diffuse pollution remains. Diffuse pollution is arising from highway runoff as well as from farmland. Pollution also results from overflowing sewers (a result of high groundwater levels infiltrating sewers) with ongoing/recurring incidents at numerous locations on the River Lambourn. The main actions in the plans are therefore designed to address diffuse pollution from the agricultural sector and also from the highways sector.</p>			<p>One of the key mechanisms for delivering measures to address agricultural diffuse pollution is the Catchment Sensitive Farming Delivery Initiative (ECSFDI). This is a partnership programme between Defra, Natural England and the EA with officers available to support farmers to take action to reduce diffuse agricultural pollution.</p>		
<p><b>Diffuse Water Pollution Plans (DWPP) (Natural England and Environment Agency)</b> DWPPs are produced where it has been recognised that diffuse pollution is preventing European sites from achieving favourable condition. The aim of the plan is to:</p> <ul style="list-style-type: none"> <li>• identify the causes, evidence of impacts and knowledge gaps;</li> <li>• identify remedies and plan when and how action will be taken;</li> <li>• identify the monitoring required to validate remedies.</li> </ul> <p>A number of plans were published around 2015. A recent plan for the River Lambourn SAC was published in 2020 and has been reviewed for this project.</p>	<p><a href="#">Name Diffuse Water Pollution Plan (kennetcatchment.org)</a></p>	<p>Non-statutory The Conservation of Habitats and Species Regulations 2017 (legislation covering designation of sites and conservation objectives for the designated sites). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. There is not a statutory requirement to produce a DWPP.</p>	<p>All diffuse sources of pollution. The plan specifically mentions the following sources/sectors:</p> <ul style="list-style-type: none"> <li>• Agriculture;</li> <li>• Wastewater treatment from non-sewered areas of the catchment (septic tanks, package sewage treatment plants);</li> <li>• Urban and transport (e.g. highways runoff).</li> </ul>	<p>Catchment specific – focussed on the designated site and its catchment.</p>	<p>Yes, the plan has a section which sets out 'evidence on how far actions will get us to achieving favourable condition'. This section is underpinned by modelling (i.e. SAGIS assessments of source apportionment and FARVSCOPE predictions of the phosphorus reductions that may be achieved through the agricultural measures).</p>	<p>Although table of measures provides opportunity to say how measure will be delivered (funding/ mechanism), who lead partner is and when measures should be started and finished, this information has not been filled in for every measure,</p>	<p>Yes, there is an opportunity to record evidence on the effectiveness of each measure. Monitoring is in place within the catchment to measure in-river nutrient concentrations which can be used to assess the condition of the site and the effectiveness of the measures,</p>	<p>For some measures, there is little/no detail about how the measure will be implemented or the required delivery date. This is a joint Natural England/EA plan and it is not clear who has overall accountability for ensuring the measures are implemented.</p>



Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
The EA noted that they have funding to do a comprehensive update of the DWFPs over the next couple of years.								
<p><b>Nutrient Neutrality</b></p> <p>Natural England has issued advice highlighting the need to carefully consider the nutrients impacts of any new plans and projects on European Protected Sites, and whether mitigation is needed to protect sites from additional nutrient pollution. The requirements for nutrient neutrality apply to all water dependent Habitats Sites that are in unfavourable condition due to high nutrient levels.</p> <p>Natural England's advice comes with tools and guidance to help undertake a Habitats Regulations Assessment (HRA) and to demonstrate nutrient impacts of the development have been assessed and mitigated where necessary. This approach is termed 'nutrient neutrality'. The methods created by Natural England use the latest evidence and bespoke catchment calculators to assess the site's current nutrient status and the likely impact of any new development. This allows competent authorities and developers to identify the level of mitigation required to cancel out the additional nutrient pollution expected from a particular project.</p>	Nutrient pollution: reducing the impact on protected sites - GOV.UK (www.gov.uk)	Statutory requirement for all water dependent Habitats Sites that are in unfavourable condition due to high nutrient levels to meet obligations under The Conservation of Habitats and Species Regulations 2017.	<p>The nutrient neutrality approach has been developed as a mechanism for new development that results in increases in overnight accommodation (primarily housing) to assess and mitigate its impact on Habitats sites.</p> <p>The Habitats Regulations, and the need to undertake HRA applies to all plans and projects. Natural England have advised Competent Authorities that other types of development (e.g. agricultural infrastructure, industrial development) also have the potential to generate additional nutrients and are also subject to HRA.</p>	National strategy which applies to 31 designated sites, spanning 27 catchments and 74 local planning authorities.	The tools and approach are designed to predict the nutrient load associated with a new development and calculate the mitigation that is necessary to offset the increased load. The tools have been developed using catchment specific data and hence provide an evidence-based estimate of the nutrient load associated with the development and its likely impact on the designated site.	The approach has only been in place in its current form since 2022. There are challenges in identifying suitable packages of land where mitigation measures can be implemented. Natural England have developed a pilot nutrient mitigation credit scheme which has been implemented in the Tees catchment. The Natural England Nutrient Mitigation Scheme will be expanded to additional catchments, and anticipate mitigation to start becoming available in catchments beyond the Tees from late 2023. Natural England's scheme is only one of a number of mitigation schemes either operating or in development. The Solent has an established mitigation scheme which has already enabled 5000 nutrient neutral	Natural England's Nutrient Mitigation Scheme has monitoring in place to ensure the mitigation provided is in place and effective for the duration the mitigation is required.	This approach aims to offset additional load from new developments which impact upon designated sites. It does not address the existing sources of nutrients which are causing sites to be in unfavourable condition. These will be addressed via other measures listed in this table (e.g. SIPs and DWFPs).





Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
						houses to be granted planning permission. There are also operational mitigation schemes in the catchments of Poole Harbour, River Lugg, and River Avon.		
<p><b>Nitrate Vulnerable Zones (Environment Agency/Defra)</b>            NVZs are areas designated as being at risk from agricultural nitrate pollution. They include about 55% of land in England.            Farmers within NVZs must comply with the Action Programme measures as specified in The Nitrate Pollution Prevention Regulations 2015.            The main rules that farmers must comply with are associated with the use of nitrogen fertilisers and storing of organic manures. For example, there are strict limits on the maximum load of nitrogen that can be applied to crops each year and restrictions on how and when fertilisers can be applied.            There are also strict rules for the storage of slurry and other manures. The storage requirements for farms within NVZs are more stringent than those required under the storage of silage, slurry and agricultural fuel oil regulations which apply to all agricultural land (see also below).</p>	<p>Nitrate vulnerable zones - GOV.UK (<a href="http://www.gov.uk">www.gov.uk</a>).</p>	<p>Statutory Rules specified, and sites designated, through The Nitrate Pollution Prevention Regulations 2015.</p>	<p>The regulations are specifically aimed at controlling nitrate loads from the agricultural sector, in areas at risk from nitrate pollution.</p>	<p>National legislation which applies to all land designated as an NVZ.</p>	<p>The legislation doesn't predict outcomes.</p>	<p>Farmers must keep records to demonstrate compliance with NVZ regulations. The EA enforces the NVZ rules through a programme of farm inspections. Farmers may be prosecuted or fined for non-compliance with NVZ rules. The Rural Payments Agency also inspects a proportion of farmers who claim under the cross-compliance scheme. Cross-Compliance refers to the requirement for farmers to comply with a set of requirements in order to qualify for full payments under a range of payment schemes. If farmers are found not to comply with the NVZ rules their</p>	<p>Defra reviews NVZ designations every 4 years based on surface and groundwater monitoring data. The designations are based on data from the EA's monitoring programme and each individual NVZ designated site is supported by an evidence pack. A review of a sample of the evidence packs suggested that the monitoring data that is available to inform the designations has reduced over the period since 1990 and particularly since 2010.</p>	<p>The EA's monitoring programme can be used as an evidence base to track trends in nitrate concentrations in designated sites. However sampling frequency has reduced significantly particularly since 2010, with no samples being collected in some years. This means that the quality of the evidence that is available to assess the effectiveness of the measures in reducing nitrate concentrations is not as good as it was pre 2010.</p>

Summary of the plan and associated measures (plan owner)	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges? Lead delivery organisation(s) named?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p><b>Farming Rules for Water (Defra)</b> All farmers must comply with measures to control all nutrients as specified in The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018. The farming rules for water were introduced to reduce and prevent diffuse water pollution from agricultural sources. It covers applying and storing fertilisers and the management of soil and livestock. Farmers must demonstrate that they have planned applications of organic manure or inorganic fertiliser in accordance with the farming rules for water, through for example, a nutrient management plan or other written plan.</p>	<p>Applying the farming rules for water - GOV.UK (<a href="http://www.gov.uk">www.gov.uk</a>)</p>	<p>Statutory. Measures specified in The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018.</p>	<p>The regulations are specifically aimed at controlling nutrient loads from the agricultural sector.</p>	<p>National legislation which applies to all agricultural land.</p>	<p>The legislation doesn't predict outcomes.</p>	<p>payment may be reduced. All farmers are expected to comply with the rules. The EA will generally prioritise giving advice and guidance before taking enforcement action. The EA will direct land managers to guidance and grants and schemes like the Catchment Sensitive Farming partnership. The EA may still escalate and impose civil or criminal sanctions if appropriate, in particular if advice, guidance and warning letters do not achieve the necessary changes in behaviours.</p>	<p>The EA will maintain records of the farms that have been inspected. The EA's routine monitoring programme could be used to monitor the impact of the rules, however it is not specifically designed for this purpose. Evaluation of the Catchment Sensitive Farming is carried out on a regular basis using a range of data (the most recent <a href="#">evaluation report is available for CSF- Phases 1-4 from 2006-2018</a>)</p>	<p>Catchment Sensitive Farming is a voluntary initiative and focussed on high priority areas for water, which cover approximately 35% of England. Other areas of the country do not have the same access to the advice and guidance programme</p>
<p><b>Regulations for the storage of silage, slurry and agricultural fuel oil</b> These measures apply to all farmers and landowners. The legislation was designed specifically to prevent pollution of inland, coastal and protected water supply sources from silage effluent, slurry and agricultural fuels.</p>	<p><a href="#">String silage, slurry and agricultural fuel oil - GOV.UK</a> (<a href="http://www.gov.uk">www.gov.uk</a>)</p>	<p>The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010</p>	<p>Agriculture—all farmers, landowners and tenant farmers must comply with the rules</p>	<p>National legislation which applies to all agricultural land.</p>	<p>The legislation doesn't predict outcomes.</p>	<p>All farmers are expected to comply with the rules. Farmers must notify the EA at least 14 days before they construct a new storage facility, or make significant amendments to an existing facility. The EA will usually provide a written assessment to confirm whether the</p>	<p>There are no specific evaluation programmes in place. The EA will maintain records of the facilities that have been approved and will inspect storage facilities as part of their routine inspection programme.</p>	



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						<p>proposal has been approved or not.</p> <p>If the EA considers there is a significant risk of pollution associated with an existing storage facility (e.g. insufficient capacity) they can serve a notice to stop farmers using the unsuitable facility until it has been improved or relocated.</p>		



**Table 4-3 Assessment of adequacy of plans in England to address metals**

Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions / Gap Analysis
<p>RBMP summary programmes of measures</p> <p>The measures in the summary programme that mention metals are: Regulation - The Environment Bill will make provisions for the setting of long-term, legally-binding environment targets, including for metals. (This summary of measures was developed and published whilst the Environment Bill was still in progress).</p> <p>Defra abandoned metal mines programme with the aim of reducing existing pollution of rivers by metals through mine water remediation schemes and diffuse metal controls.</p> <p>Department for Business, Energy &amp; Industrial Strategy (BEIS) abandoned coal mine water programme (lead organisation: Coal Authority)</p> <p>These are national programmes, with Central Government responsible for implementing the measures.</p> <p>These three measures are not linked to 2027 outcomes.</p>	<p>River basin management plans: updated 2022 - GOV.UK (<a href="http://www.gov.uk">www.gov.uk</a>)</p> <p>Measures data for England   Catchment Data Explorer</p>	<p>Statutory. Measures are developed to meet requirements of The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017</p>	<p>The measures identified cover the abandoned metal mines and coal mines sector. The Environment Act 2021 targets cover a range of sectors.</p>	<p>National programmes. The summary programme notes a number of RBDs where abandoned coal and metal mine projects will be implemented but doesn't give specific information on sites.</p>	<p>No outcomes predicted.</p>	<p>National programme, therefore dependent on the funding available for each of the abandoned metal mines and abandoned coal mines programmes.</p>	<p>None specified</p>	<p>No information available on specific measures and where/when they will be implemented. It is therefore difficult to predict the outcomes of the programme of measures.</p>
<p>National Highways Strategic Road Investment Strategy (RIS2) 2020-2025</p> <p>National Highways produced a strategic business plan for 2020-2025 which sets out how they respond to the Government's Road Investment Strategy (RIS2). The strategic business plan is supported by a delivery plan which provides the detail of specific funding, activities and projects that will be delivered over the five year period. The delivery plan in turn refers to a designated funds plan which is the means by which improvements to water quality</p>	<p><a href="#">strategic-business-plan-2020-25.pdf</a> (<a href="http://publishing.service.gov.uk">publishing.service.gov.uk</a>)</p> <p><a href="#">5-year-delivery-plan-2020-2025-final.pdf</a> (<a href="http://nationalhighways.co.uk">nationalhighways.co.uk</a>)</p>	<p>Non-statutory.</p>	<p>The fund could be used to address pollutants, including metals, from highways runoff.</p>	<p>National fund. Partners (e.g. catchment partnerships) could apply to the fund for specific projects. No details available of projects that have been funded or locations of these.</p> <p>We are aware of a former 'Priority Outfalls' initiative within National Highways that was used to assess the risk</p>	<p>No outcomes are predicted.</p>	<p>The fund is available to applicants for projects which meet the criteria. No information available on how many projects to address water quality are funded each year.</p>	<p>The plan states that performance under the water quality theme will be monitored through our water quality performance indicator, which measures the length (in kilometres) of watercourse that are enhanced through the mitigation of</p>	<p>The information on the evaluation programme states that outfalls are categorised as medium, high and very high risk. No information has been found on a strategic approach to</p>

Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p>may be made. For the purposes of this report we have reviewed the designated funds plan.</p> <p>National Highways designated funds plan (2020-2025)</p> <p>The National Highways Designated Funds plan sets out criteria by which national Highways can fund projects to address issues under four headings:</p> <ul style="list-style-type: none"> <li>Users and communities</li> <li>Environment and wellbeing</li> <li>Innovation and modernisation</li> <li>Safety and congestion</li> </ul> <p>Water quality is one of nine themes under the Environment and wellbeing fund. The fund can be used for projects to stop harmful discharges from running off roads in to ground and surface water, and to restore damaged and modified waterbodies.</p> <p>The plan states that a key focus over the next five years is to improve areas which pose a pollution risk such as outfall locations, and to restore waterbodies to a more natural condition.</p>	<p><a href="https://nationalhighways.co.uk/media/172110ao/designated-funds-plan-2020-2025.pdf">https://nationalhighways.co.uk/media/172110ao/designated-funds-plan-2020-2025.pdf</a></p>			<p>of highways outfalls and provide a list of outfalls which could be retrofitted with mitigation to reduce their impact on water quality. The designated funds plan and the RBMP programmes of measures do not refer to this initiative.</p> <p>The plan does not set out any information about a strategic approach to assessing impacts of highways outfalls and remediating these.</p>			<p>medium, high, and very high-risk outfalls. Other enhancements, such as river retraining and rewilding, are also included in the metric.</p>	<p>address these outfalls. The fund appears to rely on applicants to propose a project to address an area of local concern.</p>
<p>Mine water programmes for coal and metal mine water treatment</p> <p>The Water and Abandoned Metal Mines programme aims to tackle the water pollution caused by historical metal mining.</p> <p>Until 31 December 1999, mine operators could abandon a mine without notifying anyone and disregard any responsibility for allowing contaminated water to enter into waterways.</p> <p>The operators could be found guilty of causing pollution, but due to the complexities of historical mining, underground connections and mine ownership, it was difficult to prove that the</p>	<p>Metal mine water treatment - GOV.UK (<a href="http://www.gov.uk">www.gov.uk</a>)</p>	<p>Non-statutory.</p>	<p>The Water and Abandoned Metal Mines national programme will target the watercourses that are most heavily impacted by pollution from historical metal mining.</p>	<p>Data published by the Coal Authority shows that over 1500 km of watercourse are thought to be impacted by metal pollution from abandoned mines.</p> <p>A number of schemes have been implemented and investigations are underway or planned for most of the watercourses affected by metal mine pollution.</p> <p>It isn't clear how schemes are prioritised and when all the</p>	<p>No outcomes are predicted.</p>	<p>The programme aims to target the watercourses that are most heavily impacted by pollution from historical metal mining. The first scheme under this programme became operational in 2014 and since then a number of other schemes have become operational. However it isn't clear how the</p>	<p>Each completed mine water treatment scheme is evaluated through monitoring to assess its effectiveness.</p>	<p>No information has been found on the strategic approach to address the mine water discharges. There is no definitive information on which mines have been addressed and the plan for future schemes.</p>



Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
act of abandoning a mine caused the pollution. The Water and Abandoned Metal Mines programme provides funds to the Coal Authority and the EA to clean up pollution caused by historical metal mining.				remaining abandoned mine discharges will be addressed.		programme is prioritised.		



#### 4.2.2. Plans in Northern Ireland

**Table 4-4 - Summary of plans in Northern Ireland**

Summary of the plan	Link to plan	Nitrogen	Phosphorus	Metals
<p><b>Draft 3rd Cycle River Basin Management Plan for the North Western, Neagh Bann and North Eastern River Basin Districts</b></p> <p>The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017 seek to establish an integrated approach to the protection and sustainable use of the water environment. They require the:</p> <ul style="list-style-type: none"> <li>preparation and publication of a RBMP</li> <li>setting of environmental objectives for groundwater and surface waters (including estuaries and coastal waters)</li> <li>devising and implementing of programmes of measures to meet those objectives.</li> </ul> <p>The draft 3rd cycle plan for the three RBDs in Northern Ireland was published for consultation in 2021. The final plan has not yet been published.</p> <p>The RBMP takes an integrated approach to management of the water environment, identifying those water bodies which can be classified as being at 'good or better' status. It also sets the objectives and a programme of measures for the next six-year cycle to help improve those water bodies which are classified as below 'good' status.</p> <p>The WFD objectives covered by the plans include:</p> <ul style="list-style-type: none"> <li>preventing deterioration of the status of surface waters and groundwater;</li> <li>achieving objectives and standards for protected areas;</li> <li>aiming to achieve good ecological status (or good ecological potential for artificial and heavily modified waterbodies) for all surface water bodies;</li> <li>reversing any significant and sustained upward trends in pollutant concentrations in groundwater;</li> <li>aiming progressively to reduce pollution from priority substances and aiming to cease or phase-out discharges, emissions and losses of priority hazardous substances into surface waters; and</li> <li>preventing or limiting the entry of pollutants to groundwater; and</li> <li>reversing any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater.</li> </ul> <p>The evidence from monitoring showed that the main pressures on the water environment were from nutrients, and are attributed to agricultural activities and sewage related impacts.</p> <p>The plan sets out a draft programme of measures. The key focus of the measures is reducing nutrient inputs to the water environment from the following sectors:</p> <ul style="list-style-type: none"> <li>Agriculture;</li> <li>Point source discharges of sewage from the water industry, domestic sources, and industrial or private wastewater treatment plants.</li> </ul> <p>The plan also sets out measures to address:</p> <ul style="list-style-type: none"> <li>Point and diffuse sources of pollution from chemicals &amp; pesticides;</li> <li>Pressures on water quantity, flow and morphology;</li> <li>Non-Native Invasive species;</li> <li>Point and diffuse sources of pollution from the Forestry, Waste &amp; Contaminated land sectors.</li> </ul>	<p>Draft 3rd cycle River Basin Management Plan for Northern Ireland 2021-2027_0.PDF (daera-ni.gov.uk)</p>	✓	✓	✓
<p><b>Nutrients Action Programme</b></p> <p>The Nitrates Directive aims to improve water quality by protecting water against eutrophication and pollution caused by nitrates from agricultural sources. To meet the requirements of the Nitrates Directive, a Nitrates Action Programme was implemented in 2010 and aimed to improve water quality by protecting water against eutrophication and pollution caused by nitrates from agricultural sources. To meet the requirements of the Directive, the first Nitrates Action Programme to cover the whole of Northern Ireland was established for 2007-2010 through the Nitrates Action Programme Regulations (Northern Ireland) 2006. The aim of this programme was to improve the use of nutrients on farms and, as a result, improve water quality throughout Northern Ireland. At the same time the Phosphorus (Use in Agriculture) Regulations (Northern Ireland) 2006 were introduced to support these objectives.</p> <p>Following a review in 2018 the regulations were revised. The previous Nitrogen and Phosphorus Regulations are now combined into a single set of Regulations (The Nutrient Action Programme Regulations (Northern Ireland) 2019). The Action Programme has been renamed the Nutrients Action Programme.</p>	<p>Nutrients Action Programme 2019-2022   Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)</p>	✓	✓	
<p><b>Draft Ammonia Strategy Consultation</b></p> <p>The Department for Agriculture, Environment and Rural Affairs (DAERA) have published a consultation into their draft ammonia strategy. The strategy aims to reduce the adverse effects of ammonia emissions on the environment and public health. Approximately 60% of the country's sites that are designated for high nature conservation value are sensitive to the impacts of ammonia and nitrogen, and are currently experiencing ammonia concentrations and nitrogen deposition at damaging levels.</p> <p>The Strategy sets targets for 2030 to:</p>	<p>Draft Ammonia Strategy for Northern Ireland Consultation   Department of Agriculture,</p>	✓		

## Summary of the plan

	Link to plan	Nitrogen	Phosphorus	Metals
<ul style="list-style-type: none"> <li>Reduce total agricultural ammonia emissions in Northern Ireland by at least 30% from 2020 levels.</li> <li>Reduce ammonia at internationally designated sites by 40% from 2020 levels, or to less than the critical ammonia level.</li> </ul> <p>The Strategy sets out a range of measures aimed at the agricultural sector to reduce ammonia loads to the environment. It also sets out conservation actions to protect and enhance designated sites for nature conservation. The Strategy focuses on wet and dry deposition of atmospheric nitrogen and its impact on habitats and ecosystems. The key policy tool for controlling pollution and the impacts on the environment has been the development of Critical Levels (the concentration of ammonia in the air) and critical loads of atmospheric nitrogen deposition.</p> <p>The Strategy doesn't focus on the concentrations of ammonia in the water environment, or the impacts of ammonia on the water environment. However many of the measures in the strategy have the potential to improve water quality, in addition to their benefits for atmospheric nitrogen concentrations.</p>	Environment and Rural Affairs (derra-ni.gov.uk)			
<p><b>Drinking Water Safety Plans</b></p> <p>Drinking Water Protected Areas (DWPAs) are identified and designated under Article 8 of The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017 and aim to enhance the safety of drinking water supplies, and to reduce the need for additional treatment to be provided. In addition, Safeguard Zones (SGZs) may also be identified around DWPAs, when considered necessary.</p> <p>In Northern Ireland, there are 26 surface water DWPAs and 65 groundwater DWPAs. The Water Supply (Water Quality) Regulations (Northern Ireland) 2017 and The Private Water Supplies Regulations (Northern Ireland) 2017 implement a risk-based approach to the regulation of drinking water quality. For the public water supply, there is a requirement for Northern Ireland Water to undertake risk assessments of its catchments, water treatment works, and distribution systems leading to the Drinking Water Safety Plans (DWSPs).</p> <p>A sample of DWSPs was requested for this project, but none were made available.</p>		✓	✓	✓
<p><b>Northern Ireland Water and Sewerage Services Price Control 2021-2027</b></p> <p>Price Control (PC) is the regulatory process which determines the levels of customer bills, capital investment and company performance during the control period. The Utility Regulator makes a Determination based on a Business Plan submitted by Northern Ireland Water and the funding allocations indicated by the Department for Infrastructure (DfI).</p> <p>The PC determination includes a section on Nominated Outputs. Within this section, details of the improvements that are planned to WwTWs to reduce P and/or N emissions are presented.</p>	PC21 Final Determination   Utility Regulator (uregni.gov.uk)	✓	✓	

Table 4-5 Assessment of adequacy of plans in Northern Ireland to address nutrients

Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<p><b>Draft 3rd Cycle River Basin Management Plan for the North Western, Neagh Bann and North Eastern River Basin Districts</b></p> <p>Nutrient pressures, either in the form of soluble reactive phosphorus (SRP), dissolved inorganic nitrogen or nitrate are the biggest reason why water bodies have not achieved good status.</p> <p>Between 2015 and 2018, SRP was the cause of decline in status for 100 river water bodies across Northern Ireland.</p> <p>Measures to reduce nutrient inputs to the water environment is the key focus of the plan and draft programme of measures.</p>	<p>Draft 3rd cycle River Basin Management Plan for Northern Ireland 2021-2027_0.PDF (daera-ni.gov.uk)</p>	<p>Statutory. Measures are developed to meet requirements of The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017.</p>	<p>Measures are listed to reduce nutrient inputs from two main sectors:</p> <ul style="list-style-type: none"> <li>• Agriculture;</li> <li>• Point source discharges of sewage from the water industry, domestic sources, and industrial or private wastewater treatment plants.</li> <li>• The plan provides source apportionment estimates for P load to the water environment: 60% of the load arises from agriculture, 24% from waste water treatment facilities and 12% is linked to septic tanks.</li> <li>• Equivalent figures for N apportionment are not provided.</li> </ul>	<p>The draft 3rd cycle RBMP covers the three river basin districts in Northern Ireland.</p> <p>The majority of the measures are defined at a national scale.</p> <p>The RBMP sets out criteria for defining priority waterbodies. Some measures will be implemented in the priority waterbodies. However very few site-specific or catchment specific measures are defined.</p>	<p>The plan does not predict outcomes.</p> <p>The plan proposes a working target of 70% of waterbodies to be at good or better status by 2027.</p> <p>The proportion of waterbodies at good or better status was 37% in 2015 and 38% in 2018 classification.</p> <p>There is no clear evidence base to demonstrate the likely impact of the proposed programmes of measures in terms of the likely load reduction associated with each measure.</p> <p>There is also no prediction of how each measure will contribute to achieving the working target of 70% of waterbodies to be at good or better status by 2027.</p>	<p>The programmes of measures list one or more 'owners' of each measure. DAERA are the owner of the greatest proportion of measures, followed by Northern Ireland Water, one or both of these two organisations are listed as the lead for all except one of the measures. A range of other organisations (e.g. Government Departments, Environmental Non-Governmental Organisations (eNGOs), agricultural stakeholders etc.) are also noted as joint leads for a number of measures.</p> <p>There is no indication of whether each measure is adequately funded or how DAERA will prioritise their resources against all of the measures for which they are the lead.</p>	<p>Many of the measures are not worded in a way that allows monitoring of the implementation of the measure to be tracked or evaluated (they are not SMART – specific, measurable, time-based etc.)</p> <p>NIEA have a comprehensive WFD surveillance monitoring programme. In 2021 SRP was monitored at 450 sites across the country. In the 2021 classification, 39% of waterbodies were classified as less than Good status.</p> <p>Ammonia was measured as a Specific Pollutant at 450 river waterbody sites in 2021. 24 waterbodies were classified at less than good status in 2021.</p> <p>This long-term monitoring programme can be used to assess the impact of the whole programme of measures on concentrations of each substance in</p>	<p>Although the measures all have a named 'owner' there is no indication as to whether the measures are funded or how they will be prioritised.</p> <p>There is no clear evidence base to demonstrate the likely impact of the proposed programmes of measures.</p> <p>Many of the measures are not worded in a way that allows monitoring of the implementation of the measure to be tracked or evaluated.</p>





Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
							the water environment. Specific monitoring to evaluate the impact of individual measures is not carried out.	
<p><b>Nutrient Action Programme</b> The Nutrient Action Programme Regulations set out a range of measures or requirements associated with:</p> <ul style="list-style-type: none"> <li>• Spreading of fertiliser to land</li> <li>• Fertiliser application limits, and limits of N and P within manures and fertilisers</li> <li>• Storage requirements for livestock manure and silage effluent</li> <li>• Land management</li> <li>• Record keeping</li> </ul>	Nutrient Action Programme 2019-2022   Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)	Statutory, Measures set out within <a href="https://www.daera-ni.gov.uk/the-nutrient-action-programme-regulations-northern-ireland-2019">The Nutrient Action Programme Regulations (Northern Ireland) 2019</a> (daera-ni.gov.uk).	The Nutrients Action Programme Regulations apply to all agricultural land in Northern Ireland and are specifically aimed at addressing nutrient loads from the agricultural sector.	These are nationally applicable regulations. No catchment specific measures are identified.	The plan doesn't predict outcomes associated with the measures.	Each farm must keep a comprehensive set of records which can be checked by NIEA for cross compliance purposes. Cross-Compliance refers to the requirement for farmers to comply with a set of requirements in order to qualify for full payments under a range of payment schemes.	NIEA can monitor individual farm compliance with the regulations, through assessment of the records. Each year, Northern Ireland produces a Nutrients Action Programme derogation report. This includes a chapter on water quality which shows trends in nitrate concentrations in freshwater and groundwater and trends in phosphorus concentrations in rivers and lakes.	The plan doesn't predict outcomes associated with the programme of measures.
<p><b>Draft Ammonia Strategy Consultation</b> The Strategy sets out a range of measures aimed at the agricultural sector to reduce ammonia loads to the environment. The management and application of manure from livestock housing is the key driver of ammonia emissions in Northern Ireland and is responsible for a combined 81.5% of all emissions. The main measures proposed are:</p> <ul style="list-style-type: none"> <li>• Low Emission Livestock Housing</li> </ul>	Draft Ammonia Strategy for Northern Ireland Consultation   Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)	Non-statutory.	The strategy focuses on the agricultural sector.	This is a national strategy, and the proposed measures would apply at a national scale.	The strategy provides case studies which demonstrate the impact of implementing specific measures on ammonia emissions. The strategy does not specifically aim to reduce concentrations in the water environment and so no predictions of impact on water quality are made.	At present, the strategy is in a draft form for consultation.	Various tools are available to monitor the impact of the Strategy e.g. National Ammonia Reduction Strategy Evaluation System which uses an inventory model to estimate ammonia emissions from farm systems.	The strategy does not specifically aim to reduce concentrations in the water environment and so it does not predict the likely impact on water quality.

Summary of the plan and associated measures	Link to plan and measures	Plan status (statutory or non-statutory) and associated legislation	What sources/sectors does the plan cover? Are there any major missing sources/sectors? Phases of e.g. nutrients	Scale of the plan? National strategy, catchment specific? Is there sufficient nesting/hierarchy of plans? Level of detail of measures	Does the plan predict outcomes? Does the plan assess future risks e.g. to delivery pathway? What data/evidence underpins the measures and outcomes (e.g. SAGIS, climate change scenarios, land management scenarios etc.)?	Effectiveness of the plan (e.g. is it funded? Are there mechanisms in place to ensure the plan can be delivered? Any challenges?)	Are there evaluation programmes in place?	Omissions/ Gap Analysis
<ul style="list-style-type: none"> <li>Review of emerging technologies to reduce the impact of agricultural practices on ammonia</li> <li>Low Emission Slurry Spreading Equipment</li> <li>Longer Grazing Seasons</li> <li>Move to Stabilised Urea Fertiliser</li> <li>Reducing Crude Protein in Livestock Diets</li> <li>Improving Feed Efficiency Through Genetic Improvement</li> <li>Establishing Tree Plantations around Livestock Housing</li> <li>Covering Above Ground Slurry Store</li> </ul>								
<p><b>Northern Ireland Water and Sewerage Services Price Control 2021-2027</b> The nominated outputs document sets out that: Northern Ireland Water plans to deliver improvements at 45 WwTWs with a population equivalent greater than 250 during PC21. These upgrades are required to meet discharge consent standards set by NIEA and to release development constraints. It also sets out plans to upgrade 36 small WwTWs serving a population equivalent between 20 and 250. It doesn't specify whether the improvements are to reduce ammonia, BOD or phosphorus concentrations in the final effluent.</p>	<p>Annex E - Outputs 02.00.pdf (uregni.gov.uk)</p>	<p>The Water and Sewerage Services (Northern Ireland) Order 2006</p>	<p>The measures address pollutant loads from the water industry assets (wastewater treatment works, storm overflows).</p>	<p>National plan, but specifies individual WwTW to be upgraded.</p>	<p>The plan doesn't predict outcomes. However NIEA will have set the permit requirements that must be achieved at each of the assets to be upgraded, to ensure downstream compliance with EQS.</p>	<p>The measures that are funded with the Price Control 2021-2027 may not cover all of the required WwTW upgrades that are needed to achieve WFD compliance.</p>	<p>NIEA's long-term monitoring programme can be used to assess the impact of the WwTW improvements on concentrations of each substance in the water environment. Specific monitoring to evaluate the impact of individual measures is not carried out.</p>	<p>The funding allocation for each Price Control period may not be sufficient to make all the required improvements to wastewater infrastructure that are needed to achieve WFD compliance. Specific monitoring to evaluate the impact of individual measures is not carried out.</p>

### 4.2.3. Assessment of the plans

#### 4.2.3.1. Nutrients

There are a wide range of plans and measures which are aimed at addressing nutrient pollution in both England and Northern Ireland, reflecting the fact that nutrients are one of the most significant pressures on the water environment in both countries.

The two main sources of nutrient inputs to the water environment are agriculture, and point source discharges of sewage from the water industry, domestic sources, and industrial or private wastewater treatment plants.

Both countries have implemented legislation aimed at reducing the impact of nutrient loads on the water environment from the agricultural sector. In England, the Farming Rules for Water and the regulations for the storage of silage, slurry and agricultural fuel oil apply to all agricultural land. Similarly in Northern Ireland the measures set out within the Nutrient Action Programme regulations apply to all agricultural land. More stringent rules also apply to areas designated as NVZs in England. Compliance with the legislation in both countries has historically been linked to cross compliance, in order to qualify for full payment under rural payment schemes. If these regulations are well enforced, this has been likely to provide a strong incentive for complying with the regulations. Under the new Environmental Land Management schemes, payment will be linked to measures that go beyond complying with basic regulatory requirements. The regulators are also reforming their approach to farm regulation to make it clearer, fairer and more effective. As these schemes are still in the early days of implementation, it is too early to assess their impact in relation to reducing the impact of the agricultural sector on the nutrient load to the water environment.

Obtaining information on how many farms are inspected each year by the EA, NIEA or the Rural Payments Agency was beyond the scope of this study. As this legislation applies to all agricultural land, or areas designated as NVZs which cover approximately 55% of land in England, it is not possible to monitor the effectiveness of measures at an individual farm scale. In England, Defra produces a report every 4 years to review NVZ classifications and in Northern Ireland the NIEA produce an annual Nutrients Action Programme derogation report. These reports rely on data from each country's water quality monitoring programme.

The RBMPs for England and Northern Ireland also set out measures to reduce nutrient loads from the agricultural sector. In addition to the reliance on the general provisions set out under the legislation above, some site-specific measures are proposed. In England, the site-specific measures that are listed are generally those which will deliver multiple benefits (e.g. measures designed for natural flood management or habitat creation which will deliver nutrient reduction as a secondary benefit rather than the primary purpose).

A comprehensive set of plans have been developed in England to address nutrient inputs to sites designated for nature conservation (e.g. European sites (formerly Natura 2000 sites)). These plans do set out site specific measures, and in general, appear to identify a lead and a funding source. Natural England periodically carry out a site condition assessment for sites designated for nature conservation. This assesses the overall condition of each SSSI unit taking into account all pressures on the site (water quality, flow, invasive species etc.). Although this can be used as a measure of how site condition changes over time, there appears to be limited data to track whether the measures have been implemented or to evaluate the effectiveness of the individual measures to reduce nutrient loads.

Both countries use a cycle of water company investment to implement measures to reduce nutrient loads to the water environment from WwTWs (WINEP in England, Price Control in Northern Ireland). These programmes are underpinned by good evidence and, when compared to agricultural measures, it is more straightforward to predict the likely impact of each measure on nutrient concentrations in the water environment. The measures that are funded in each 5-year programme will depend on each water company's price review determination. In general, a significant programme of measures to address nutrient inputs are funded in England. There was, however, concern raised by stakeholders at the OEP event in Northern Ireland that insufficient funding has been made available to deliver nutrient reduction measures in Northern Ireland over recent years. This has led to many WwTWs being at capacity, and is leading to impacts on the planning system as there is not the required infrastructure for new development. There are, nonetheless, good mechanisms to track delivery of the measures in the water company investment programmes. Evaluation of the impact of the measures relies on each country's water quality monitoring programmes.

Both countries recognise that nutrient loads from the non-mains wastewater treatment sector (e.g. private package treatment plants and septic tanks) can be significant in some catchments. No strong measures to address the load from this sector were identified.

The main gaps in relation to measures to address nutrient pollutants appear to be:

- Uncertainty as to the resources available to inspect and regulate the agricultural sector;
- Limited data and assessment techniques to identify where site specific measures to address diffuse inputs may be needed; reliance on schemes for other purposes (e.g. flood risk management) to deliver reductions in diffuse loads;
- Insufficient funding for water company measures in Northern Ireland.
- Limited measures to address nutrient loads from non-mains wastewater treatment sector.
- Limited data to evaluate the effectiveness of measures.

#### 4.2.3.2. Metals

Within the RBMPs, measures to address metals are limited to the use of the Environment Act to set long term targets for a range of substances, including metals; and the Defra abandoned metal mines programme. The RBMP programme of measures also refers to the National Highways Strategic Road Investment Strategy which can be used to mitigate the impacts of road runoff. The mitigation measures used are generally Sustainable Urban Drainage Systems (SuDS) which will give some pollutant removal benefit, including for removal of metals such as copper and zinc as well as a range of other chemicals associated with vehicle and tyre wear that are less well understood (e.g. microplastics and associated leached chemicals).

The abandoned metal mines programme has an aim to target the watercourses that are most heavily impacted by pollution from historical metal mining. A number of schemes have been implemented though it isn't clear how schemes are prioritised and when all the remaining abandoned mine discharges will be addressed.

The National Highways Designated Fund could also be used to address pollution from the road network on the water environment. This is a fund which partners can apply to for a specific project. National Highways refer to outfalls being categorised as medium, high and very high risk to the water environment. We are aware of a former 'Priority Outfalls' initiative within National Highways that was used to assess the risk of highways outfalls and provide a list of outfalls which could be retrofitted with mitigation to reduce their impact on water quality. However, the designated funds plan and the RBMP programmes of measures do not refer to this initiative and it is unclear whether it is still in operation.

It is therefore unclear as to whether there is a strategic approach or a prioritised set of measures to be delivered.

The main gaps in relation to measures to address metal pollutants appear to be:

- Although waterbodies that are impacted by abandoned metal mines have been identified, there does not appear to be a clear strategy or prioritised programme of schemes to address the pollution.
- Although the risk of pollution from outfalls from the road network appears to have been assessed, there is no information as to a clear strategy or programme of schemes to address them.

### 4.3. Emerging substances

For many of the emerging substances, due to them being emerging, it is less likely that plans have been developed to address the pollutants. Therefore for these substances we have:

- Reviewed the approach that the regulatory bodies in each country take to determining whether to develop regulatory measures for emerging pollutants;
- Assessed the shortlisted substances (from Task 3) to determine what measures have been developed to address these substances;
- Where plans or measures have been developed, assessed the likely effectiveness of those plans or measures. This has been a qualitative assessment, considering factors such as resource availability to deliver the measures, funding, other challenges etc.

#### 4.3.1. Overview of approach to regulation in England

The EA Chemicals Programme have two key processes involved in the identification and potential mitigation of emerging pollutants in the environment in England. The first is the PEWS, which aims to filter nominations, assess exposure and hazard information and prioritise pollutants for further measures. The second stage is regulatory planning which aims to establish if new interventions are required, and if so, what the most suitable approaches are for each pollutant. The various stages involved in PEWS are summarised in Figure 4-1 and described below.



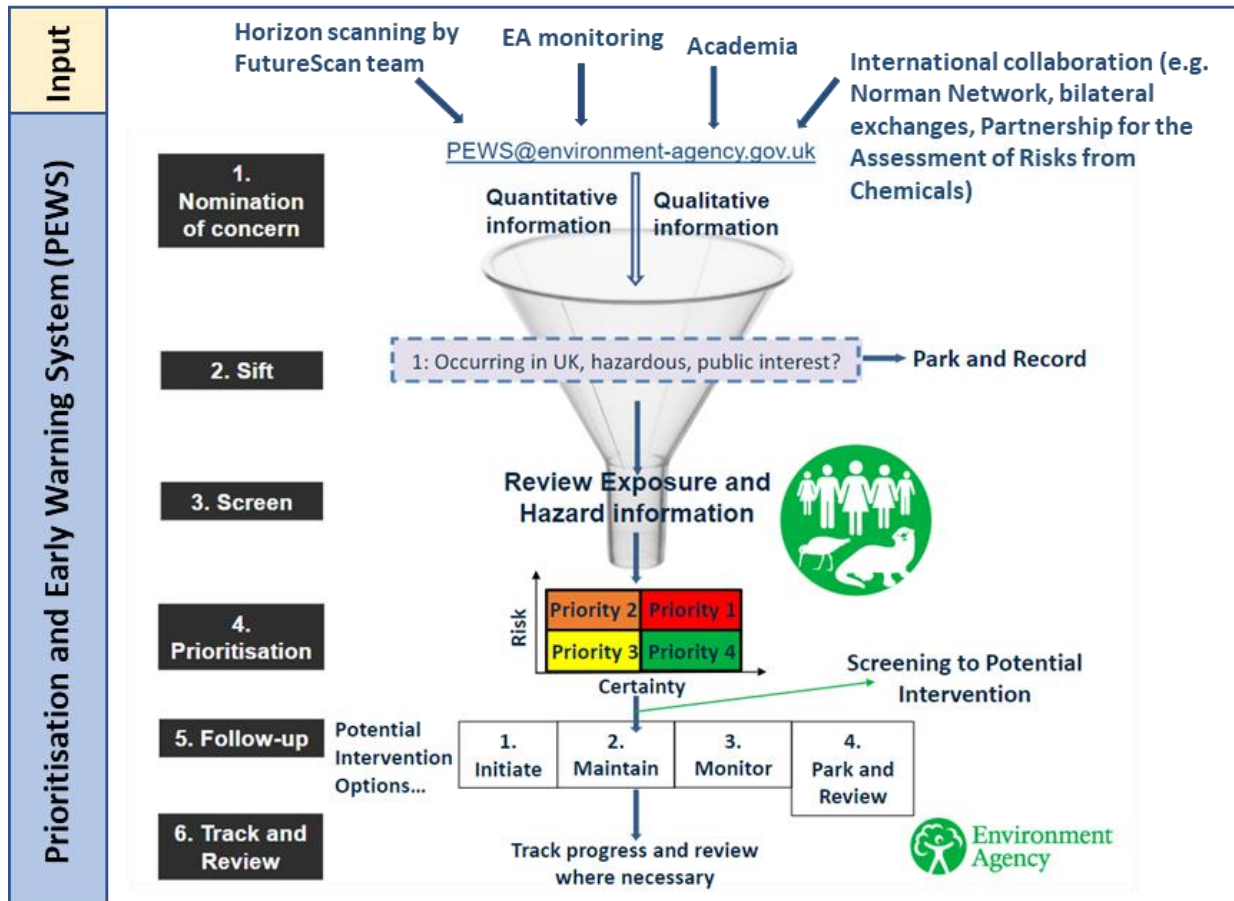


Figure 4-1 - Conceptual model of the processes involved in the identification and prioritisation of emerging pollutants in the aquatic and terrestrial environment in England by the Environment Agency, from an EA presentation shared in February 2023.

#### 4.3.1.1. PEWS

**Stage 1:** Chemicals are nominated for assessment in PEWS from a range of sources such as:

- The EA's dedicated horizon scanning team 'FutureScan', which reviews large volumes of data using a Really Simple Syndication (RSS) feed aggregator, and incorporates 'emerging signals', 'clusters of change' and 'wildcards'. Outputs are considered for relevance in PEWS.
- Targeted horizon scan activity is undertaken such as recently published here, "A Horizon Scan to support Chemical Pollution related policymaking for sustainable and climate resilient economies"<sup>48</sup>. Relevant topics are taken forwards into projects to understand chemicals to include within PEWS.
- Chemicals of emerging concern (CECs) identified from weekly screening of a sub-set of academic publications.
- EA monitoring data (both fully- and semi-quantitative).

<sup>48</sup> [A Horizon Scan to support Chemical Pollution related policymaking for sustainable and climate resilient economies - Green - Environmental Toxicology and Chemistry - Wiley Online Library](#)

- International collaboration on emerging substances such as through the Norman Network<sup>49</sup>, bilateral exchange and collaboration in PARC (Partnership for the Assessment of Risk from Chemicals)<sup>50</sup>.
- Anyone is able to nominate a substance to the system via PEWS@environment-agency.gov.uk.

### Step 2: Sift information

Of all the nominations, criteria are used to sift and rank the substances to decide which are taken forward to the next stage. Only substances that are sifted and ranked as high risk are taken forward, though substances can be resifted, as new information becomes available.

The criteria include:

- External interest at the time of sifting – always rate high
- If a substance or issue is not mature in the UK/EU at the time of sifting give a priority of low, ignore other criteria (except external interest).
- If a substance is hazardous or toxic (has a very low PNEC- we have opted to take this as less than 0.001mg/L) and dispersed – always rate high.
- If a substance is hazardous or toxic (has a very low PNEC- we have opted to take this is less than 0.001mg/L) and not dispersed – medium
- If a substance is not hazardous and not toxic (has a PNEC above 0.001mg/L) and not dispersed – low
- If no PNEC available assume not toxic.

### Step 3: Screen

The screening process involves reviewing exposure and hazard information for the pollutant relating to:

- Hazard Designation – Persistent Organic Pollutants (POPs), REACH, and the Classification, Labelling and Packaging (CLP) Classifications (e.g., persistent (P), bioaccumulate (B), toxic (T), endocrine disruption (ED), SVHC and/or carcinogenic, mutagenic or toxic to reproduction (CMR)).
- Hazard Thresholds – PNECs, EQS, Drinking Water Threshold, Derived No-Effect Level (DNEL), Derived Minimal Effect Level (DMEL), Acceptable Daily Intake (ADI), and Tolerable Daily Intake (TDI).
- Hazard Designation from available data - relating to persistence, bioaccumulation potential and toxicity.
- Exposure data is taken where available from EA monitoring data (either quantitative or semi-quantitative). In the absence of EA monitoring data, data is sought from scientific literature.

### Step 4: Prioritisation

The prioritisation stage provides a priority level for surface water, groundwater, soil, biota and sediment, and then gives an overall priority level.

For surface and groundwater there are four priority levels:

	Priority 1	High risk, high certainty
	Priority 2	High risk, low certainty
	Priority 3	Low risk, low certainty
	Priority 4	Low risk, high certainty

For soil, biota and sediment there are three categories:

	Yes	Flag for further consideration
	No	No further consideration required
	Unclassified	Insufficient information

<sup>49</sup> An international network which enhances the exchange of information on emerging environmental substances.

<sup>50</sup> [Partnership for the Assessment of Risks from Chemicals | Parc \(eu-parc.eu\)](https://eu-parc.eu)

#### **Step 4a: Screening to potential intervention**

The PEWS system applies a set of principles for determining potential intervention based on the screening outputs (Table 4-6). For example, action would be required where the median concentration of a substance (from water quality monitoring data) exceeds the lowest available credible PNEC/EQS. This may include refining the PNEC if necessary or conducting a more detailed assessment of potential harm.

#### **Step 5: Follow-up**

Substances identified as Priority 1 or 2 may require potential interventions to protect the environment and/or human health via the environment through regulatory planning (described below). This may include measures such as referral for EQS development, referral to the Joint Agencies Groundwater Directive Advisory Group (JAGDAG) for determining if a substance is deemed hazardous to groundwater, increased environmental monitoring by the EA, and engagement with other regulators (e.g., Veterinary Medicines Directive) to encourage the potential implementation of restrictions for specific uses within the UK.

Priority 3 substances may be flagged for increased or improved monitoring or research (e.g., where ecotoxicological/hazard information was insufficient to allow for prioritisation). If Priority 3 substances are detected by newly commissioned monitoring programmes, they will be re-visited after three years.

In most cases, if substances are under evaluation as SVHC under EU (or UK) REACH, then no further action is taken until the outcome from the regulatory process is complete.

#### **Step 6: Track and review**

The final stage involves tracking the progress of the chemicals and conducting a review where necessary.



Table 4-6 Assessment table from Environment Agency’s ‘PEWS principles from Screening to Potential Intervention’ internal guidance document. Substances are flagged for further action based on the below criteria.

Action Criteria							
Ongoing EU CoRAP or Candidate SVHC Evaluation	Human health via the environment	Plant Protection Products in Drinking Water	Protection of Surface Water	Protection of Ground Water	Protection of Soil	Protection of Biota	Protection of Sediment
Presumption is to not take action if ongoing EU CoRAP or candidate SVHC process is ongoing.	Take action if;  Human health T and persistent	If our monitoring results show exceedance of the proposal for the revised Drinking Water Directive 0.1 µg/L limit then consider discussing with water companies and Drinking Water Inspectorate.	Take action if;  Median monitored value exceeds PNEC/EQS	Take action if;  Same criteria as fresh water	Only consider for action if flagged for concern by the PEWS screen	Only consider for action if flagged for concern by PEWS screen	Only consider for action if flagged for concern by PEWS screen
The presumption not to take action applies even if other criteria for action are met.	OR  Human health T and bioaccumulative	Otherwise, no action.	OR  25% of monitored values exceed the PNEC/EQS	OR  Persistent and present in more than 0.5% of monitoring samples or evidence of increasing contamination of groundwater	<b>AND</b>  P and T (terrestrial system and human health) properties <b>AND</b> Applied directly to soil <b>OR</b> Applied indirectly with substantial production (ECHA REACH database > 1,000tpa)	<b>AND</b>  T and P and/or B (i.e. PT, BT or PBT)	<b>AND</b>  T and P and/or B (i.e. PT, BT or PBT )
Can make exceptions where there is a UK driver for action.			OR  Exceedances of the PNEC/EQS show a pattern such as repeated exceedances at one location.	OR  Where the median value of our monitored concentrations exceeds the drinking water standard <sup>4</sup> .	OR  For biocides, pharmaceuticals, veterinary medicines not directly applied to soil evaluate on a substance by substance basis.	OR  vPvB	<b>AND</b>  Where there is evidence that the substance is present in sediment, or a plausible pathway to sediment exists.
			OR  Any exceedance of the PNEC/EQS by a factor of a hundred.	OR  Where 5% of monitored concentrations (all tests, not just positive tests above LOD)) are above the drinking water standard.	OR  Where significant adverse impacts have been reported.	OR  vPvM	<b>AND</b> (applies to all of the above)  Where there is evidence that the substance is present in biota, or a plausible pathway to biota exists.
			OR  If no data on persistence and substances is detected in more than 10% of samples	OR  Where exceedances of the drinking water standard are below these thresholds and show a pattern such as repeated exceedances of the drinking water standard at one location.	OR  Where a substance is bioaccumulative in terrestrial and agricultural food chains and is toxic (terrestrial system and human health).	OR  <b>AND</b> (applies to all of the above)	
			OR  No monitoring data is available	OR  Any exceedances of the drinking water standard by more than a factor of one hundred should be investigated.	OR  We have received advice from other relevant bodies such as the Food Standards Agency, Defra, or other environmental agencies.		

\*Monitoring refers to EA monitoring, usually the semi-quantitative LC-MS/GC-MS target scan data

#### 4.3.1.2. Regulatory Planning

Regulatory planning prioritises EA resources for chemicals regulation. Chemicals can be put forward for regulatory planning for a number of reasons. A substance may be proposed from PEWS or the Chemicals Assessment Unit; a review of monitoring data may suggest the need for further action; or there may be a legislative driver.

There are four key stages to regulatory planning:

1. The first step is to identify what the EA is trying to achieve. This stage is used to explain why the substance has been selected (e.g. a request from PEWS or the Chemicals Assessment Unit, or following a review of monitoring data) and what the EA are trying to achieve (e.g. reduce the amount of the substance in surface waters).
2. The second step is to review current knowledge, assessing:
  - a. the existing legislative framework (summarising the relevant laws, restrictions and standards)
  - b. the sources, pathways, receptor and properties (e.g., persistent organic pollutant) if known,
  - c. a summary of current regulatory activities.
3. The third step identifies evidence and outcome gaps. This includes consideration of potential new interventions (e.g., enforcement, permitting, new legislation, new monitoring, and/or engagement).
4. The final step involves a regular (e.g., annual) review to determine:
  - a. if the interventions are working as planned,
  - b. to identify if there are any common issues or problems across a range of strategies (e.g., permitting).

There are a range of measures that can be considered as part of step 3 to either fill knowledge and outcome gaps or progress the development of interventions. Examples of these include:

- Submitting the substance to be considered for development of a new EQS.
- Expanding the monitoring of the substance by the EA (e.g. reviewing existing data, adding the substance to the monitoring programme, developing new analytical methodologies, inclusion of new environmental compartments).
- Including the substance as part of the UKWIR CIP.
- Engaging with other organisations (e.g. Health and Safety Executive (HSE), Defra) on the potential development of new legislation/restrictions (e.g., new REACH restrictions, no longer approving a chemical for use as a plant protection product, biocide etc.)
- Carrying out further data or literature reviews to further evaluate the substance or develop a Regulatory Management Options Analysis under UK REACH
- Carrying out compliance activities (e.g. permitting reviews, campaigns by the Chemical Compliance Team)
- Actions associated with impacts on human health (e.g. engaging with the HSE or pharmaceutical industry, considering endocrine disruption, antimicrobial resistance)
- Engaging with the agricultural chemicals and veterinary medicines sectors
- Engaging with other EA sector groups and teams (e.g., agricultural, chemical, textile, landfill sector groups)
- Actions associated with impacts on land/soils
- Actions associated with the landfill and waste sector
- Actions associated with air quality or climate change.

Although regulatory planning identifies a range of potential measures for each substance, the resource availability within the EA, and in relevant government and non-government organisations, will influence whether and how quickly each measure can be taken forward. As of June 2023, regulatory planning has been undertaken for 80 priority and emerging substances with 48 having received their first annual review.

### 4.3.2. Review of measures developed in England to address the substances of concern from Task 3

This section sets out a summary of the regulatory measures that have been developed by the EA's Chemicals Programme for the seven substances that were identified for the risk assessment (Task 3), plus PFAS and PBDEs.

Firstly, Table 4-7 shows whether each substance has been through PEWS and regulatory planning. As shown in the table, only 5 substances have been taken through regulatory planning.

**Table 4-7 Summary of the nine example substances to show their inclusion in PEWS and/or regulatory planning**

Pollutant	In PEWS (and overall PEWS priority score)?	Has regulatory planning been undertaken?
Carbamazepine	Priority 2, Tranche 1	No
Climbazole <sup>51</sup>	Yes (awaiting screening and prioritisation)	No
Galaxolide	Priority 2, Tranche 6	Yes
Diclofenac	Priority 1, Tranche 1	Yes
Fipronil	Priority 1, Tranche 1	Yes
Bisphenol A	Priority 1, Tranche 1	Yes for Bisphenols (group)
1,4-dioxane	Priority 1, Tranche 2	Yes
PFAS	Only the most emerging PFAS, trifluoroacetic acid (TFA) has been screened through PEWS in Tranche 4B. It was Priority 3	No. There is a separate team within the EA dedicated to PFAS and related substances.
PDBEs	No	Yes

For the five substances / groups of substances for which regulatory planning has been carried out, the resulting actions or measures that have been identified to control that substance are set out in the sections below.

#### 4.3.2.1. Galaxolide

Galaxolide was screened in PEWS Tranche 6 and was given a Priority 2 classification (high risk, low certainty). As there was no monitoring data available at the time of regulatory planning (January 2023), both PEWS and regulatory planning recommended that it be added to the EA's monitoring programme to obtain evidence of any environmental contamination; potential regulatory actions will be reviewed in full once sufficient monitoring data is available to identify potential harm to the environment. The following actions have been suggested:

- Consider for future monitoring in sediment – funding is available for this, but laboratory capacity is too limited to develop these methods at present.
- Add to the CIP4 sewage sludge monitoring work to understand compartmentalisation into sludge during wastewater treatment.
- Refer to the H4 indicator working group as a potential concern for biota.
- Discuss internally with colleagues in endocrine disruption, antimicrobial resistance, landfill leachate and air quality to identify further actions.

<sup>51</sup> Climbazole is within PEWS and being tracked. However the EA are awaiting substance evaluation work on endocrine disruption in fish to conclude in the EU before screening and prioritising.



- Refer to human health regulatory organisations if monitoring data suggests that there could be a risk to human health.
- Possibly conduct a literature review to better understand galaxolide's source-pathway-receptor activity, due to the wide range of possible sources.

#### 4.3.2.2. Diclofenac

Diclofenac was included on the 2015 WFD Watch list<sup>52</sup>. At the EU level, a draft EQS has recently been derived<sup>53</sup>.

Diclofenac was screened in PEWS Tranche 1 and was given a Priority 1 classification (high risk, high certainty). Regulatory planning took place in May 2021 and this was reviewed in March 2023. The following actions were suggested; note that the majority are currently lacking resource:

- Submit diclofenac to be considered for development of a new EQS (there is currently no capacity to develop new EQS until the multi-agency UK Technical Advisory Group is re-instigated).
- Refer diclofenac to the JAGDAG as diclofenac was assigned Priority 1 for groundwater by PEWS. JAGDAG is not currently running due to lack of resource, and there is a backlog of substances to be reviewed.
- Review data from the EA's monitoring and from past CIP investigations in combination with prescription data to identify hotspots.
- The Chemicals Assessment Unit to consider a substance evaluation for diclofenac.
- Refer to the H4 indicator working group as a potential concern for biota.
- Include diclofenac in ongoing work on human pharmaceuticals: this includes sector engagement; an internal workshop; projects on social prescribing and innovative pathway control; and the cross-government Pharmaceuticals in the Environment working group.
- Review the availability of diclofenac through online pharmacies and whether this is contributing to the environmental load.

#### 4.3.2.3. Fipronil

Fipronil was screened in PEWS Tranche 1 and was given a Priority 1 classification (high risk, high certainty). Regulatory planning was conducted in April 2021 and reviewed in May 2023. The Veterinary Medicines Directorate (VMD) and the HSE are the regulating bodies for the uses of fipronil as a veterinary medicine and biocide respectively, and so EA engagement with these regulators is essential to reduce the amount of this substance entering the environment. Fipronil was added to the EU Watch List under the WFD in 2022<sup>54</sup>. Planned and delivered regulatory actions are described below:

- An evidence review on fipronil and other veterinary medicines was conducted to identify knowledge and data gaps – this included engagement with academics, NGOs, vets and the VMD. A follow-up paper on how the EA can reduce work with other regulators to reduce impacts on the environment for certain substances, namely pesticides and veterinary medicines, is in development.
- Referred to the cross-government Pharmaceuticals in the Environment working group for intervention alongside other priority veterinary medicines.
- Successful engagement with the Royal Veterinary College to include the topic of environmental impacts of veterinary medicines in teaching materials.
- Submit fipronil to be considered for development of a new EQS (there is currently no capacity to develop new EQS until the multi-agency UK Technical Advisory Group is re-instigated).
- Refer fipronil to the JAGDAG as fipronil was assigned Priority 1 for groundwater by PEWS. JAGDAG is not currently running due to lack of resource, and there is a backlog of substances to be reviewed.
- Review fipronil metabolites and breakdown products for potential PEWS screening and addition to monitoring programme: fipronil sulphide, fipronil sulphone & fipronil amide are awaiting PEWS screening.
- Refer to the H4 indicator working group as a potential concern for biota.

<sup>52</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015D0495&from=EN>

<sup>53</sup> [https://health.ec.europa.eu/system/files/2022-08/scheer\\_o\\_038.pdf](https://health.ec.europa.eu/system/files/2022-08/scheer_o_038.pdf)

<sup>54</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022D1307&qid=1658824912292>

- Consult internal waste to land and sewage sludge team on risk of fipronil entering the environment via sewage sludge and waste applied to land.

#### 4.3.2.4. Bisphenols (group)

Bisphenol A was screened in PEWS Tranche 1 where it was given a Priority 1 classification and in follow up the group of bisphenols were considered by the Chemicals Assessment Unit in December 2021, and were subsequently fast tracked for regulatory planning. Regulatory planning took place in May 2022 and was reviewed in June 2023.

Bisphenol A has been nominated for inclusion as a priority substance in a legislative proposal for the Water Framework Directive at European level<sup>55</sup> and an EQS is currently under development (EU level)<sup>56</sup>.

The following regulatory actions for bisphenols have been developed:

- Add several bisphenols to the EA's monitoring programme and to CIP investigations, to be reviewed once sufficient data is available to aid regulatory planning.
- Engage with the EA's Chemicals Sector group to discuss options for adding bisphenols to their business plan and tracking emissions from manufacture.
- The Chemicals Assessment Unit to conduct a substance evaluation for some bisphenols.
- Discuss internally with colleagues in endocrine disruption, sewage sludge, landfill leachate, land contamination and air quality to identify further actions.
- Consider bisphenols in internal projects on construction waste and PVC classification.
- The Chemical Compliance Team reviewed bisphenols to identify any compliance and enforcement action that could be taken; it was concluded that lack of restrictions meant that no action was possible at this time.
- Discuss with the EA's internal Paper Pulp sector group due to their presence in thermal paper.
- Review the EU EQS decision for Bisphenol A when available.
- Refer bisphenols to the JAGDAG as bisphenols were assigned Priority 1 for groundwater by PEWS. JAGDAG is not currently running due to lack of resource, and there is a backlog of substances to be reviewed.

#### 4.3.2.5. 1,4-dioxane

1,4-dioxane was screened in PEWS Tranche 2 and was given a Priority 1 classification (high risk, high certainty). Regulatory planning was carried out in June 2021 and reviewed in March 2023. The potential regulatory actions are summarised below:

- Submit 1,4-dioxane to be considered for development of a new EQS (there is currently no capacity to develop new EQS until the multi-agency UK Technical Advisory Group is re-instigated).
- Refer 1,4-dioxane to the JAGDAG as 1,4-dioxane was assigned Priority 1 for groundwater by PEWS. JAGDAG is not currently running due to lack of resource, and there is a backlog of substances to be reviewed.
- A Regulatory management option analysis (RMOA) for 1,4-dioxane was proposed and is currently in development; the HSE call for evidence ended in April 2022.
- Review relevant sector groups for engagement following publication of RMOA.
- Refer 1,4-dioxane concerns to human health regulators given carcinogenic properties and presence in surface waters – the EA is awaiting meetings chaired by the UK Health Security Agency to begin.
- Review products sold by online retailers containing 1,4-dioxane to better understand sources and pathways to the environment – note that this requires significant resource to test products for the presence of 1,4-dioxane contamination.

#### 4.3.2.6. PFAS

Only one individual PFAS has gone through PEWS (perfluoroethanoic acid (PFEA – better known as trifluoroacetic acid), assigned as Priority 3). PFAS are unlikely to go through the usual regulatory planning process as there is significant work elsewhere within the EA. For example, PFAS are included as a priority for

<sup>55</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022PC0540&from=EN>

<sup>56</sup> [https://health.ec.europa.eu/system/files/2022-10/scheer\\_o\\_042.pdf](https://health.ec.europa.eu/system/files/2022-10/scheer_o_042.pdf)



the 2022-2023 UK REACH programme and the EA and HSE have recently (April 2023) published an analysis of the most appropriate management options' (RMOA<sup>57</sup>) which makes recommendations on how to manage the identified risks of using PFAS. Following publication of the RMOA, the appropriate authorities will act on the recommendations, which may indicate that a restriction is the most appropriate option to control any identified risks<sup>58</sup>. The Plan for Water, published in April 2023, states a commitment to following the RMOA recommendations<sup>59</sup>.

#### 4.3.2.7. PDBEs

PDBEs did not go through PEWS but were referred for regulatory planning through a non-PEWS trigger (unspecified). Regulatory planning initially took place in March 2021 and was reviewed in April 2023, with a range of actions identified:

- Conduct an internal mapping exercise to identify existing work within the EA on PDBEs and ensure this is coordinated.
- Refer PBDEs to the JAGDAG as PBDEs were assigned Priority 1 for groundwater by PEWS. JAGDAG is not currently running due to lack of resource, and there is a backlog of substances to be reviewed.
- Review EA monitoring data and CIP investigation data, including sewage sludge, to explore whether PBDE levels are truly declining as suggested by initial findings.
- Consult internal waste teams to identify further actions.

#### 4.3.3. Assessment of Gaps

The approach that the EA uses to determine whether and how to regulate individual emerging substances appears to be sound and based on good evidence and a well-documented set of criteria. Measures have been identified for six out of the nine example substances that we used to inform this review. However although measures have been identified, the EA have indicated that at present their resources that are available to take forward many of the measures are limited.

Regulatory planning has not yet been carried out for two of the substances identified by the OEP for the risk assessment (carbamazepine and climbazole) and so measures have not yet been identified by the EA Chemicals Programme for these pollutants. The EU are currently carrying out substance evaluation on climbazole in relation to endocrine disruption in fish. The EA will carry out further work on climbazole once this evaluation has concluded.

### 4.4. Overview of approach to regulation in Northern Ireland

To inform this section we had a number of conversations with representatives from the NIEA who were responsible for implementing the WFD regulations and associated monitoring programmes. It was not possible to speak with someone with a role in chemicals regulation, though NIEA made available a comprehensive document on the role and responsibilities of the Chemicals and Industrial Pollution Team in the DAERA, as well as a number of documents setting out their approach to monitoring.

In this section we have therefore firstly provided information on the overall approach to chemicals regulation, based on the information in the documents provided. We have then summarised NIEA's approach to monitoring of chemicals, which is a key measure in understanding their presence and prevalence, using information from documents provided by NIEA as well as from conversations with representatives of NIEA's monitoring team. NIEA did not provide detailed information in relation to the seven substances that were identified for the risk assessment (Task 3), plus PFAS and PBDEs. Therefore this section provides a review of NIEA's overall approach to chemicals regulation and monitoring without focussing on specific substances.

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<sup>57</sup> [Analysis of the most appropriate regulatory management options \(hse.gov.uk\)](https://www.hse.gov.uk/reach/rmoa/)

<sup>58</sup> GOV.UK, (2022). Rationale for prioritising substances in the UK REACH work programme, 2022 to 2023. Available at: <https://www.gov.uk/government/publications/uk-reach-rationale-for-priorities-in-2022-to-2023/rationale-for-prioritising-substances-in-the-uk-reach-work-programme-2022-to-2023>

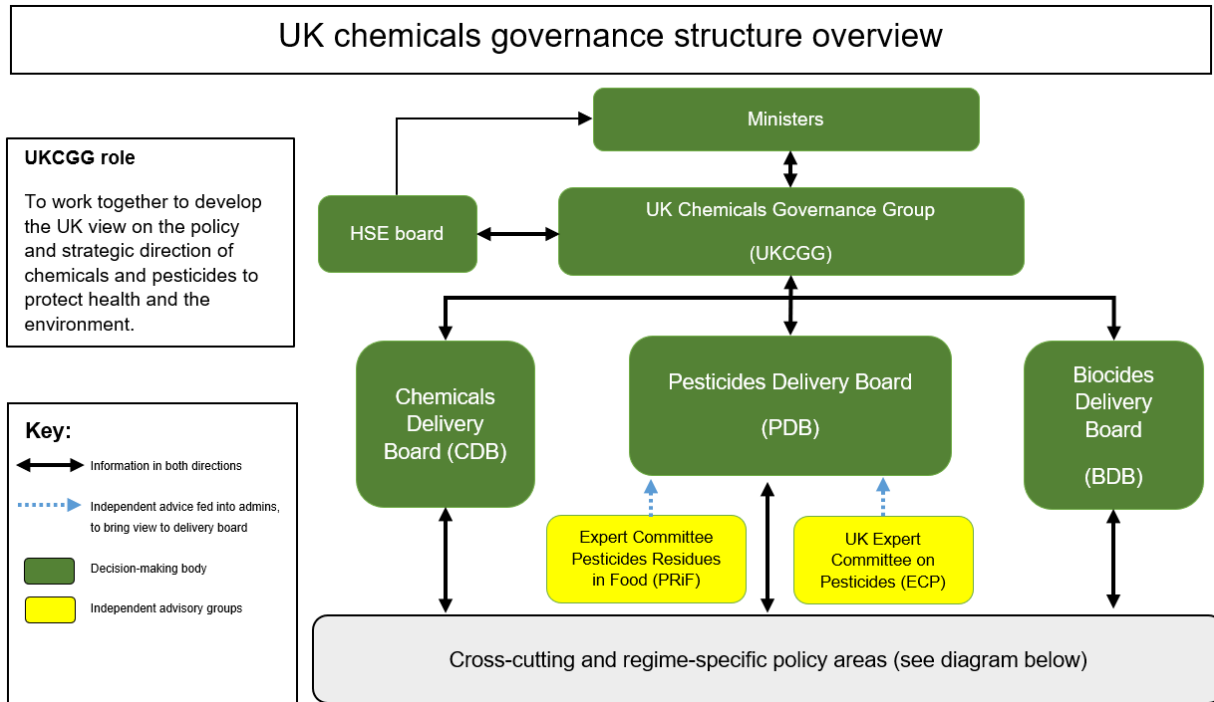
<sup>59</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1148704/Plan\\_for\\_Water\\_-\\_our\\_integrated\\_plan\\_for\\_delivering\\_clean\\_and\\_plentiful\\_water\\_\\_PDF\\_version\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1148704/Plan_for_Water_-_our_integrated_plan_for_delivering_clean_and_plentiful_water__PDF_version_.pdf)

### 4.4.1. Chemicals regulation in Northern Ireland

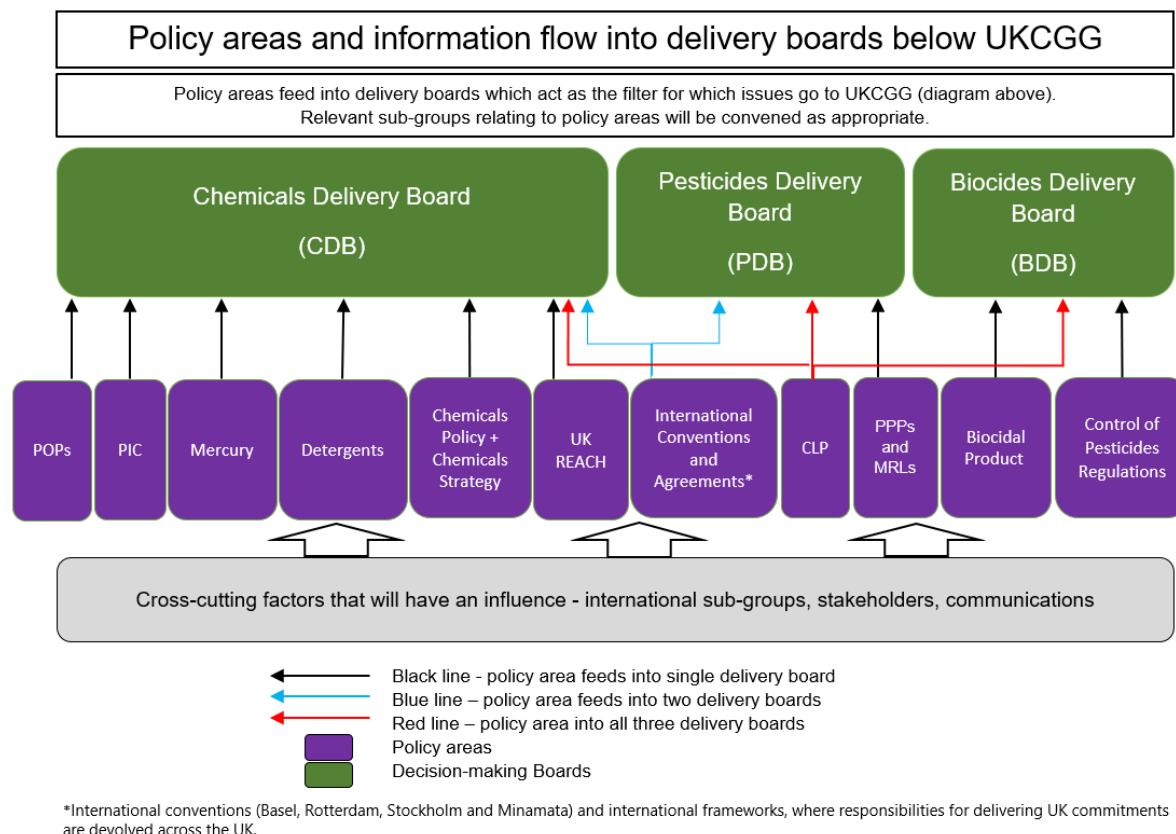
The management and regulation of chemicals in Northern Ireland is led by the Chemical and Industrial Pollution Policy (CIPP) team, in Northern Ireland's DAERA.

Chemicals Regulation in the UK is managed through a governance structure as set out in Figure 4-3.

Figure 4-3 sets out the policy areas which feed into the decision-making delivery boards. DAERA is a member of all of the groups that are shown in Figure 4-2, with the exception of the UK Biocides Delivery Board.



**Figure 4-2 - Overview of the UK chemicals governance structure**



**Figure 4-3 – Policy areas and information flow to the delivery boards below the UKCGG**

In addition there are a number of supporting UK Chemicals Stakeholder Groups that DAERA are involved in as a member or an observer.

#### 4.4.1.1. Monitoring of chemicals

NIEA's monitoring network for the WFD comprises both surveillance and operational monitoring stations with investigative sites selected as required on an ad hoc basis. Surveillance monitoring aims to allow assessment of long-term changes while Operational Monitoring aims to establish the status of waterbodies identified at being at risk of failing to meet their environmental objectives and assess any changes in the status of such bodies resulting from the programmes of measures.

##### 4.4.1.1.1. Water Framework Directive Specific Pollutants and Priority Substances

NIEA provided a document which describes the development of the WFD monitoring programmes for the analysis of specific pollutants (UK Annex V111) and priority substances (EU Annex X) through the first and second cycles and the current plans for the third cycle. The information presented below is largely taken from this document.

Given the large number of Annex 8 and Annex 10 substances for which monitoring must be conducted, and the need to develop many new and challenging methods of analysis, it was decided at the beginning of the programme to analyse several suites of determinands each year at all selected sites with a view to having completed monitoring of all substances by the end of each cycle. This approach was adopted for first and second river basin cycles and it is proposed that this will continue for third cycle monitoring.

The monitoring programme for the second cycle followed a similar programme to the first cycle programme with each WFD specific pollutant and priority substance monitored monthly for one year during the life of the plan.

For the second cycle one of the biggest monitoring challenges was the greater range of new priority substance and specific pollutant trace organics and ever-tightening EQS which required considerable analytical method development. The trace organics monitoring programme was extended in 2019 to include monitoring of the full list of priority substances and specific pollutants at eleven river and lake surveillance monitoring stations located within drinking water protected areas.

NIEA undertook annual monitoring at three surveillance monitoring stations of the WFD Watch List 2 which commenced in 2016 and was completed in 2019. The suite of analysis included new/emerging chemicals and a number of antibiotics and neonicotinoids.

Trace metal monitoring was carried out each year at surveillance stations and at stations where exceedances of the standards were detected during earlier monitoring at a monthly frequency. All remaining monitoring stations (operational) were monitored four times each year.

The monitoring programme for trace organics at surveillance stations for the third cycle will follow a similar programme to the previous cycle with each WFD specific pollutant and priority substance monitored monthly for one year during the life of the plan using the risk assessment approach. This will ensure NIEA meets their WFD obligations under the Water (Amendment) (Northern Ireland) (EU Exit) Regulations 2019. Additional substances will be added to the Annex 10 list during Cycle 3, although the process of prioritisation at EU level is currently running behind schedule. This may require more new methods of analysis to be developed, if the WFD obligations continue to be followed in NI.

The trace organics monitoring programme was extended in 2021 to include the analysis of the full list of priority substances and specific pollutants at the surveillance lake monitoring stations not already being monitored as part of the drinking water protected area project.

Watch List 3 substances will be monitored for the next four years. Fungicide/insecticides substances are currently being monitored with the monitoring of antibiotics/pharmaceuticals substances taking place once methodology is up and running and resources permit.

The monitoring frequency for metals and total ammonia currently remains unchanged.

Over the course of the third cycle, further data analysis of the substances found will be undertaken in the context of their spatial occurrence, and links to potential sources. This will be used to inform the risk assessment process for programmes in future.

#### 4.4.1.2. Chemicals of Emerging Concern

All of the water quality monitoring that NIEA programme into their routine monitoring programmes each year is associated with a specific purpose or 'driver'. For example, monitoring may be required to comply with WFD regulations (WFD driver), Bathing Water Regulations (Bathing Water 'driver') etc. NIEA do not have a driver for a specific monitoring programme for CECs. Some CECs have been included in WFD analytical suites and so are monitored as part of the WFD Surveillance Programme. Sample numbers vary according to the analytical suite concerned, which drives the risk assessment process for sites, but is circa 500 to 800 samples per annum. Once again this only applies to those analytical methods where CECs have been added to the determinand suite.

NIEA use GC-MS to carry out a qualitative screen for a large number of substances. Where analysis identifies substances that are regularly present in samples these can then be prioritised for further substance specific monitoring. Information from this screening programme will also be fed into the EA's PEWS database.

NIEA have been developing analytical methodologies for monitoring some CECs, which are considered to be high risk in Northern Ireland. Examples include:

- **Synthetic pyrethroid insecticides.** In addition to the WFD substances (cypermethrin and permethrin), the analytical methodology was developed to measure the concentrations of 6 other synthetic pyrethroids, all high use in Northern Ireland.
- **Fungicides and insecticides:** targeted screening methodology has been developed to cover a range of WFD insecticides but also includes a number of high use fungicides never before monitored in the local aquatic ecosystem. Being a targeted screen this method of analysis is fully quantitative.
- **PFAS.** In addition to monitoring for PFOS and PFOA, NIEA is in the process of developing a method of analysis for a further 50 PFAS substances. This methodology will be fully quantitative for target analytes but will also be able to qualitatively screen for non-target PFAS substances that were co-extracted from each sample. It is hoped that this approach can be used to build the target list as monitoring progresses.
- **Antibiotics and pharmaceuticals for veterinary use.** A more comprehensive screening method is being developed to detect the presence of a range of antibiotics from different classes and a number of commonly used pharmaceuticals. In common with the approach being developed for PFAS substances, there will be a target list of antibiotics/pharma for which the method of analysis will be fully quantitative and also the capability to qualitatively screen for non-target analytes co-extracted from each sample.

The NIEA team responsible for developing the annual monitoring programme confirmed that they currently do not have sufficient resources to develop a bespoke monitoring programme for CECs. The work that they have progressed recently (e.g. developing analytical methodologies for high risk CECs) will mean that if further funding becomes available they will be in a good position to monitor these high risk substances.

#### 4.4.2. Review of measures developed in Northern Ireland to address the substances of concern from Task 3

No specific information was made available on the measures that Northern Ireland are taking to address the substances identified in Task 3.

#### 4.4.3. Assessment of Gaps

No specific information was made available on the measures that Northern Ireland are taking to address the substances identified in Task 3 and so at present it isn't possible to assess Northern Ireland's approach to the regulation of these substances.

## 5. Principal project highlights

This project has aimed to bring together latest scientific information on chemicals in the water environment, focusing on emerging pollutants and those with significant new scientific insights. A summary of key findings is provided at the end of each of the project tasks, in sections 2 to 4. Principal highlights include:

### *Water quality stocktake*

- Review of literature identified a 'long list' of 195 chemicals of interest, which was then narrowed down to a shortlist of 74 key emerging substances and/or substances with significant new insights. These included, for example, macrolide antibiotics, microplastics, UV filters, NSAIDs and parabens.
- 25 factsheets were produced for selected emerging and new insights substances, in some cases grouped to facilitate gathering of information. Factsheets were also produced for nine key established pollutants for completeness, including nitrogen, phosphorus and PFAS.
- The current level of monitoring varies significantly between substances. There are significant knowledge gaps for many pollutants, for example with regards to their sources, the role of sediment sorption, risks of transformation products, endocrine disrupting properties, environmental and human health risk, the development of EQS and the effectiveness of wastewater treatment processes.

### *Risk assessment*

- Selected pollutants were taken forward for more detailed consideration by risk assessment to determine the extent, magnitude and future evolution of the risks posed to the aquatic environments of England and Northern Ireland. These were carbamazepine, climbazole, galaxolide, diclofenac, fipronil, bisphenol A and 1,4-dioxane.
- Substances were selected to ensure that there was a representative for each category of pollutant (i.e. pharmaceuticals, personal care products, industrial chemicals and EDCs) and on the basis of specific concerns highlighted in the factsheets.
- The qualitative risk assessments were based on a categorisation approach and the overall risk rating for a pollutant was described as 'low', 'moderate', 'high' or 'very high'.
- As these are emerging substances, they are not yet subject to regulation under the WFD regulations, and EQS have not yet been developed for them.
- 1,4-dioxane, an industrial solvent, and fipronil, an insecticide used in flea treatments for pets, were determined to present a very high risk to the aquatic environment in England and Northern Ireland. Fipronil is on the WFD watch list and the EA has identified the need to develop an EQS for both substances in its regulatory strategy for each substance.
- Galaxolide, a fragrance used in household products and bisphenol A, used in plastics and polymers were judged to pose high risks in both countries, whereas the pharmaceutical diclofenac was judged to present a high risk in England but a low risk in Northern Ireland based on significantly lower concentrations measured in water bodies in Northern Ireland. The EU have proposed an EQS for



diclofenac and the EA has identified the need to develop an EQS for both diclofenac and bisphenol A in its regulatory strategy for each substance. The EA's regulatory strategy for galaxolide includes the need to carry out further monitoring. Once additional monitoring data is available the regulatory strategy will be reviewed and this will inform the decision as to whether further measures, including EQS development, are required.

- Climbazole, a fungicide used in personal care products and carbamazepine, a pharmaceutical, were determined to present a moderate risk. EQS development is not yet proposed for these two substances.

#### *Delivery plans review*

- We reviewed existing delivery plans linked to water quality, considering a broad range of existing regulatory tools and consulting with relevant organisations.
- In England:
  - Overall, delivery plans with regards to nutrients appear comprehensive, particularly in protected areas. In catchments not designated as protected areas, there is less detail about specific locations where measures to reduce nutrient inputs should be implemented. In the RBMPs, specific measures to reduce nutrients are in general listed where they are associated with another wider initiative, such as habitat creation or natural flood management.
  - The legislation aimed at reducing the impact of nitrates on the water environment from the agricultural sector and the Farming Rules for Water are good tools to address nutrient inputs from this sector, though rely on sufficient resource to carry out farm inspections and assess compliance.
  - The Price Review process and WINEP provide a strong mechanism to address nutrients from the water industry sector. The picture is very different with regards to delivery plans for metals. There are only a small number of measures aimed at reducing pollution from metals within the RBMPs. Two key measures noted within the RBMPs address metals from abandoned mines and highways sectors. Although funding for measures is available under these programmes, no information on a strategic approach to addressing pollution from these sources was found.
  - The EA's process to developing regulatory measures to address emerging substances is robust and underpinned by a strong evidence-base. PEWS is a well structured process and the EA's internal process to develop regulatory measures provides a good evidence base of the decision making process. In some cases, the EA has indicated that there are not sufficient resources to implement all the measures identified by the above processes.
- In Northern Ireland:
  - Delivery plans are largely focused on nutrients and target both agricultural and wastewater sources. Measures are often generic and catchment-specific measures aren't always noted.
  - The Nutrients Action Programme and associated legislation is designed to address both nitrogen and phosphorus loads from the agricultural sector. The success of this measure is dependent on the sufficient resource to carry out farm inspections and assess compliance. The Price Control process provides a strong mechanism to address nutrients from the water industry sector, though the effectiveness depends on the funding that is allocated in each Price Control period.
  - Staff resourcing issues in NIEA meant that we received very limited information with regards to emerging pollutants in Northern Ireland.

## 6. Recommendations

Key recommendations arising from this work are as follows. We envisage these actions will be undertaken largely by the EA and Defra

#### *Water quality stocktake*

- Up until now, information on these significant emerging/new insight pollutants identified in this report has not been compiled. We were struck by the difficulty in locating information on certain substances, some of which carry potential significant environmental and/or health risks. It would be useful to explore options to

make some of the sources of information on these chemicals more user-friendly and accessible to a non-specialist, e.g. the EA WIMS and UK REACH database.

- Linked to the above, it would be useful to create a wider overarching database on emerging chemicals. This would need to be regularly updated to respond to the fast pace of technological and scientific developments in this area.
- Consideration should be given to expanding the factsheet repository produced for this project to further chemicals on the long list of pollutants identified in Section 2.

#### *Risk assessment*

- For most of the substances considered in the risk assessments, it is recommended that monitoring programmes are undertaken to address data gaps identified during this review. These monitoring requirements are substance-specific and outlined in Section 3 for each chemical.

#### *Review of delivery plans*

- It was difficult to collate information on all relevant delivery plans. For example, searches had to be undertaken in a variety of different sources and organisations (e.g. the main Government website for RBMPs, Natural England for SSSIs and SACs; while some relevant information remains unpublished). It would be very useful to have a publicly-available 'signposting document', explaining how delivery plans are inter-linked.
- The RBMP summary programmes of measures often present the measures at a high spatial level, and it is difficult to find information about where measures will be implemented at a local level or at specific locations of interest. We would recommend delivery plans, in particular the RBMPs, should present more detail of proposed measures at, for example, catchment or waterbody scale.
- We found little evidence of monitoring to track the effectiveness of many of the delivery plans. Generic water quality monitoring (e.g. for water body status) is carried out, but this cannot be used to measure the impact of individual measures. It would be useful to make the measures listed in delivery plans SMARTer (Specific, Measurable, Achievable, Realistic and Timely); and it would be beneficial to include a named delivery lead, information on how the effectiveness of the measure will be evaluated, information on how the delivery of the measures will be tracked, and record of what has been delivered and achieved each year.



# Appendices

# Appendix A. Stakeholder engagement

**Table A-1 - Details of stakeholder engagement held throughout the project**

Date	Meeting title	Location	Stakeholder/organisation engaged with	Purpose	Information received/other details
24/01/2023	Water quality stocktake catch-up with the Environment Agency	Teams	EA	Obtain information on existing data and delivery plans.	Received from the EA: comments on pollutant long list; detailed outputs from PEWS; regulatory plans for relevant substances; unpublished completed reports on some of these substances.
15/02/2023	OEP Water quality Stocktake project – EA / Atkins meeting	Teams	EA (Chemicals Regulatory Development Team)	Obtain information on EA's approach to regulation of emerging substances	<p>Presentation describing the PEWS process</p> <p>EA internal guidance: PEWS – Principles from screening to potential intervention.</p> <p>Information on the regulatory planning process for chemicals.</p> <p>Information on the specific regulatory measures that have been identified for the 9 substances considered as part of the risk assessment.</p>
17/02/2023	OEP Pollutant Stocktake – NIEA discussion	Teams	NIEA	Obtain information on existing data and delivery plans.	Multiple documents provided by NIEA
28/02/2023	OEP Pollutant Stocktake – NIEA discussion	Teams	NIEA	Review of NIEA's approach to monitoring and regulating emerging substances.	Feedback from Ray Thomas on Atkins' interpretation of NIEA's approach to monitoring.
02/03/2023	OEP Project Belisama Stakeholder event	Belfast	A number of stakeholders, including DAERA, NIEA, Ulster Wildlife, Northern Ireland Water, Ulster Farmers Union, Ulster Angling Federation.	Inform stakeholders and seek their view on this project.	Notes with key points from the meeting received from the OEP.
13/03/2023	OEP Project Belisama Stakeholder event	London	A number of stakeholders, including Natural England, Water UK, NGOs, academics.	Inform stakeholders and seek their view on this project.	Notes with key points from the meeting received from the OEP
22/03/2023	Discussion with NIEA	Email	Silke Hartmann (NIEA)	Request for meeting to understand NIEA/ DAERA's approach to regulating chemicals	<p>As DAERA representative was not available to speak to, DAERA provided the following documents:</p> <p>NIEA Industrial Pollution and Radiochemicals Inspectorate</p>



Date	Meeting title	Location	Stakeholder/organisation engaged with	Purpose	Information received/other details
				and emerging substances.	(IPRI) – Chemicals Team OEP Questions – response NIEA IPRI Chemicals Team – Chemicals and Industrial Pollution Governance and Stakeholder Groups.
14/04/2023 and 21/06/2023	EA	Email	Martin Flack, Kerry Simms (EA) and Alice Wilson McNeal	Comments on Draft of Section 4.3 of report.	Clarification on specific points in relation to EA regulatory measures
14/06/2023	NE	Email	Alice Kimpton (Natural England)	Comments on Table 4.2 of the report	Clarification on specific points in relation to SSSIs, SIPs; DWPPs and nutrient neutrality





# Appendix B. Notes on factsheets

## Disclaimer

Information included within the water quality factsheets is for reference only. The factsheets were produced in February and March 2023. The field of emerging pollutants is ever evolving, and information included within the factsheets may become outdated as new information becomes available. In cases where groups of pollutants are discussed, the information included within each category was only provided for the example pollutants where information was readily available.

This document provides a glossary of acronyms and technical language included within the factsheets and describes the core information and key references included within each category in the factsheets (

Table B-2, Table B-3, Table B-4 ). For a detailed methodology of pollutant selection, please refer to Section 3 of the report document.

**Table B-1 - Description of acronym and technical language used in the factsheets**

Technical language	Description
AA	Annual average
ANSES	French Agency for Food, Environmental and Occupational Health & Safety
Authorisation / Restriction	Authorisation (Annex XIV to REACH) – Process whereby substances are banned from being placed on market unless the company has been authorised to do so  Restriction (Annex XV to REACH) - Process to limit or ban the placing on the market or use of a substance; this can impose any relevant condition, such as concentration limits, requiring technical measures or specific labels.
Bioaccumulate	A chemical that can accumulate within the body of an organism. A substance is determined to be bioaccumulative if it meets certain criteria; for example those laid out in Section 1 of Annex XIII to the REACH Regulation.
Biodegradation	The breakdown of organic matter by microorganisms (e.g., bacteria and/or fungi).
Biomagnification	The process whereby a chemical increases in concentration as it transfers from lower levels to higher levels within a food web that results in a higher concentration in apex predators.
CAS numbers	A Chemical Abstracts Service (CAS) Registry Number is a unique and unambiguous identifier for a specific substance.
CIP	The UKWIR Chemicals Investigation Programme (CIP) brings together the water and wastewater companies in England and Wales with the various regulators to assess the discharge of chemicals in wastewater. The CIP is a collaborative programme in response to current and emerging legislation on trace substances in the water environment.
CLP	Classification, Labelling and Packaging
COPR	The Control of Pesticides Regulation
CoRAP	Community rolling action plan
ECHA	The European Chemicals Agency
Endocrine disrupter (ED/EDC)	Chemicals that interfere with hormones (the endocrine system) causing potential developmental, reproductive, brain and immune problems.
EFSA	European Food Safety Authority
ECHA	European Chemicals Agency
EQS	Environmental Quality Standard
Half life	The time taken for the concentration of a substance to reduce to half its original value.
INERIS	French National Institute for Industrial Environment and Risks

Technical language	Description
LC-MS and GC-MS	Analytical chemistry methodologies: Liquid chromatography-mass spectrometry (LC-MS) and Gas-chromatography-mass spectrometry (GC-MS).
LoD	Limit of detection.
LoQ	Limit of quantification
Mandatory/harmonised classifications	Mandatory classifications refer to UK regulations <sup>60</sup> , and harmonised classifications are based on EU regulations <sup>61</sup> .
Metabolites	A substance (by-product) formed during the breakdown of a substance by metabolic reactions.
Miscibility	The property of two substances to fully dissolve into each other, forming a homogenous mixture.
mg/L, µg/L, ng/L	Concentrations in milligram per litre, microgram per litre, and nanogram per litre.
PBT	Persistent, bioaccumulative and toxic
PHS	Priority hazardous substance
POP	Persistent organic pollutant
Persistent/ pseudo-persistent	Persistence is the length of time a contaminant remains in the environment. A substance is determined to be persistent if it meets certain criteria; for example those laid out in Section 1 of Annex XIII to the REACH Regulation.
Photolysis	A chemical reaction whereby molecules are broken down into smaller components through the adsorption of light
PNEC	Predicted no effect concentration. This is a value that has been derived for the protection of aquatic life, unless otherwise stated, PNEC values were obtained from the ECHA portal <sup>62</sup> and Norman Network <sup>63</sup> .
REACH and UK REACH	The European Union regulation for the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) addresses the production and use of chemicals substances and their potential environmental and human health effects.
Routine Monitoring	Monitoring conducted for a specific, usually regulatory, purpose using a compound specific method
Screening Monitoring	The Environment Agency uses gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS) analytical methods to screen individual water samples for a wide range of chemical compounds. The screening is performed against a library of containing pre-determined unique signatures for each compound listed in it.
Skin sensitiser	A substance that causes sensitivity when in contact with skin
STP	Sewage Treatment Plant

<sup>60</sup> [mcl-list.xlsx \(live.com\)](#)

<sup>61</sup> [Homepage - ECHA \(europa.eu\)](#)

<sup>62</sup> <https://echa.europa.eu/information-on-chemicals/registered-substances>

<sup>63</sup> [NORMAN Ecotoxicology Database \(norman-network.com\)](#)



Technical language	Description
SVHC	Substance of Very High Concern
vPvB	Very Persistent, Very Bioaccumulative
WFD	Water Framework Directive
WFD Watch List	A group of selected substances that must be monitored in the specified media for a period that should not exceed four years. After the period of continuous monitoring is completed, an evaluation is performed to assess the data and next steps
WwTW	Wastewater treatment works

The factsheets are split into three sections, and a summary of the type of information recorded in each sub-section is described below.

1. Core information about the pollutant (



2. Table **B-2**)
3. Summary of legislation, plans, strategies and synergies (Table B-3)
4. Quality of evidence and gaps in knowledge (Table B-4)



**Table B-2 Summary of the core information included about the pollutant or group of pollutants**

Description and example pollutants within group	<ul style="list-style-type: none"> <li>• A brief description of the pollutant/ group of pollutants</li> <li>• List of the examples pollutants included within the group</li> <li>• Chemical structure diagram and CAS number per pollutant were obtained from the ECHA website<sup>64</sup>.</li> </ul>
Pollutant classification	The group of chemicals that the pollutant belongs to, e.g., Pharmaceutical, Personal care products, Biocides, Veterinary medicines, Plants protection products, Industrial chemicals, Endocrine disrupting chemicals.
Primary source	<p>Tracing the pollutant to the primary producer (e.g., agriculture, industry, public) and identifying the source apportionment of the sources, where possible.</p> <p>Unless otherwise specified, the pollutants only exist because of human activity (xenobiotics).</p>
Potential ecological Impact	<p>Any known (or suspected) risks to the environment listed on the European Chemicals Agency (ECHA) websites<sup>64</sup> (harmonised classification) and reported in the wider literature.</p> <p>A classification is GB mandatory if it appears on the UK chemical classification list<sup>65</sup>.</p> <p>Where formal environmental quality standards are not available (see '<b>Current level of legislation/action</b>'), the predicted no effect concentrations (PNEC) will be included within this section.</p>
Potential human health effects	Any known (or suspected) risks to human health listed on the ECHA websites and reported in the wider literature.
Hotspots	Are there any hotspots of note with regards to the presence of this substance in the environment?
Persistence	<ul style="list-style-type: none"> <li>• How long after release into the environment is the substance likely to remain</li> <li>• What is known about the persistence of its decay by-products?</li> </ul>
By-products	<ul style="list-style-type: none"> <li>• Are there any by-products of note?</li> <li>• Are decay by-products more or less harmful than the parent compound?</li> </ul>
Current and emerging trends and states	<p>Detailing the typical/observed environmental concentrations of the pollutant from a range of sources, where available:</p> <ul style="list-style-type: none"> <li>• Routine Environment Agency (EA) monitoring</li> <li>• Chemicals Investigations Programme (CIP)</li> <li>• EA screening programme (via LC-MS or GC-MS analytical methods)</li> <li>• Academic studies</li> </ul> <p>Where information is available, this section will also discuss how and why the trends in state have changed over recent years (e.g., recent increase/decrease).</p>
Projected changes in	Detailing any projections for how concentrations of the pollutant may change in the future, e.g., due to population increase, changing land use patterns, increased agricultural practice or climate change substance bans.

<sup>64</sup> <https://echa.europa.eu/search-for-chemicals><sup>65</sup> [mcl-list.xlsx \(live.com\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61441/mcl-list.xlsx)

trends and states	
Relationship with other pollutants/ pressures	<p>Detailing any correlations observed between the pollutant and other substances, or any potential interactions with other chemicals present in the environment, where identified.</p> <p>In several cases no relationships were identified, however this does not mean that relationships do not exist</p>

**Table B-3 Summary of information included in the ‘legislation, plans, strategies and synergies’ section**

Current level of legislation/action	Detailing the current level of legislation/ action relating to those pollutants (or members of the pollutant group). In some cases there are numerous national and international legislations for a given substance. This section will consider several main sources of action/legislation:	
	Legislation	Relevance to *insert pollutant name*
	The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) <sup>66</sup> , which was transposed by the WFD Regulations (2017) <sup>67,68</sup> . The standards for Priority Substances are included within the 2015 WFD Directions (England and Wales <sup>69,70</sup> ) and Regulations (Northern Ireland <sup>71</sup> ).	<p>Detailed in the factsheet if the pollutant (or which pollutants within the group) are covered by these legislations.</p> <p>At the time of writing (May 2023), there is general alignment between the EU EQS values and those included in The Water Environment (WFD) Regulations (England and Wales/Northern Ireland) (2017). However, the direction of EQS development in England and Wales/ Northern Ireland may differ from the EU standards in the future.</p>
	EU Water Framework Directive (WFD) Watch List	<p>Detailed in the factsheet if the substance(s) are listed on any of the WFD Watch List:</p> <ol style="list-style-type: none"> <li>1. First Watch List (2105)<sup>72</sup></li> <li>2. Second Watch List (2018)<sup>10</sup></li> <li>3. Third Watch List (2020)<sup>73</sup></li> <li>4. Fourth Watch List (2022)<sup>74</sup></li> </ol>
	EU REACH (Registration, Evaluation, Authorisation and restriction of Chemicals) (Regulation EC 1907/2006 <sup>75</sup> ).	Detailed in the factsheet if the pollutant is registered in the European Union REACH regulation (2007) (REACH status for each substance obtained via the ECHA website <sup>64</sup> )
UK REACH (the REACH (Amendment) Regulations 2023 (draft) <sup>76</sup> ).	<p>Detailed in the factsheet if the substance is included under UK REACH regulation (2021), with reference to the following lists:</p> <ol style="list-style-type: none"> <li>1. Candidate list of substances of very high concern (SVHC) for authorisation<sup>77</sup></li> </ol>	

<sup>66</sup> DIRECTIVE 2008/105/EC of the European parliament and of the council. Available at: [untitled \(europa.eu\)](#)

<sup>67</sup> [The Water Environment \(Water Framework Directive\) \(England and Wales\) Regulations 2017 \(legislation.gov.uk\)](#)

<sup>68</sup> [The Water Environment \(Water Framework Directive\) Regulations \(Northern Ireland\) 2017 \(legislation.gov.uk\)](#)

<sup>69</sup> [The Water Framework Directive \(Standards and Classification\) Directions \(England and Wales\) 2015 \(legislation.gov.uk\)](#)

<sup>70</sup> [Surface water pollution risk assessment for your environmental permit - GOV.UK \(www.gov.uk\)](#)

<sup>71</sup> [The Water Framework Directive \(Priority Substances and Classification\) \(Amendment\) Regulations \(Northern Ireland\) 2015 \(legislation.gov.uk\)](#)

<sup>72</sup> [Review of the 1st Watch List under the Water Framework Directive and recommendations for the 2nd Watch List - Publications Office of the EU \(europa.eu\)](#)

<sup>73</sup> [Selection of substances for the 3rd Watch List under the Water Framework Directive - Publications Office of the EU \(europa.eu\)](#)

<sup>74</sup> [Selection of substances for the 4th Watch List under the Water Framework Directive - Publications Office of the EU \(europa.eu\)](#)

<sup>75</sup> Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). Available at: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32006R1907>

<sup>76</sup> The REACH (Amendment) Regulations 2023 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/ukdsi/2023/9780348247329>

<sup>77</sup> [candidate-list.xlsx \(live.com\)](#)

	2. Authorisation list (SVHC) <sup>78</sup>
Drinking water limits defined by the UK Drinking Water Standards and Regulations (Drinking water Inspectorate) <sup>79</sup> under the Water Supply (Water Quality) Regulations 2016 (England and Wales) <sup>80</sup> and the Water Supply (Water Quality) Regulations 2017 (Northern Ireland) <sup>81</sup> .	Detailed in the factsheet if the substance is listed on the Drinking Water Inspectorate <sup>82</sup>

In some cases, specific additional legislation such as drinking water limits or food intake guidelines may also be mentioned (e.g., for plant protection products and biocides).

Furthermore, this section will summarise standards for acceptable limits, including where available/applicable Environmental Quality standards (as listed in the WFD regulations listed above) for freshwater, marine water, groundwater and biota.

Mitigation methods	Detailing any mitigation methods (practical or legislative) currently employed (or proposed) to tackle this emerging pollutant.
Trade-offs/synergies towards reducing each water quality issue	Any potential mitigation collaborations (or conflicts) with improving other water quality issues.
Trade-offs/synergies with climate change actions	Any proposed climate change actions likely to have implications for reducing (or increasing) the pollutant.

**Table B-4 Information included in the ‘Quality of evidence and gaps in knowledge’ section**

<b>Quality of evidence</b>	<p>This section will detail the source and quality of information available about each pollutant (e.g., measurability, data availability). It will consider a range of sources, with varying degrees of quality:</p> <ul style="list-style-type: none"> <li>• Routinely monitored/regulated in England/Northern Ireland</li> <li>• Included in the CIP</li> <li>• Evidence on the ecological and human health effects available through in REACH</li> <li>• Included in and Environment Agency semi-quantitative screening programme</li> <li>• Evidence available from academic studies</li> </ul>
<b>Data availability</b>	<p>This section will summarise the data availability for each pollutant, including several key sources:</p> <ul style="list-style-type: none"> <li>• Routinely monitoring in England/Northern Ireland</li> <li>• The CIP</li> <li>• Environment Agency screening programme</li> </ul>

<sup>78</sup> [authorisation-list-annex-xiv.xlsx \(live.com\)](#)

<sup>79</sup> Drinking Water Standards and Regulations - Drinking Water Inspectorate (dwi.gov.uk). Available at: <https://www.dwi.gov.uk/drinking-water-standards-and-regulations/>

<sup>80</sup> The Water Supply (Water Quality) Regulations 2016 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2016/614/contents>

<sup>81</sup> The Water Supply (Water Quality) Regulations (Northern Ireland) 2017 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/nisr/2017/212/made>

<sup>82</sup> [Drinking Water Standards and Regulations - Drinking Water Inspectorate \(dwi.gov.uk\)](#)



- Academic literature

**Gaps in knowledge**

Gaps in knowledge identified by others or inferred from this review.



# Appendix C. Factsheets

Provided as a separate folder.





# Appendix D. Risk assessments

Provided as a separate folder.



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