UK Technical Advisory Group

Proposed Biological and Environmental Standards for River Basin Planning

Consultation Document

May 2019

Water
Framework
Directive
UK TAG

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1. Introduction

1.1 The UK Technical Advisory Group (UKTAG) develops and makes recommendations to the UK's government administrations on the environmental and biological standards for implementing the Water Framework Directive (WFD). These values are used for classification and setting management thresholds to prevent deterioration and driving restoration. UKTAG is a working group of experts drawn from environment agencies and conservation agencies including Natural Resources Wales (NRW), Environment Agency (EA), Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency (NIEA), Natural England (NE), Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC). It also includes representatives from the Republic of Ireland.

1.2 The group also offers advice to the agencies that provide its members.

1.3 In using the term “standard”, UKTAG means numerical limits on things like the concentrations of chemicals, river flow or water levels, or measurements for biological communities. In some cases a failure of a standard leads directly to firm action on protection. In others, a failure leads only to further investigation and monitoring

1.4 Proposals for standards were first published in 2007 and 2008. These were adopted for the first cycle of the Directive’s river basin management plans. A further set of new and updated standards were published in 2012. River basin plans were published in 2009 and 2016. The standards help focus efforts to improve and protect the water environment.

1.5 This document contains proposals for new and revised standards. The proposals are seen as sufficiently developed to help with the third cycle of plans.

1.6 As understanding improves, any standard can be revised. UKTAG’s role is to look at the evidence. This can lead to proposals that are tighter or more relaxed than current standards.

1.7 As part of the review of its proposals, UKTAG welcomes your comments via its website: https://www.wfduk.org/stakeholders/uktag-standards-consultation-may-2019.

1.8 Once UKTAG has reviewed and taken account of the feedback received through this consultation a final report will be sent as advice to the UK’s government administrations, and statutory environment agencies and conservation agencies.

1.9 The approach to the adoption and implementation of proposals can vary for each country within the UK, depending on present and proposed legislation, and on policy in each country. This is for Ministers to decide.

Scope of the report

1.10 This document includes information on:

- standards for flows in rivers.
- non-native species.
- standards for nitrogen in lakes.
- fish communities in rivers.
- standards for emamectin benzoate.
- standards for river acidity.

1.11 The standards recommended:

- are matched correctly to processes of monitoring and mathematical modelling;
- allow a proper assessment of compliance;
- lead to sound and transparent methods for taking decisions to protect and improve the water environment.

1.12 This report does not describe all the details of these three activities. This is done by the individual agencies and countries, within the requirements of the Water Framework Directive.

1.13 Consultations on updates to the current river fish barrier method and river morphology system (MIMAS) used in Scotland, and a new lake fish method are expected to be held later in the summer.

The Water Framework Directive

1.14 The Directive establishes a legal framework for setting objectives for rivers, lakes, groundwater, estuaries and coastal waters. The objectives are set for each "water body" and expressed in terms of "status". The objectives include:

- prevent a deterioration in status.
- restore to "good status" where proportionate and feasible to do so.

1.15 Alternative objectives can be set, for example, if the measures that achieve Good status by 2015 would be technically infeasible or disproportionately expensive. In such cases, the WFD allows an extension to the timetable, or, subject to review every six years, an objective that is less stringent than Good status.

1.16 Certain uses of water, such as navigation, flood defence and the generation of hydropower, might lead to and depend on physical alterations to a water body. These can be incompatible with Good status. Such waters can be defined as Heavily Modified Water Bodies. Objectives are set for these waters that can be met without having a significant effect on the uses that led to the designation of "Heavily Modified".

The role of standards

1.17 Standards are matched to the objectives of the Directive. The environment agencies use standards to suggest, for example, limits on the amount of water that can be abstracted, and restrictions on how much pollutant can enter the environment. In this way, the environment agencies assess and control, for example, the impact of industries and the effects of land use.

1.18 A new discharge will not be allowed, for example, to cause the concentration of a pollutant to increase in a water body up to the limit defined by a standard for the water body. In practice, less than this is authorised. The decision on how much of a pollutant can be discharged or how much water can be abstracted is taken in the context of long term plans for development, and will address the requirements of the legislation in terms of caution or exceptions.

1.19 Where standards are met, the agencies seek to prevent new developments from causing a future deterioration of status. They do this by limiting, for example, how much of a pollutant can be discharged, so that environmental standards are not breached in future.

1.20 In cases where a standard has already been failed, there are a few ways in which standards are used to make decisions:

- prevent a deterioration in status.
- directly: In this case there is no need, for example to collect and assess local data on biology to confirm that there is damage – the standard is such that the risk is clear once it is failed.
- indirectly: This applies where there is less confidence that failure of the standard is always associated with harm. We need to examine whether a water body is actually damaged by the failure. We check, for example, for the absence of key species, the occurrence of nuisance species, or do calculations using mathematical models to confirm a link between the failure and the damage.

1.21 Action to improve or protect the condition of the water environment may take at least two forms:

- Calculate local and bespoke controls, in order to meet a standard in a particular water body.
- Apply uniform controls across all operators of a certain type or size. This constitutes a step that benefits all water bodies in a region or nation – a step that can be reduced or extended once its impact is demonstrated.

Assessing compliance and confidence

1.22 In most cases, data from monitoring are used to make a comparison with the standard. In others, calculations with mathematical models are also used to assess whether a standard is passed or failed. The output from such data or models will always be associated with uncertainty.

1.23 UKTAG requires that such errors can be and are quantified, and that they can be used in all assessments of compliance. This allows a general facility to state the confidence that any standard has been met or failed.

1.24 The Directive expects us to know and report these levels of confidence. They help decide the amount of monitoring required to detect particular levels of failure or deterioration. The confidence that the standard has been failed or met is also important in deciding action to secure compliance or prevent deterioration.

1.25 In many cases where a standard is used to assess compliance, the same standard plays a direct part in designing action to achieve compliance or prevent deterioration. Within the process of deciding action to remove failure, the advice of UKTAG is often that that standard be used in a way that demands more statistical confidence than might have been used to assess the reported failure in the first place.

1.26 For some standards action may also be deemed to require extra corroboration such as that provided by biological and chemical evidence that both point to the same damage or risk. Lack of such corroboration may indicate that action should be postponed.

1.27 The net result is that initial assessments of compliance can indicate more failure than will justify eventual action.

Classification

1.28 The term “Good status” has already been noted. Surface water bodies are assigned to one of five classes: High, Good, Moderate, Poor or Bad status. To assign a class, the UK agencies start by assessing the condition of communities of plant and animals. The achievement of environmental standards for things like chemicals is also taken into account. For example, if a water quality standard identified for Good status is not met, the status will be Moderate or worse.

1.29 The Directive requires that the overall status of the water body is determined by the lowest status from all the standards that have been assessed. This is known as the ‘one out – all out’ rule. To have High status, for example, a water body cannot fail any of the standards associated with High status.

1.30 The use of the one-out all-out rule means that numbers expressed in terms of the percentage of water bodies in Good or better status have a strong pessimistic bias. This error is caused by the largely unavoidable uncertainties in monitoring. These generate a risk of declaring wrongly that a standard is passed or failed.

1.31 To help minimise this bias, UKTAG recommends that in cases where a pressure can be measured in several ways, only the single most sensitive indicator is used in classification. It also recommends that, in reporting results, emphasis is given to reports of the separate assessments of each type of impact on water bodies (for example, the effect of abstractions; impact of pollution by nutrients; etc.) rather than to summaries that combine all assessments across all the impacts.

River Basin Management Plans

1.32 The environment agencies will produce drafts for the third cycle of river basin management plans and issue them for public consultation by the end of 2020. To prepare the plans, the agencies estimate the shortfall in meeting the standards established for the Directive's objectives. The agencies use monitoring and assessment, targeted at risk, and focused on the causes of these risks. They seek to calculate what needs to be done to achieve the standards.

1.33 All contributions to current or potential failure are considered. This means looking at water quality, water quantity, and the impact of man-made structures. It involves checking the contributions from groundwater to the failure of standards in rivers, lakes and wetlands. It means looking at the effect of physical changes to water bodies, at the impact of current and future abstractions and discharges, and at contributions from the uses made of land. These pressures can occur on their own, or in combination at times leading to synergistic effects between these pressures.

1.34 The agencies, in partnership with others, appraise options to meet the objectives and identify the most cost-effective combinations of actions. The plans are also subject to "regulatory impact assessment" and "strategic environmental assessment", where appropriate. These cover estimates of the full costs and benefits and who will pay and receive these.

Protected Areas

1.35 Member States must also meet objectives that originate in legislation outside the Water Framework Directive. Such legislation can lead to the definition of waters as various types of "protected area". Where this means that a water body has more than one objective, the most stringent requirement applies. The context of the particular legislation can dictate the eventual action.

1.36 As well as protecting and improving the status of water bodies, river basin management planning is intended to help secure the achievement of the objectives for protected areas. These include areas designated for the conservation of habitats and species, such as Special Areas of Conservation, where the maintenance or improvement of the status of water is an important factor in their protection.

1.37 The conservation agencies set conservation objectives for Natura 2000 sites (designated under the Birds or Habitats Directives for species or habitats of importance at European level) and other Sites of Special Scientific Interest. These objectives are underpinned by targets which are used in reporting and to guide decision-making on designated sites. The targets are based on a Common Standards Monitoring Guidance which is agreed across the conservation agencies.

1.38 UKTAG examined the evidence used to develop Common Standards for a number of parameters (river flow, organic determinands and nitrate in wetlands) with the aim of aligning, where possible, standards for WFD and Natura 2000 Protected Areas. This work is still ongoing and, as a result, proposals for Natura 2000 sites are not included within this consultation. The indications are that some of the standards recommended for protecting the status of water bodies could also apply in the context of Natura 2000.

Deriving standards

1.39 UKTAG seeks standards that apply to all water bodies of the same type. It wants standards that can lead to and make use of sound monitoring programmes and so produce unbiased estimates of compliance and national performance. These help take decisions to improve and protect waters, decisions that are well-targeted and which can be shown not to be wasteful.

1.40 In developing some of its standards, UKTAG may be able to use biological data collected from hundreds or thousands of sites. UKTAG can compare these with information for the same sites on the environmental conditions to which the plants and animals are sensitive. This process can identify standards that correspond directly with the biological definition of Good status. Such standards are well matched to the objectives expanded in the preceding paragraph – produce sensible estimates of compliance and lead to good decisions.

1.41 In other cases, in estuaries and coastal waters for example, and generally for pollutants not subject to big programmes of monitoring, there are insufficient data to derive standards in this way. In such cases, UKTAG uses the current scientific understanding of the causes of ecological change. UKTAG compares this understanding with the Directive's biological descriptions of the classes. In doing this, UKTAG relies on advice from independent experts from a range of scientific disciplines. UKTAG has used this approach to identify limits for river flow and water levels, and for standards for particular chemicals.

Revising the standards

1.42 Existing standards may need to be revised for two main reasons:

- Biological standards have changed. The UK works with Member States, and with the European Commission, to compare methods of biological classification. This is known as inter-calibration. The aim is to ensure that the boundaries of Good status are consistent across Europe and within the Directive's requirements. The results of inter-calibration may lead to new or revised biological standards. To achieve these may require that new or revised environmental standards are developed for water quality, water flows or levels, or morphological characteristics of water bodies.
- Improved scientific understanding. Environmental standards are also revised where improved understanding through research and monitoring, or the benefit of experience in their practical application, shows that existing standards are not as well matched to ecological quality as they could be.

2. River flows

2.1 UKTAG has developed recommendations on proposed changes to the standards for river flows [1, 2] for introduction in the third cycle of WFD River Basin Management Plans. The recommendations are consistent with the relevant EU Common Implementation Strategy guidance [3] and propose:

a) a revision to the river flow standards defining High status and
b) a revision of the standards for Good status to allow for a short term exceedance from the thresholds set for classification provided that a number of tests are met. This chapter describes these proposed revisions, together with contextual information and a high level assessment of the implications for classification of river water bodies. Further technical details are provided in Annex A.

Questions/ invitation for comments

Prior to making recommendations on the standards to UK government administrations, views from stakeholders are sought on the following:

Q1. Do you support the proposals to revise the definition of High status water bodies to include set limits for artificially elevated flows? If not please explain why, together with any supporting evidence.

Q2. Do you support the proposals to take account of short-term abstraction in classification? If not, please explain why together with any supporting evidence.

Q3. Are you content that the approach taken to revise the standards agrees with relevant EU guidance?

Background

2.2 River flow standards were recommended in the first report from UKTAG on environmental standards and conditions (2008)[1], with subsequent review and revisions in 2009 and 2013. The standards for river flows were developed from work undertaken by SNIFFER project WFD48 and were developed in order to assess the risk to ecological status posed by alterations in flows across the flow regime.

2.3 Environmental standards for flows have been defined for all five ecological status classes although, under the WFD, hydrology is stipulated as a determinant of ecological status only at High status. For other status classes, hydrology can be used as a supporting element.

[1] The Environment Agency uses the Environmental Flow Indicator, derived from the flow standards.

2.4 The current flow standards are in the form of a series of limits of allowable reduction from natural flows (essentially abstraction limits) at a range of flow conditions (flow percentiles, as defined by a flow duration curve). The limits vary according to river type. The standards for Good status also vary by season. These standards apply on an instantaneous basis i.e. any breach constitutes a failure.

2.5 UKTAG recognised that additional evidence has been amassed since the last review. The next cycle of river basin plans offers an opportunity to consider how this evidence might be taken into account within the current flow standards.

2.6 The review looked at scientific developments since UKTAG made its previous recommendations and was informed by a number of projects. The criteria for this review are set out in Annex A.

Findings of the review

2.7 UKTAG concluded that there is no new quantitative information that can be used to refine the standards for low flows, in terms of the magnitude of the abstraction limits. Consequently, UKTAG proposes no changes to its current recommendations on standards for flow thresholds for Good status.

2.8 In contrast, UKTAG did conclude that there is a need to revise its recommendations on flow standards for High status to incorporate evidence of impact on the ecology from artificially increased flows. In addition, UKTAG considered that there was sufficient evidence to support a revision of standards for Good status to allow for a short term deviation from the thresholds set provided that a number of tests are met.

Ecological responses to artificially increased flows

2.9 Some waters have flows that are significantly increased over the natural position due to the transfer of water into the catchment. This happens if water from one catchment is transferred to a different catchment.

2.10 It has been known for some time that, conceptually at least, persistent artificially increased flows could impact ecological health due to the reduction in low flow disturbance events and loss of habitat variability [4, 5 for example]. In the period since the existing flow standards were developed, there has been growing evidence from the UK to support the theory that augmented flows arising from additional flow from discharges (from reservoirs or treated effluent) or water transfers may have a detrimental impact on riverine ecology.

2.11 An Environment Agency commissioned report [6] analysed macroinvertebrate data linked to flow alteration data from over 3,500 monitoring sites across England, Wales and Scotland. This dataset covered reduced, natural and artificially increased flows. Sites with poor water quality which might override the relationship between the macroinvertebrate community and flow alteration were excluded from this data set. Results showed a clear negative impact of persistently elevated flows on macroinvertebrate scores. More detail on these results can be found in Annex A.

Recommendations

2.12 Evidence presented in Annex A suggests that persistent artificially increased flows have a negative impact on river macroinvertebrates. Under WFD, High ecological status is defined as near naturalness associated with no or very low human pressure. Consequently UKTAG believes that that the High hydrological status thresholds should take account of persistent artificially elevated flows in addition to the current limits on flow from abstraction pressures.

2.13 UKTAG recommends that the existing flow standards for High hydrological status are amended to include an upper threshold of 5% deviation above natural at flow less than or equal to Qn95. This mirrors the thresholds for flow reduction for High status. Details are shown in Table 2.1.

Table 2.1
Recommended revisions to the "High" standards for river flows

	Permitted maximum as a proportion of natural flow			
	At daily flows (Qn) less than Q95		At daily flows (Qn) greater than Q95	
River Type	Existing standards	**Proposed revision**	Existing standards	**Proposed revision**
ALL	-5%	+/- 5%	-10%	+/- 10%

- No changes are proposed to the existing standards for daily flows for Good status

2.14 This proposal brings greater alignment with the WFD normative definition for High status, for which the quantity and dynamics of flow should reflect totally, or nearly totally, undisturbed conditions. It also brings greater alignment with the Common Standards Monitoring Guidance (CSMG) used for condition assessment of river sites with conservation designations. This specifies flow targets in the form of percent deviations from natural flow, which includes artificial increases.

2.15 Whilst artificially increased flows would not be part of the standards for less than High, UKTAG recommends that the impact of these flows should be considered when confirming Good status or determining what action is required to address water bodies at less than Good status.

2.16 The above recommendations do not apply to Heavily Modified Water Bodies (HMWBs). Separate guidance is provided on river flows for HMWBs [7]. UKTAG recommends that this guidance is revised to take account of the evidence provided that artificially elevated flows have an adverse impact on river ecology whilst ensuring that measures associated with flow augmentation for conservation purposes are not compromised

Implications of proposals

2.17 In general terms, as hydrology is a defining element for overall High ecological status (HES), any changes resulting in a change from High to Good hydrology would result in a deterioration in overall status class where a water body is currently classed at HES.

2.18 Each agency has considered the implications of these changes based on their current approach. There are very few water bodies currently classed at HES which have a significant volume of water transferred into them. Consequently the impact of these proposals on classification is very low with an indicative number of two water bodies deteriorating in overall class.

Short-term abstraction

2.19 The current flow standards are in the form of a series of limits of allowable reduction from natural flows at a range of flow conditions. However, this takes no account of the duration of an abstraction, nor how frequently it occurs. This means that an abstraction that breaches a standard for a few days once a year is treated the same as one causing a continuous breach; the same limits apply to both.

2.20 River animals and plants have evolved to live under a highly variable flow regime. This includes short-term periods of naturally low flow, which animals and plants are expected to be better adapted to than longer term events. To investigate whether this is indeed the case UKTAG commissioned a review of evidence of the impacts of short-term flow reductions on river ecology [8].

2.21 For flow reductions lasting less than one month, impacts on aquatic life forms were found to be low, provided some flowing water remains in the channel. Fish and invertebrates will move from areas where habitat is lost, or becomes unfavourable, to more favourable areas, such as deeper pools, or into river bed gravels. Whilst this may lead to increased densities and potentially greater predation the evidence suggests that there is generally no change to the range of species present during these shorter flow impacts. The exception to this is where the low flows result in a loss of connectivity, with the appearance of isolated pools. Under these conditions significant ecological impacts can arise quickly.

Recommendations

2.22 UKTAG recommends that a temporal element is applied to the flow standards, such that, depending upon frequency and duration, short-term exceedances might not result in a deterioration in class. The magnitude of allowable exceedance would depend on both the duration of, and typical interval between, exceedances. This accounts for the resilience of aquatic ecology to short low flow events but also the need for a recovery period.

2.23 The proposed allowable exceedances would apply across all flows above Qn98, provided that longitudinal connectivity of the water environment in the river channel is maintained. However, the likelihood of short-term abstractions occurring, as well as the likely scale of their impact, are greatest at low flows.

2.24 The proposed allowable exceedances only apply to flow deviations that meet the poor standard or above or where natural flows exceed Qn98 (these are exceptionally low flows where the risk of a disruption in the longitudinal wetted channel connectivity is high). Deviations greater than the Poor standard can potentially cause significant ecological impacts after even a short duration, especially where habitat fragmentation or dewatering occurs. For this reason, these revisions do not apply to flow deviations that exceed the existing Poor standard, whatever the duration of exceedance.

2.25 Table 2.2 shows a matrix of allowable flow standard exceedances for short-term flow reductions. An allowable exceedance means Good or High hydrology status can be confirmed even if the threshold for Good status is exceeded (within the given time constraints) if the water body is at Good or High hydrology status prior to the low flow event, or if hydrology is at less than Good status pre low flow event, it will inform deterioration risk to a lower class. Exceedances are not permitted, i.e. current standards continue to apply, where:

- the standard for Poor is exceeded, or
- an exceedance lasts more than twenty days, or
- exceedances typically occur more frequently than once every two months, or
- the natural daily mean flow is below Qn98.

Table 2.2

Revised classification accounting for short-term flow deviations

Median interval between abstraction events - select as appropriate	>3 years					≤3 years to >1 year					≤1 year to >2 months				
Abstraction event reducing flow to H/G/M/P/B - select as appropriate	H	G	M	P	B	H	G	M	P	B	H	G	M	P	B
Abstraction Event Duration (days):								**Revised class**							
>10 to ≤20	H	G	G	M	B	H	G	M	P	B	H	G	M	P	B
>5 to ≤10	H	G	G	M	B	H	G	G	M	B	H	G	M	P	B
≤5	H	H	G	G	B	H	G	G	M	B	H	G	G	M	B

Note: look up event interval, magnitude (class) and duration to find revised class

2.26 The revision allows an increasing degree of exceedance of the current standards as flow reduction events become shorter and less frequent. For example, an event of a magnitude that breaches the existing Moderate standard (i.e. Poor class) which occurs typically between one and six times per year (interval 2 months to ≤1 year) and lasts up to five days would still meet the Moderate short-term standard.

2.27 The allowable exceedances would mean that, where the frequencies and durations of abstraction events are small, a higher class than permitted by the current standards may be assigned. This would apply to the water body (not an individual abstraction) and would need to take account of any cumulative effects from multiple abstractions, as well as effects on flow on any downstream water bodies. Normal classification spatial rules would apply.

Implications of proposals

2.28 Hydrology is used as a supporting element of the classification of Good ecological status across the UK as a whole. As such, these changes would potentially change the way ecological evidence of a failure of Good status is interpreted where there are short-term abstractions i.e. whether the ecological class of less than Good status is due to a water resource pressure.

2.29 In the absence of ecological classification metrics sufficiently sensitive to water resource pressures, the environmental flow standards have been used in Scotland as an element to indicate ecological status of Moderate, Good and High. A hydrology class of Poor (or Bad) is only assigned where evidence from ecological indicators confirms ecological impact equivalent to Poor (or Bad) status. The impact of the proposed change will be on water bodies in Scotland currently assigned a class of Moderate or Good for hydrology due to the influence of intermittent abstractions, typically for irrigation. It is estimated that up to 20 water bodies impacted by short-term abstractions could change class from Moderate to Good status as a result of these changes.

References

[1] SNIFFER WFD 48: Development of Environmental Standards (Water Resources) Stage 3: Environmental Standards. March, 2006: http://www.sniffer.org.uk/project-search-results.aspx?searchterm=wfd48

[2] UKTAG (2008); UK Environmental Standards and Conditions (Phase 2); Final (SR1 – 2007); March, 2008: https://www.wfduk.org/sites/default/files/Media/Environmental%20standards/Environmental%20standards%20phase%202_Final_110309.pdf

[3] WFD CIS (2015). Ecological flows in the implementation of the Water Framework Directive: Guidance Document No. 31. ISBN 978-92-79-45758-6. https://circabc.europa.eu/sd/a/4063d635-957b-4b6f-bfd4-b51b0acb2570/Guidance%20No%2031%20-%20Ecological%20flows%20%28final%20version%29.pdf

[4] Richter B.D., Baumgartner J.V., Powell, J. & Braun, D.P. (1996). A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10:1163-1174.

[5] SNIFFER: WFD21d. Ecological indicators of the effects of abstraction and flow regulation; and Optimisation of flow releases from water storage reservoirs: http://www.wfduk.org/stakeholders/stakeholder-review

[6] Macroinvertebrate response to flow alteration: does it vary by river type? 2018. WRc.

[7] UKTAG River Flows for Good Ecological Potential 2013.

[8] Literature review of short-term flow reduction ecological impacts and recovery: R16115QQ. APEM/SEPA 2017.

3. Invasive Species List

3.1 This section describes UKTAG's proposed revisions to its recommendations on invasive non-native (alien) species. An alien species is defined by the International Union for Conservation of Nature and Natural Resources as a species introduced “outside its normal past or present distribution”. “Invasive” alien species are those which “threaten ecosystems, habitats or species with environmental or socio-economic harm.” [1]

3.2 There are no changes to the methods of using alien species within WFD classification within this consultation. It is only the list of high impact species that we recommend should change.

Questions/ invitation for comments

Q4. Are there any invasive non-native species not included on the high impact list that may pose a significant risk to the water environment, and what are the reasons for this view?

Background

3.3 UKTAG's existing guidance places invasive non-native species in Great Britain (GB) on one of four lists – high impact, moderate impact, low impact, or unknown impact - in relation to the risks they pose to the water environment. A separate list containing only high impact species is compiled for Northern Ireland and the Republic of Ireland. [2]

3.4 The effect on the ecological quality of waters in which a high impact alien species is established is expected to be more than very minor. This means the waters cannot be classed as in High ecological status and may be classified as less than Good where the established species causes a more than a slight adverse impact on the structure and functioning of the ecosystem. [3]

3.5 The high impact species list used within classification is fixed at the start of each river basin planning cycle and published in the standards documents and directions. However, the impact lists are regularly updated. Species may arrive in the country and hence be added, and species may move between impact classes on the basis of new evidence or observations. High impact species arriving between cycles are flagged as ‘waiting list’ species in preparation for inclusion in classification in the next river basin planning cycle.

3.6 The full listings across all impact categories are intended to help prioritise efforts to:

- monitor and assess risks.
- prevent or contain introductions.
- attempt eradication.

It is important to note that the WFD impact lists are not a comprehensive list of all aquatic alien species, or of all alien species that may impact aquatic ecosystems.

3.7 Decisions on the appropriate listing for an alien species are based on the ecological impacts reported in risk assessments coordinated by the Great Britain Non-native Species Secretariat (GBNNSS) for the GB list [4] and Ireland Risk Assessments for the Ecoregion 17 list [5]. Where risk assessments are in raft, absent, or there is evidence to justify a divergence from the risk assessment, available evidence and expert judgement has been used to assign species to impact categories.

Recommendations

3.8 We recommend that high impact species that have arrived or been discovered since 2015 are added to UKTAG list. There are a number of new or updated risk assessments since 2015 which resulted in a change to our understanding of the ecological impact of existing species. We recommend that those changes are also accounted for in the UKTAG lists.

3.9 Annex B contains the full UKTAG high impact lists including the proposed changes and additions.

GB changes to the high impact list

3.10 Addition of new arrivals/discoveries since 2015 to the high impact list:

- *Dreissena rostriformis bugensis.*
- *Myriophyllum hererophyllum.*
- *Rangia cuneata.*
- *Hemigrapsus sanguineus.*
- *Hemigrapsus takanoi.*
- *Homarus americanus*.

3.11 Addition to the high impact list following risk assessments or new evidence:

- *Azolla caroliniana.*
- *Ludwigia peploides.*
- *Lysichiton americanus.*
- *Gunnera* spp.
- *Persicaria wallichi.*
- *Undaria pinnatifida*.

3.12 *Elodea nuttallii* remains on the high impact list. *Elodea canadensis* has been moved to the moderate list following risk assessment.

3.13 Note that other species have been moved to the low and moderate lists following risk assessment or new evidence. These are not included in the consultation as they do not directly impact on classification and will be published with the final cycle 3 lists following this consultation, but are included for reference in Annex B.

Ecoregion 17 (Northern Ireland and the Republic of Ireland) changes to the high impact list

3.14 The high impact list has been consolidated into a single list, rather than one split by water body type.

3.15 Addition to the high impact list following risk assessment and expert judgement:

- *Gunnera* spp.
- *Cyprinus carpio.*
- *Rutilus rutilus*.

3.16 Removal of the following species from the high impact list as they are now considered to have been eradicated in ER17:

- *Leuciscus cephalus.*
- *Ludwigia grandiflora.*
- *Eriocheir sinensis.*

References

[1] McNeely JA, Mooney HA, Neville LE, Schei PJ, Waage JK. (eds). (2001). Global Strategy on Invasive Alien Species. International Union for Conservation of Nature and Natural Resources, Gland.

[2] WFD UKTAG (2015). Revised classification of aquatic alien species according to their level of impact. https://www.wfduk.org/resources/classification-alien-species-according-their-level-impact-revised-list.

[3] WFD UKTAG (2014). Aquatic Alien Species. ISBN: 978-1-906934-55-2 https://www.wfduk.org/resources/surface-waters-alien-species.

[4] GBNNSS. GB risk assessments. http://www.nonnativespecies.org/index.cfm?pageid=143

[5] NNSRAI. Ecoregion 17 risk assessments. http://nonnativespecies.ie/risk-assessments/

4. Nitrogen standards for lakes

4.1 UKTAG have developed proposed lake nitrogen standards, for introduction in the 3rd Cycle of WFD River Basin Management Plans. This chapter describes the methodology used and the proposed standards, together with contextual information and a high level assessment of the implications for classification of lake water bodies. Further technical details and a short literature review are provided in Annex C.

Questions/ invitation for comments

Prior to making recommendations on the standards to UK government administrations, views from national stakeholder organisations are sought on the following:

Q5. Do you support the proposals to introduce lake nitrogen standards alongside the existing standards for phosphorus? If not, please explain why, together with any supporting evidence.

Q6. Do you support the proposals to introduce nitrogen as an independent supporting element in the classification of lakes? If not, please explain why.

Q7. Do you agree with how the proposed standards have been derived and are you content with the evidence base used for the proposed standard? If not, please explain why.

Background

4.2 Nitrogen is a plant nutrient. Elevated concentrations in lakes can lead to accelerated growth of algae and higher plants and changes to plant species composition. The impact on the composition and abundance of algal/ plant species can have adverse implications for other aspects of water quality, such as oxygen levels, and for the characteristics of lake habitats. These various changes can cause undesirable disturbances to other elements of the ecology, such as invertebrates and fish. The process of nutrient enrichment, accelerated algal/plant growth and associated adverse effects is termed eutrophication.

4.3 Nutrient standards are used in managing the risk of these adverse ecological impacts. Where lakes are already adversely affected, nutrient standards can indicate the likely degree to which nutrient concentrations would need to be reduced (e.g. by reducing concentrations in discharges) to improve ecological quality. Where a new discharge is proposed, nutrient standards can indicate whether or not the lake is likely to be able to accommodate the additional inputs without significant risk of adverse ecological effects. WFD also requires that relevant standards for nutrients are met for a lake to be classed as being at Good or High ecological status.

4.4 Annex V of the WFD refers to “nutrient conditions” as one of the general physicochemical elements supporting ecological status. To date, in the UK phosphorus has been the only nutrient used as a supporting element in freshwaters, primarily because historically it has been considered the most likely to be limiting to plant/algal growth. However, for lakes there is convincing evidence from the recent scientific literature that nitrogen can also play a significant role in the eutrophication process, and that control of both phosphorus and nitrogen concentrations/loadings is desirable where they are both present in excess (see Annex C for a short review of scientific literature).

4.5 Having considered the scientific evidence, some UK countries and agencies developed nitrogen thresholds or targets to support decisions on the designation of eutrophic nitrate vulnerable zones under the Nitrates Directive [1], and for assessment of site condition in lakes designated under the Habitats Directive, and for SSSIs with standing water features [2]. These thresholds/targets do not have a statutory basis in the context of driving expensive control actions.

4.6 Under the EU WFD Common Implementation Strategy (CIS), work was undertaken during Cycle 2 of the WFD to review and improve the comparability and consistency of WFD nutrient boundary values across Member States. The outputs of this work, in which the UK had a leading role, are a best practice guide and a statistical toolkit for the determination of the most appropriate nutrient boundary values [3]. These have been used in an analysis of UK lake data to produce the total nitrogen status class boundaries for lakes, proposed here to be used as standards, by UKTAG.

Recommendations

4.7 UKTAG recommends the adoption of the proposed nitrogen standards for the WFD classification, to support assessment of ecological status, regulatory decisions and the implementation of programmes of measures aimed at achieving improvements in ecological status in lakes.

Derivation of standards

4.8 Water quality monitoring data from lakes in England, Wales and Scotland, together with ecological quality ratio (EQR) values for phytoplankton and macrophyte classifications, from the published classification datasets for the same time period from each country, were collated. Data from Northern Ireland's lakes were excluded because total nitrogen (TN) data were not available for the relevant time period.

4.9 The CIS best practice toolkit [3] was used to examine the data, determine the strength of the nitrogen/biology relationships and subsequently the best fit model. The toolkit provides a range of methods, but recommends that where data are adequate and relationships are strong enough, derivation of boundary values based on linear regression modelling should be adopted.

4.10 Relationships of TN with both phytoplankton and macrophyte EQRs, as determined by the Pluto and LEAFPACS classification tools [4, 5], met the criteria for adoption of the linear modelling approach.

4.11 The relationship of nitrogen with phytoplankton was significantly stronger than that with macrophytes but regression modelling using the macrophyte data resulted in more stringent boundary values, suggesting macrophytes are more sensitive to nitrogen enrichment than phytoplankton. However, as the relative weakness of the relationship with macrophytes introduces more uncertainty we derived boundary values on the basis of the stronger relationship of TN with phytoplankton.

4.12 A number of regression models were produced, testing the impact of different typology variables. A model based on the relationship of TN to phytoplankton, including the typology variables depth (very shallow/shallow/deep) and humic type (humic/polyhumic and clear, based on measured colour) emerged as the best fit model. The lake types used were as defined in the UK WFD reporting typology.

4.13 Using this model, High/Good and Good/Moderate ecological status class boundary values for total nitrogen concentration (based on annual mean values for up to three years) were derived.

4.14 Following past practice (eg. for lake phosphorus boundary values [6]) the Moderate/ Poor and Poor/ Bad boundaries were calculated from a doubling of the concentrations at the Good/ Moderate boundary (Table 4.1). Note that supporting elements do not drive the overall WFD classification below Moderate status (unlike biological elements), but the regulatory agencies require indicative boundaries below Moderate status for management purposes. A more detailed description of the data analysis is provided in Annex C.

Proposed standards

4.15 The total nitrogen standards proposed by UKTAG are show in Table 4.1.

4.16 UKTAG recommends that the nitrogen standards are applied in classification as an independent supporting element, in line with the one-out-all-out principle that applies in WFD classification.

Table 4.1

Proposed total nitrogen boundary values (standards) for lakes (mg/l N, annual mean concentration).

Lake type*	Status boundary			
	High/ Good	Good/ Moderate	Moderate/ Poor	Poor/ Bad
Clear, Very Shallow	0.67	1.07	2.13	4.27
Clear, Shallow	0.48	0.77	1.54	3.08
Clear, Deep	0.46	0.74	1.47	2.94
Humic, Very shallow	0.91	1.46	2.92	5.85
Humic, Shallow	0.81	1.30	2.60	5.20
Humic, Deep	0.72	1.16	2.32	4.65

*type as for the UK reporting typology: clear = <30 mg/l Pt, humic > 30 mg/l Pt (includes polyhumic), depth classes (mean depth): very shallow <3m, shallow 3-15m, deep >15m.

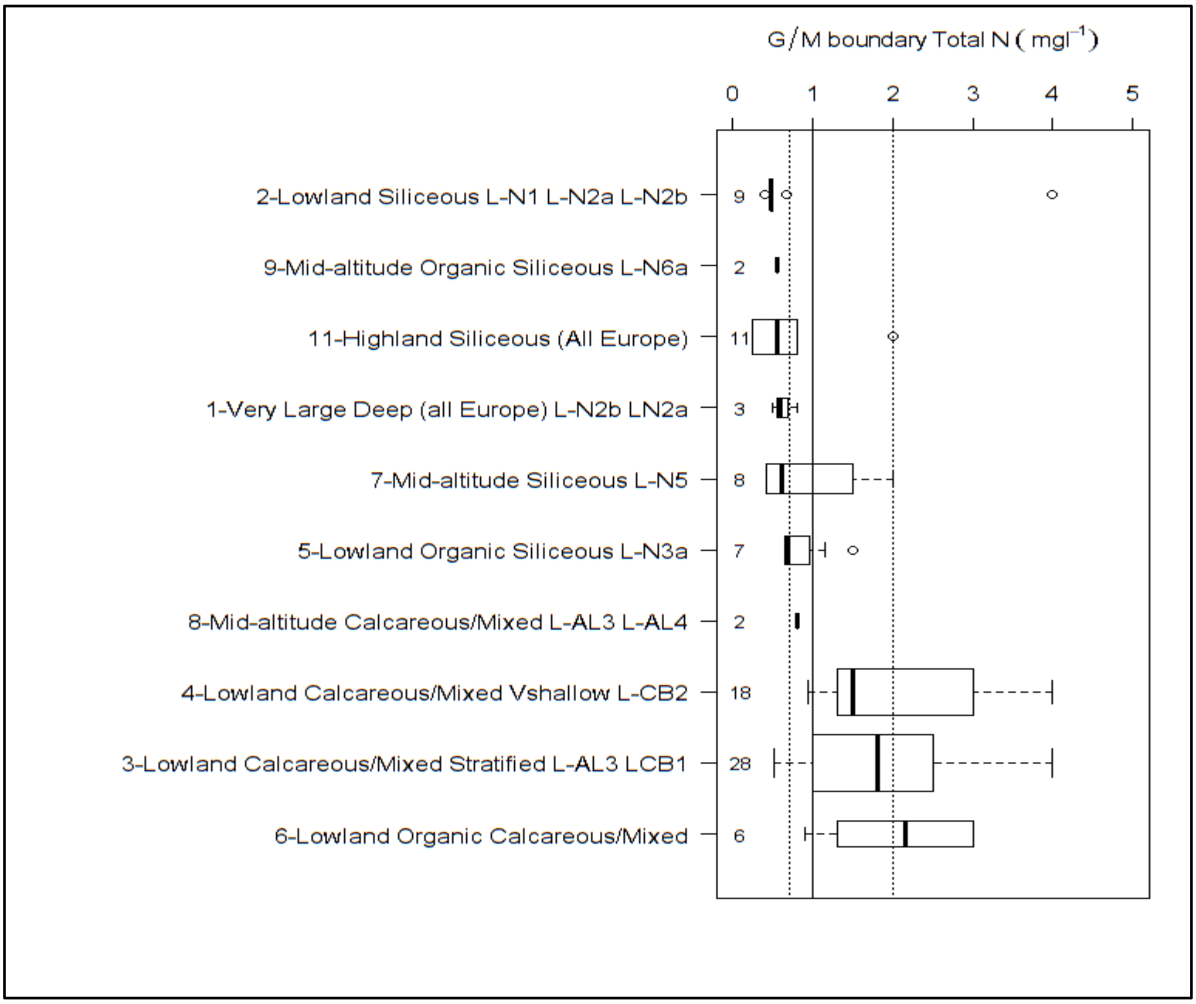
The proposed standards in context

4.17 The proposed values at the High/ Good and Good/ Moderate boundaries are closely aligned with the range of values currently used in parts of the UK for designation of eutrophic lake NVZs under the Nitrates Directive in England (threshold values 1-2 mg/l TN, Defra 2016) [1], and target values adopted for the UK Common Standards Monitoring Guidance for Lakes (JNCC, 2015) [2] (generic target 1.5 mg/l, site specific targets applied for some lakes in England range 0.4 – 1.5 mg/l).

4.18 A survey of nutrient standards in use for the WFD across European member states [7] revealed a range of concentrations in use for the Good/Moderate boundary (related to such factors as different methods for boundary setting and differences in lake type), but as Figure 1 below illustrates, for most lake types the median values for the Good/Moderate boundary are almost all within the range proposed by UKTAG.

Figure 4.1

Range of reported total nitrogen Good/Moderate boundary values for lakes grouped by broad types. Numbers show the number of national types with boundary values contributing to each broad type. Lines show 25th, 50th, and 75th percentiles of all reported Good/Moderate total nitrogen boundary values (Source: Phillips and Pitt, 2015).



Implications of proposals

4.19 The proposed boundary values (standards) were used to apply a “face value” classification of all lakes with available total nitrogen data in England, Scotland and Wales (416 water bodies, including the 206 used to derive the boundaries). Table 4.2 shows the distribution by class in terms of number of water bodies and percentage in each country.

4.20 The nitrogen classification was compared to the reported overall classification (within the same time period) for the lakes to determine if nitrogen might become a driving element in the classification under the one-out all-out rule.

4.21 Nine water bodies (7 in England, 2 in Wales), i.e. approximately 2%, would move from Good to Moderate or worse status overall as a result of introducing a nitrogen standard.

4.22 A larger number reported as Moderate overall status had nitrogen at Poor (17) or Bad (25) status. This would not change the reported overall status from Moderate, since supporting elements cannot drive class below Moderate.

Table 4.2

Distribution of lakes in each status class, and at “Good or better” and “Moderate or worse” class for total nitrogen

	GB*		England		Scotland**		Wales	
	Number of water bodies	%	Number of water bodies	%	Number of water bodies	%	Number of water bodies	%
High	142	34	61	20	33	87	48	60
Good	98	24	80	27	2	5	16	20
Moderate	91	22	77	26	3	8	11	14
Poor	42	10	38	13	0	0	4	5
Bad	43	10	42	14	0	0	1	1
Total	**416**		**298**		**38**		**80**	
Good or better	240	58	141	47	35	92	64	80
Moderate or worse	176	42	157	53	3	8	16	20

*There are no total nitrogen data available for Northern Ireland’s lakes, but monitoring is now underway to enable application of the standards in future.

**Relatively few Scottish lochs have been routinely monitored for total nitrogen in recent years.

Relationship with phosphorus and biological classifications

4.23 Previous work by UKTAG to develop nutrient (phosphorus) standards and to refine the biological classification tools aimed to improve the relationship between the biological and supporting element classifications, so reducing the number of "mis-matched" classifications and any bias in the classifications produced by different elements.

4.24 The proposed nitrogen classification was compared with reported phosphorus, phytoplankton and macrophyte classifications where these were available (Table 4.3). The dataset used for this comparison consisted of 198 water bodies where classification results for all of the elements were available. Since this is a relatively small dataset, further subdivision by country has not been undertaken.

4.25 While rates of "misclassification" between the biology and nitrogen appear relatively high overall, consideration of the mis-match at the Good/Moderate boundary and the percentage of classifications agreeing to within one class, shows that nitrogen performs slightly better than the current lake phosphorus classification for phytoplankton, but slightly less well for macrophytes (Table 4.4).

4.26 Compared with phosphorus, nitrogen tends to produce a better status classification (49% of lakes had P class worse than N class).

4.27 For phytoplankton there is a slight positive bias with biology class appearing better than nitrogen class in 27% of sites, and for macrophytes the reverse is the case with biology class worse than nitrogen class in 54% of sites. (Table 4.4).

4.28 This analysis cannot take into account how close to the relevant boundary each element classification is – thus an apparent mis-match may be a result of classifications that are in relatively good agreement but fall either side of the relevant class boundary.

4.29 As all classifications have a degree of uncertainty attached, this is something that should be taken into account when conducting further investigations of failing elements and deciding on appropriate measures.

4.30 In line with its previous advice on ecological status standards for nutrients, UKTAG continues to recommend that expensive regulatory action to reduce nutrient concentrations at a site should be considered only where there is supporting evidence of adverse ecological/ biological impacts. This is the "weight-of-evidence" approach to managing eutrophication for WFD, Urban Waste Water Treatment and Nitrates Directives/Regulations purposes.

Table 4.3

Matrices comparing classification by total nitrogen with phosphorus, phytoplankton and macrophytes.

Total Phosphorus vs Total Nitrogen						
	Phosphorus class					
Nitrogen class	Bad	Poor	Moderate	Good	High	Total
Bad	6	4	4	2	0	16
Poor	3	7	10	3	1	24
Moderate	9	10	17	4	2	42
Good	2	8	20	10	3	43
High	1	2	16	26	28	73
Total	21	31	67	45	34	

Phytoplankton vs Total Nitrogen						
	Phytoplankton class					
Nitrogen class	Bad	Poor	Moderate	Good	High	Total
Bad	0	6	7	3	0	16
Poor	0	9	8	7	0	24
Moderate	0	13	17	10	2	42
Good	0	1	10	22	10	43
High	0	0	1	8	64	73
Total	0	29	43	50	76	

Macrophytes vs Total Nitrogen						
	Macrophyte class					
Nitrogen class	Bad	Poor	Moderate	Good	High	Total
Bad	1	7	7	1	0	16
Poor	3	9	9	3	0	24
Moderate	2	14	19	6	1	42
Good	2	9	18	10	4	43
High	3	4	17	34	15	73
Total	11	43	70	54	20	

Note: Highlighted cells indicate where class is the same by each method. Cells above this indicate TN at lower class, and cells below indicate TN at higher class, than the element being compared. Numbers are the number of lake water bodies.

Table 4.4
Summary of classification mis-match rates for nitrogen and biological elements in lake water bodies.

	% biology worse than nutrient	% biology better than nutrient	% same +/- 1 class	Bias
N vs Phytoplankton	17	27	89	0.20
N vs Macrophytes	54	19	75	-0.53
For comparison - P classification				
P vs phytoplankton	11	55	79	0.67
P vs Macrophytes	39	30	85	-0.06

References

[1] Defra (2016). Implementation of the Nitrate Pollution Regulations 2015 in England. Method for designating Nitrate Vulnerable Zones for waters affected by eutrophication. https://www.gov.uk/government/publications/nitrate-vulnerable-zones-nvzs-2017-review-method-statements

[2] JNCC (2015). Common Standards Monitoring Guidance for Freshwater Lakes ISSN 1743-8160 (online). http://jncc.defra.gov.uk/pdf/0315_CSM_Freshwater_lakes.pdf

[3] WFD CIS (2018). Best practice for establishing nutrient concentrations to support good ecological status. https://circabc.europa.eu/sd/a/5aa80709-9ce8-411d-94e8-f0577f3632fa/CIS_Guidance_for_Ecostat_Oct18.pdf

[4] WFD UKTAG (2014). UKTAG Lake Assessment Method – Phytoplankton. Phytoplankton Lake Assessment Tool with Uncertainty Module (PLUTO). ISBN: 978-1-906934-47-7. http://wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/Lake%20Phytoplankton%20UKTAG%20Method%20Statement.pdf

[5] WFD UKTAG (2014). UKTAG Lake Assessment Method – Macrophytes and Phytobenthos – Macrophytes (Lake LEAFPACS2). ISBN: 978-1-906934-45-3. http://wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/Lake%20Macrophytes%20UKTAG%20Method%20Statement.pdf

[6] WFD UKTAG (2008). UK Environmental Standards and Conditions (Phase 2) Final March 2008. http://wfduk.org/sites/default/files/Media/Environmental%20standards/Environmental%20standards%20phase%202_Final_110309.pdf

[7] Phillips, G and Pitt, J-A. (2015) A Comparison of European freshwater nutrient boundaries: A Report to WG ECOSTAT. https://circabc.europa.eu/sd/a/37778f00-5a8a-4198-9ff3-8b15360ba975/ComparisonNutrientBoundaries_2016J_FINAL%20for%20CIRCABC(0).pdf

5. River fish FCS2 (Scotland)

5.1 This section describes the proposed revisions to the Fish Classification System for Scotland (FCS2 (Scotland)). Changes are proposed to the method by which results are aggregated at the water body level. These changes would only apply to Scotland, as the method is specific to this part of the UK.

Questions/ invitation for comments

Prior to making recommendations on the standards to UK government administrations, views from national stakeholder organisations are sought on the following:

Q8. Do you support how results from multiple sites are aggregated to give a water body level result? If not, please explain why, together with any supporting evidence.

Background

5.2 The current tool for classifying river fish in Scotland for the Water Framework Directive is FCS2 (Scotland). This tool was developed, intercalibrated and adopted in Scotland for RBP Cycle 2. FCS2 uses data generated by standard electrofishing techniques, based on the CEN methods embedded in the WFD.

5.3 FCS2 (Scotland) calculates status class using a Bayesian approach implemented using specially developed software. The underlying approach is similar to that used in England, and Northern Ireland, but the Scottish method relies solely on information from salmon and trout. The method is described in detail in SNIFFER [1], and in the UKTAG method statement produced for the 2nd RBP [2].

5.4 If there are multiple sites in a water body, the Scottish method amalgamates these to generate a single water body EQR result. Bayesian statistical methods are used for this step, but these can produce results which are not consistent with the accepted definition of the Ecological Quality Ratio (EQR).

5.5 Instead of producing an EQR value which is an average of results at each of the individual sites, the Bayesian EQR value is a measure of how likely the waterbody is to reach Good status. Where there are several sites slightly below the Good/ Moderate boundary, this means that the likelihood that the waterbody is Good or better will be very low, which will in turn produce a very low overall EQR value. Often this value will mean that the water body is at a lower class status than any of the individual sites. Similarly, if multiple sites are slightly above the Good/ Moderate boundary, this will result in an overall water body EQR which is higher any of the individual site results.

5.6 As an example, Table 5.1 below shows results from two water bodies each with two separate survey sites. For the first, it can be seen that both sites return EQR results of between 0.25 and 0.3, which are consistent with Moderate status. When amalgamated at the water body level however, the overall EQR value is far lower, at 0.05, which is in the middle of Poor status.

5.7 The example for the second water body shows a similar pattern occurring with the amalgamation of high quality sites. Here, each individual site has an identical EQR of 0.79, which is towards the upper end of Good status. When amalgamated using the current FCS2 approach, the overall water body EQR is, 0.89, however, which is High status.

Table 5.1
Example of EQRs calculated at individual sites and amalgamated to water body level under the current FCS2 (Scotland) method, and following the proposed change.

	Site 1	Site 2	Bayesian WB EQR	Mean WB EQR
WB 10207	0.25	0.29	**0.05**	**0.27**
WB 5309	0.79	0.79	**0.89**	**0.79**

Recommendations

5.8 UKTAG recommends applying a simple arithmetic mean to the individual site EQR values provided by the FCS2 (Scotland) tool, rather than using the Bayesian amalgamation approach for this final stage. This provides a clearer reflection of the overall ecological quality across multiple sites.

Relevance to different parts of the UK

5.9 In England and Wales, the FCS2 method describes the calculation of single site EQRs, but does not describe the amalgamation of these by water body. The approach has been to use mean values, in the same way now being proposed for Scotland. Northern Ireland classifies on the basis of a single site in each water body. These proposed changes are therefore only relevant to Scotland.

Implications of proposals

5.10 The proposed change will only make a difference for water bodies which have multiple sites available. The overall impact of this has been compared using existing classification data and is presented below. The overall impact on river fish classification results is limited in terms of the overall number of water bodies at Good or better status. (Table 5.2).

Table 5.2

Percentage of water body classifications at Good or better, and Moderate or worse status using current and proposed new variants of the river fish classification method.

	FCS2 (Scotland) - current method		**FCS2 (Scotland)** - proposed method		No. water bodies
	% Good or better	% Moderate or worse	% Good or better	% Moderate or worse	
Fish class	45	55	42	58	572

5.11 Table 5.3 described the change in class in detail. The table shows that 35 water bodies would be downgraded from High to Good, and 22 downgraded from Good to Moderate, while 47 water bodies would be upgraded from Poor to Moderate.

Table 5.3

Direct comparison of river fish status results using the existing and proposed new method of amalgamating multiple sites within water bodies. The rows show the result using the existing method, and the columns the result using the new method. The highlighted values show where the class results would change if implementing the new method.

		Proposed method				
		High	Good	Moderate	Poor	Bad
Existing method	High	96	**35**			
	Good		107	**22**		
	Moderate			180		
	Poor			**47**	79	
	Bad					6

5.12 The full list of water bodies which would drop in class is given in Annex D. It can be seen that of the 57 occasions in total where fish would drop in class, there are nine occasions which would result in the overall water body lowering in status. This value is reduced either because there are other elements which are already at a lower status, or because the water body is designated as heavily modified. These rows are highlighted in the table. One water body would drop from High to Good overall, while eight would drop from Good to Moderate.

5.13 The proposed change will also have no implications for intercalibration, because FCS2 (Scotland) was intercalibrated at the individual site level.

References

[1] SNIFFER (2011). River fish classification tool: Science work phase 3 report. https://www.sniffer.org.uk/Handlers/Download.ashx?IDMF=e6583077-7a98-4b0f-a912-b069b6d7fb21

[2] WFD-UKTAG (2014). UKTAG river assessment method fish fauna: Fish classification scheme 2 (FCS2) Scotland. ISBN: 978-1-906934-50-7. https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/River%20Fish%20Scotland%20UKTAG%20Method%20Statement.pdf

6. Emamectin benzoate EQS

6.1 The Water Framework Directive requires that Member States identify Specific Pollutants and set standards for them. Specific Pollutants are toxic substances that are discharged in significant quantities into the water environment. UKTAG has developed a standard for the specific pollutant emamectin benzoate. This chapter describes the methodology used and the proposed standards.

Questions/ invitation for comments

Prior to making recommendations on the standards to UK government administrations, views from national stakeholder organisations are sought on the following:

Q9. Do you support how the proposed EQS has been derived? If not, please explain your reasons why.

Q10. Are you aware of any relevant data that has not been considered in the derivation of these EQS? (New data submitted during the consultation period will be considered in the derivation – see paragraph 6.9)

Background

6.2 The Scottish Environment Protection Agency (SEPA) previously set standards for the substance emamectin benzoate in 1999, before current EQS development guidance and significant new data were available. Given the substance's widespread use as a veterinary medicine in the fish farm industry, SEPA asked UKTAG to derive EQS for the substance based on our expertise in this area according to the latest data and science.

6.3 UKTAG considered several key pieces of information in deriving EQS for this substance:

i. an EQS report commissioned by SEPA and produced by the consultant WRc in January 2017 (WRc 2017) [1];
ii. the comments of three independent peer reviewers on the WRc report;
iii. a 2018 SEPA field study conducted in the Shetland isles (SEPA 2018) [2], including one of the peer reviewer's comments on this;
iv. a recent industry-funded fish farm field survey (SAMS 2018) [3];
v. results of more recent ecotoxicity testing conducted by Industry.

6.4 A paper that describes the available information and each step in the EQS derivation in detail is available as part of this consultation (see Background Report "*Chemistry Task Team Recommendation for an EQS for Emamectin Benzoate*").

6.5 UKTAG also received an industry-sponsored EQS derivation report that includes the new ecotoxicity data and discusses the industry-led field survey as part of the data package. A second background document has been produced that reviews this report ("*Chemistry Task Team comments on 2018 industry-sponsored EQS derivation report for Emamectin Benzoate*").

Recommendation

6.6 The only known current use of emamectin benzoate in the UK is as an in-feed medicine in finfish aquaculture to control sealice, for example *Lepeophtheirus salmonis*. For this reason UKTAG has only derived EQS for the marine environment.

6.7 UKTAG's recommendations have been organised into sub-sections for each EQS. Each sub-section summaries the available dataset and the key points in the EQS derivation. The impact of the field data on the sediment EQS is considered last. A table at the end of the section summarises the EQS recommendations for sediment and water.

6.8 Recommendations are made following the EU Common Implementation Strategy Technical Guidance on setting EQS document number 27, published in 2011 [4]. In accordance with the guidance, EQS are derived for both marine waters and sediments. Where necessary data were reviewed according to the principles of the CRED system; this is a way of assessing a test's reliability and relevance for use in EQS setting and more generally in chemical hazard assessment.

6.9 UKTAG has been made aware that relevant new data relating to chronic sediment toxicity should become available during the period of this consultation. We are planning to take this into account so long as it is submitted in a timely manner.

6.10 It is standard practice to periodically update EQS as and when significant new data become available that are reliable and relevant. However as this is a resource intensive exercise such updates are unlikely to be frequent (ie considered within the timescales of river basin management planning).

Pelagic EQS

6.11 The technical guidance [4] notes that if no systematic or statistical differences are apparent between marine and freshwater data, then it is appropriate to pool datasets in EQS derivation. UKTAG believe this is appropriate in this case.

6.12 There are currently two recommended approaches to EQS derivation, the so-called deterministic and probabilistic approaches. In the former, the key data point (ie. lowest ecotoxicity result from a reliable and relevant study) in the compartment-specific ecotoxicity dataset is selected and an assessment factor is applied to it to account for uncertainties that include laboratory to field extrapolation, representiveness (unknown sensitivity of untested taxa), etc. The latter approach can be used for larger datasets, where a substance's toxicity profile has been better investigated through laboratory tests representing many taxonomic groups and species. In this approach a distribution of the sensitivities of tested species is plotted relative to common toxicity metrics (NOEC or EC10 for chronic toxicity studies) in a Species Sensitivity Distribution (SSD), and this is used to derive the concentration that is hazardous for 5% of the tested species (the HC_5). An assessment factor is applied to this HC5 to derive the EQS. The AF is lower than those used in the deterministic approach because levels of uncertainty are lower owing to the more extensive dataset.

MAC-$EQS_{pelagic}$

6.13 This standard endpoint is designed to be protective of acute effects (lethality) in pelagic organisms following intermittent exposures of short duration.

6.14 The available reliable and relevant dataset includes:

- Marine: acute toxicity in 7 crustacean (1 lobster, 2 shrimp and 4 copepod species), 1 mollusc and 1 fish species
- Freshwater: acute toxicity in 1 algal, 1 crustacean, 1 insect and 4 fish species

6.15 There are not enough data to satisfy the requirements for the construction of a species sensitivity distribution to use a probabilistic EQS derivation, so the deterministic approach is used [4].

6.16 Based on the dataset, knowledge of the substance's mode of action, and the inclusion of sensitive taxonomic groups in the dataset an assessment factor of 10 can be applied to the lowest reliable acute result (a 96h LC50 of 0.078ug/l from a recent mysid shrimp acute toxicity study). This gives a **MAC-$QS_{pelagic}$ of 0.0078 ug/l, or 7.8 ng/l**.

AA-$EQS_{pelagic}$

6.17 This standard endpoint is designed to be protective of sub-lethal (chronic) effects (for example on growth, development or reproduction) in pelagic organisms following long term exposures.

6.18 Available reliable and relevant dataset:

- Marine: long term toxicity in 2 crustacean species
- Freshwater: long term toxicity in 2 primary producers (algae and lemna), 1 crustacean, and 1 fish species; freshwater microcosm study

6.19 Again there are not enough data to satisfy the TGD's requirement for the construction of a species sensitivity distribution to use a probabilistic EQS derivation, so the deterministic approach is used [4].

6.20 The dataset includes four reliable chronic studies in freshwater organisms (3 taxa) in addition to the mysid shrimp and the *Acartia clausi* marine studies (older oyster studies are considered sub-lethal, not true chronic studies). In order to use a less stringent assessment factor than 50, the additional marine studies have to represent taxa with different living/feeding strategies to those of the organisms used in "core" chronic studies. In this case, UKTAG believes this difference is not marked enough for the copepod species, so based on the additional marine study an assessment factor of 50 can be applied to the lowest result (an EC10 of 9.44ng/l for reproduction in a recent mysid shrimp study) to give an **AA-QS$_{pelagic}$ of 0.19 ng/L**.

Sediment EQS

6.21 As is the case for the pelagic data, CTT has followed CIS 27 guidance and pooled fresh- and saltwater data. This is further discussed in the full report for this derivation (see Background Report "*Chemistry Task Team Recommendation for an EQS for Emamectin Benzoate*").

6.22 Unlike pelagic EQS, where EQS protective of short term (acute) and long term (chronic) effects are derived separately, sediment EQS are derived to be protective of long term effects in sediment dwelling organisms. This is because chemicals can have long residence times in sediments especially if they are persistent, regardless of use or release regimes.

6.23 As is the case for the pelagic data, UKTAG believe it is appropriate to pool the available freshwater and saltwater sediment data. The reasons for this are discussed in the Background Report "*Chemistry Task Team Recommendation for an EQS for Emamectin Benzoate*".

6.24 Available reliable and relevant dataset:

- Marine: long term toxicity in 2 crustacean species (3 studies in 2 copepod species); sub-lethal endpoint from acute toxicity study in a polychaete species (the lugworm *Arenicola marina*)
- Freshwater: long term toxicity in 1 insect (midge) species

6.25 Of the truly chronic dataset, the most sensitive species was the freshwater insect. However, considering the marine data in isolation the sub-lethal endpoint in the acute Arenicola lugworm study gave a lower result than those observed in the three marine chronic studies. This species was also the most sensitive in the available acute toxicity tests.

6.26 Whilst the technical guidance [4] sets out to be as comprehensive as possible, there are often cases where a dataset does not quite match with the situations described in the guidance. The emamectin benzoate sediment dataset is an example of this.

6.27 The technical guidance explicitly states that in some cases expert judgement will be required in relation to the adjustment of assessment factors based on additional information. According to the technical guidance, an assessment factor of 100 applies when there are chronic toxicity data for two species (freshwater or marine) that have a significantly different living and feeding condition. Because the additional marine species is very similar to the other marine test species in this case, this is the situation here. However, based on the increased confidence the additional marine copepod study gives for toxicity in this taxa, the supporting sub-lethal effects data from the acute arenicola study, and the fact that the freshwater data represent a taxa known to be sensitive to the substance's mode of action, UKTAG believes that an assessment factor of 50 can be applied to the freshwater midge data when considering the laboratory data in isolation.

6.28 Additional lines of evidence can be used to modify assessment factors recommended for laboratory data through expert judgement [4]. Such information generally relates to field studies.

6.29 Based on the results of statistical analysis for the SEPA field study [2], no threshold for effects can easily be derived from these data. However the SEPA field study suggests that a concentration somewhere in the region 10 – 100 ng/kg dwt should be protective of impacts on macroinvertebrate abundance/diversity of benthic fauna. For a more detailed description of this study see the Background Report "*Chemistry Task Team Recommendation for an EQS for Emamectin Benzoate*".

6.30 The industry-led field study [3] gave quite different results. Various statistical approaches were applied to the data, but no plausible correlation between substance concentrations and impacts in the benthic macroinvertebrate community could be derived. Again a summary of this study and possible reasons for its findings can be found in the Background Report "*Chemistry Task Team Recommendation for an EQS for Emamectin Benzoate*".

6.31 Taking the results of both studies into account, CTT does not see a clear line of evidence that would enable a relaxing of the proposed assessment factor of 50.

6.32 Based on all considerations, UKTAG is recommending applying an assessment factor of 50 to the chironomid data to give a **sediment EQS of 23.5 ng/kg dry weight**.

6.33 Normalisation to a set organic carbon (OC) content (5%) is generally recommended for classification assessment purposes [4]. Since the freshwater chironomid study OC content was close to this value at 4.5%, we are not recommending that the EQS needs to be adjusted.

Secondary Poisoning/exposure via the food chain

6.34 Since the measured BCF of the substance is less than 100 (82 l/kg), it is not necessary to derive an EQS for secondary poisoning.

Recommendation Summary

6.35 Table 7.1 summarises the four recommendations made by UKTAG for emamectin benzoate.

Table 7.1
Summary of EQS recommendations

	EQS		
	Sediment (ng/kg dwt)	Pelagic MAC (acute effects; ng/l)	Pelagic annual average (chronic effects; ng/l)
UKTAG recommendation	**23.5**	**7.8**	**0.19**

dwt – dry weight

Implications of proposals

6.36 UKTAG has not undertaken a formal impact assessment for these recommendations.

References

[1] WRc 2017. Review of Environmental Quality Standard for Emamectin Benzoate, WRc report reference UC12191.03, February 2017. https://www.sepa.org.uk/media/299675/wrc-uc12191-03-review-of-environmental-quality-standard-for-emamectin-benzoate.pdf

[2] SEPA 2018. FISH FARM SURVEY REPORT: EVALUATION OF A NEW SEABED MONITORING APPROACH TO INVESTIGATE THE IMPACTS OF MARINE CAGE FISH FARMS, October 2018. Summarised in Bloodworth JW, Baptie MC, Preedy KF, Best, J. Negative effects of the sea lice therapeutant emamectin benzoate at low concentrations on benthic communities around Scottish fish farms, Science of the Total Environment, 2019, 669, pp 91 – 102. https://www.sciencedirect.com/science/article/pii/S0048969719309428?via%3Dihub

[3] SAMS 2018. PASSIVE FIELD MONITORING SURVEY FINAL REPORT. Document number 01963.2_0010, September 2018.

[4] WFD CIS (2011). Common implementation strategy for the water framework directive (2000/60/EC): Guidance Document No. 27. Technical guidance for deriving environmental quality standards. ISBN : 978-92-79-16228-2. https://circabc.europa.eu/sd/a/0cc3581b-5f65-4b6f-91c6-433a1e947838/TGD-EQS%20CIS-WFD%2027%20EC%202011.pdf

7. River acidity standards

7.1 Wales intends to apply new river acidity standards for the forthcoming river basin planning cycle. UKTAG consulted on proposals for river acidity standards in 2012 and as such no further consultation is required at this time.