Environmental Flow Indicator
Application of the EFI for Water Resources licensing

Position Statement **Issued 04/01/18**

What is this document about?

The Environmental Flow Indicator (EFI) plays an important role in the management of Water Resources in England and Wales. This position statement details the Environment Agency's approach to applying the EFI in order to meet our environmental legal obligations, including the Water Framework Directive (WFD). It describes our position on how we use the EFI when making water resources licensing decisions.

Who does this document apply to?

- Environment Agency staff involved in making flow related decisions for Water Resources Planning and Water Resources Licensing.
  - Area Integrated Environment Planning (IEP)
  - Area Analysis and Reporting (A&R)
  - Area Hydrology
  - National Permitting Service (NPS) Water Resources
  - Environment and Business (E&B) Water Land and Biodiversity
  - National River Basin Management Service
- Abstractors
- eNGOs

Position authorisation

- Paul Hickey (Deputy Director, Water Land and Biodiversity, Water Resources).

Contact for queries and feedback

- Please give anonymous feedback for this document.

Contents

Background

The UK Technical Advisory Group on the Water Framework Directive (UKTAG) is responsible for developing environmental standards to underpin the implementation of the Water Framework Directive.

Proposed environmental standards for river flow were first developed as part of a project undertaken for UKTAG in 2005-2006. The project developed hydrological standards for river and lake water bodies through a series of workshops attended by a panel of river scientists specializing in freshwater ecology, hydrology and water resource management. The panel put forward precautionary standards, expressed as percentage of deviation from the natural hydrological regime, where they could no longer be certain that Good Ecological Status (GES) would be achieved. Accepting that such standards were precautionary, under direction from UKTAG, the project team defined a final set of risk-based practical standards for river flow. The EFI is based directly on this set of standards. You can find more detail about the development of the EFI in our factsheet " Environmental Flow Indicator: What it is and what it does".

An equivalent UKTAG project in 2006-2007 developed standards for freshwater flows to estuaries, expressed as percentage of deviation from the natural freshwater flow regime. EFI is used to indicate where abstraction (and flow regulation) pressures may start to cause an undesirable effect on river habitats and species.

Using the EFI in licensing decisions - Summary

Licensing Approach

- The EFI is used to indicate where abstraction (and flow regulation) pressures may start to cause an undesirable effect on river habitats and species.
- Non-compliance with the EFI helps to indicate where flow may not support Good Ecological Status (GES) under WFD.
- We also use the EFI to identify where there is a risk of deterioration.
- In our Abstraction Licensing Strategies (ALS) the EFI helps to indicate where water may be available for future abstraction without causing unacceptable risk to the environment. For new abstraction proposals, carrying out initial screening against the EFI is essential. If the proposal allows the EFI to be met, then our licensing approach is considered to be hydrologically supporting GES for WFD.
- When managing abstraction licences, we must ensure that we support GES or an alternative objective for a water body given in the RBMP. The EFI will be applied as a default unless there is agreed local information that defines a more appropriate local flow constraint to support GES and objectives given in the RBMP.
- We apply the EFI as a default for renewal of time-limited licences, and for non-time limited existing licences where changes are necessary to meet the objectives outlined in our River Basin Management Plans (RBMP)
- If, in applying the principles of the position statement, local information can identify a more appropriate local flow constraint we must be at least as confident that this will support the environmental objectives defined for the waterbody.
- The annex sets out the minimum requirements as to what might constitute local information. We will decide where this is the case at a site, water body or catchment scale as deemed appropriate.

Application of the EFI for different licensing scenarios

New Licences

We use the EFI as a default flow objective to assess the impacts of an application for new abstraction. We use the EFI as an indicator of where flow pressure may compromise GES. We assume that the hydrological and morphological impacts of the abstraction will not cause deterioration of GES if flows, taking account of the new abstraction, remain above EFI.

To ensure we continue to meet RBMP objectives and prevent deterioration we must also take into account the flow situation at the local point of abstraction, and take into account flows at downstream critical points on the river network[1].

We will not normally licence abstraction of water that would reduce flow below the EFI unless the following exceptional circumstances apply:

- Where deterioration is likely to occur as a result of the proposed abstraction, but the applicant demonstrates that the criteria for Article 4.7[2] are met for their proposal.
- Natura 2000 Protected Areas[3]. Decisions on applications which will impact on these sites may be informed by the specific needs of the designated site (for example using the Joint Nature Conservation Committee Common Standards Monitoring Guidance for Rivers). Licence determination should take account of all available information. For more information on Conservation Protected Areas, please see OI 226_10 Screening and assessing new water resources permissions for impacts on conservation, heritage and landscape.
- Better local information can identify a more appropriate local flow constraint as an alternative to the EFI following previous investigations and evidence. Please note:
  - A local flow constraint cannot be described as a "local EFI" or a "new EFI" ;
  - The Annex provides more information on requirements for investigative evidence and/or studies which are required to form agreed local information;
  - We must be at least as confident that the local flow constraint will enable achievement of environmental objectives as if we applied the EFI.

Replacement Time-Limited Licences

We will use the EFI as a screen to check if any time-limited licences meet the requirements for WFD compliance as part of the determination before we grant any replacement licences. This is in order to ensure any water body flows support RBMP objectives (under actual abstraction quantities), and to address the potential risk of WFD deterioration. We will only instigate flow recovery where flow has been confirmed as the Reason for

1 In order to achieve this we rely on information provided by the Water Resources Risk Screening Tool, Water Resources Geographical Information System and the Catchment Planning System.

2 Article 4.7 relates to one of a number of exemptions detailed in the Water Framework Directive. Article 4.7 specifically, sets out certain circumstances in which modification to the characteristics of a waterbody that cause failure to achieve GES/GEP or failure to prevent deterioration in status as the result of new modifications is allowed, provided that (among other criteria), the modifications are for reasons of overriding public interest.

3 Areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection including relevant Natura 2000 sites).

not achieving Good (RNAG) or where we have good evidence that action is required on flow even if the water body is at Good.

We will determine replacement licences in accordance with the EFI unless one or more of the following apply:

- For designated sites and Natura 2000 Protected Areas - where a flow higher than the EFI is justified or where different flow objectives have been set to protect designated interest features.
- Where a time limited licence has been subject to a review (e.g. the Habitats Directive Review of Consents) and the licence has been issued to achieve a bespoke objective.
- Where agreed local information (as per Annex) has identified a more appropriate local flow constraint as an alternative to the EFI following previous investigations and evidence
- Flow is confirmed as not the RNAG (i.e. flow has been investigated and ruled out). In these cases licences should be renewed without change unless we are required to take action to address the risk of deterioration or we have good evidence that action is required on flow to address other environmental objectives.

Existing non-time limited licences

We use the EFI as a screen to check if existing licences meet the flow requirements for WFD compliance. This is in order to ensure any water body flows support RBMP objectives (under actual abstraction quantities), and to address the potential risk of deterioration of WFD classification elements. Failure of the EFI acts as an initial driver for further investigation to confirm ecological impact and the specific action that needs to be taken.

Actions will be determined by some or all of the following factors:

- Investigations – confirmation of impacts and site-specific info about need for recovery.
- For designated sites and Natura 2000 Protected Areas - where a flow higher than the EFI is justified or where different flow objectives have been set to protect designated interest features.
- Economic assessment – e.g. Restoring Sustainable Abstraction costs and benefits, and RBMP economic appraisal.
- Other actions being undertaken – e.g. morphological changes alongside a licence change as part of an adaptive management approach.
- Evidence to support alternative objectives such as extended deadlines, or less stringent objectives. A full list reasons for setting alternative objectives can be seen here: UK TAG 2009.
- Where we have good evidence that additional action is required on flow to meet other environmental obligations even if the water body is at good ecological status or good ecological potential.

Where we have confirmed that abstraction is the reason for not achieving environmental objectives, we will use the EFI as our default target to determine the extent of action to address actual and potential abstraction pressures, unless:

- Evidence from the above factors or agreed local information (as per the Annex) has identified a more appropriate local flow constraint as an alternative recovery target; or
- Where we have justified and agreed a less stringent objective for the water body (for example, achieving moderate status by 2027).

Risk of deterioration

Even in water bodies where failure of flow to meet the EFI does not currently cause failure to achieve environmental objectives, our obligations under WFD to prevent deterioration of a water body require us to consider whether NOT constraining abstractions leaves a future environmental risk to a water body.

We use the EFI to indicate the likelihood of ecological deterioration. In some cases, we may have agreed a different flow objective for the waterbody rather than a local flow constraint on which we have assessed an individual licence (for example for designated sites). Where this is the case we will use this to indicate the risk of deterioration.

We use the EFI (or agreed waterbody flow objective) to identify where future abstraction might cause a deterioration as follows:

- If both fully licensed (FL) and recent actual (RA) flow scenarios are above the EFI we will allow flows to reduce to the EFI (or agreed waterbody flow objective) provided that: this will not result in a between class ecological deterioration as defined by WFD or a failure to meet other environmental objectives.
- If FL is below the EFI (or agreed waterbody flow objective)) but RA is above it, then abstraction above RA levels may be possible, as above, but at the point where it exceeds the EFI or agreed waterbody flow objective), the risk of deterioration will need to be managed

Annex: Required levels of evidence to support development of a local flow constraint

Introduction

Whilst we will normally manage flows to the EFI, there may be cases where local information can define a more appropriate local flow constraint (LFC) to support GES and objectives given in the RBMP (this may be more or less restrictive than the EFI).

This annex sets out the minimum requirements as to what might constitute better local information. You must read it in conjunction with the detail in the main document. This annex provides a high-level overview but does not provide a stepwise approach to how you should produce this evidence or how we evaluate this evidence in our decisions.

It is important to note that:

- Where an LFC is proposed, we will only consider this where supported by studies which follow the principles that are set out in this document.
- The targets for designated sites may be different to the EFI in which case these will be out of the scope of this annex although the principles outlined in this document will be useful when designing studies for these sites.
- We expect that this annex will evolve as future studies, research, and tool development improve understanding of the relationships between flow alteration and ecological response.
- This document is not intended to provide a “how to” guide. Instead, it sets principles that you should use in any study you undertake where you plan to propose a LFC. We will consider studies which follow these principles to inform our evaluation as to whether licensing away from the EFI is appropriate.
- We intend to develop a series of technical case studies illustrating how hydroecological models are developed from site specific and wider monitoring datasets

Principles for developing evidence for an alternative local flow constraint

General

1. To enable us to manage water effectively and with confidence, any proposal to move away from the EFI must provide a comparable level of assurance to the collective knowledge on which UKTAG flow standards and the EFI are based. We must be at least as confident that any such proposal will support the ecology to achieve environmental objectives.

2. Where flow recovery is required to address unsustainable abstraction or to address a risk of deterioration from future abstraction (from either an existing licence or new licence application), any deviation from the EFI must be supported by hydroecological evidence.

3. Studies must ultimately link flow alteration (caused by abstraction, discharge and reservoir operation) to ecological response. They must demonstrate a quantitative link between river flow alteration and ecological response (hereafter termed hydroecological relationships). Because of the natural variation in river flow, studies should consider flow, in addition to flow alteration from abstraction pressures.

4. Studies to define these hydroecological relationships must be scientifically sound and meet the principles detailed in this document.

5. Studies must be underpinned by ecological monitoring data, hydrological data (which may be observed, modelled or a combination), and data on potentially confounding pressures acting on the ecology.

6. The evidence must be able to identify an acceptable flow regime based on ecological response to flow alteration in the water body types under consideration rather than describe a theoretical flow regime as an alternative to the EFI.

7. In terms of achieving environmental objectives, our confidence in the local flow constraint must be at least equal to our confidence in the applicability of the EFI in determining the flow requirements across the full flow regime.

We recommend discussing any proposals for a study to define a local flow constraint with the appropriate Environment Agency team before commissioning a study.

The appropriate flow constraint required for a water body (whether EFI or LFC) should be based on the level of protection that the ecology needs. You should not consider the costs or benefits of achieving the flow constraint when setting it. You should only apply cost and benefit assessments to determine whether the measures required to meet it are cost-beneficial.

Study design

1. Studies should take a two-stage approach:

    1. Development of hydroecological relationships using statistical modelling of historical flow and ecology monitoring time series. Use of a statistical approach, which estimates various components of uncertainty, will enable you to interpret this hydroecological relationship and its accuracy to inform the level of certainty associated with the local flow constraint you propose.

    2. Scenario analysis to assess the impact of alternative flow scenarios on the ecology

2. You should derive hydro-ecological relationships from a broad range of comparable sites unless you have long-term (typically 15- 20 years+) site-specific hydroecological monitoring data available:

- Hydroecological relationships derived from data for a single site to assess what-if questions require a significantly longer-term time series of annual monitoring (covering multiple periods of high and low flows) than when using a broader data set from the site of interest plus comparable water bodies. Long-term means typically between 15-20 years of annual ecological monitoring to achieve adequate level of confidence.
- We recommended that a study should focus on hydroecological modelling of a population of comparable water bodies along a gradient of abstraction pressure. Compared to water body-specific studies, such models can be more precise because they should contain substantially more data and can cover a wider range of flow conditions, without needing long-term time series for the waterbody or waterbodies of specific interest. This type of assessment uses relationships from the wider dataset to determine relationships for the water body or bodies of

interest. The benefits of this approach mean that it can be helpful to consider hydroecological relations outside the immediate water body or bodies of interest (see section on scale).

- When modelling against a pressure gradient this should also include pressure caused by elevated flows
- In some situations, where it is not possible to define a comparable population of water bodies (e.g. for lower reaches of large rivers), there are no alternatives to the single-water body approach outlined above.

3. You should analyse hydro-ecological relationships over a range of flow components:

- Healthy river ecosystems require a range of flow components. Protection of a single component of the flow regime (e.g. Q95 low flow) is not sufficient so your study should consider the importance of high, medium and low flows.

4. You should consider the impacts of morphological changes to the channel and banks and other anthropogenic stressors when devising your study:

- We do not understand all the factors that affect ecological sensitivity to flow change at a site level. However, we do know that morphological alteration of the channel and banks, particularly re-sectioning for land drainage and flood management purposes increases ecological sensitivity to low flows. Other anthropogenic stressors may act similarly.
- Incorporation of data on relevant associated pressures enables a holistic understanding of flow and flow alteration in the context of other pressures. Consideration of water quality time-series alongside flow and ecology is essential where circumstances dictate that a site-specific study is the only possible approach. It also enables an assessment of complementary measures to improve ecological resilience to drought/low flow as part of a catchment approach. For more information, please refer to our position statement on Managing abstraction and flow pressure: implementing hydro-morphological measures.
- Where relationships between flow and water quality (from either diffuse or point sources) are identified, these should be taken into account

5. Uncertainties in assessments for individual quality elements, e.g. fish, macro-invertebrates may be mitigated for by taking a weight of evidence approach. This also allows incorporation of assessments based on habitat in addition to those calibrated against historical ecological monitoring data

Scale

1. The size of the catchment and type of water body under consideration will inform how you define the scale of your study area. For example:

- Geographically close upper tributaries that are comparable but lie within different catchments may provide a better study area than all upper tributaries within a single catchment.
- You should consider middle reaches of a catchment alongside comparable middle reaches in other catchments to provide a more robust data set.

It may not be possible to identify comparable water bodies for lower reaches of a catchment in which case you will need to consider the additional data requirements for a single water body study.

Where possible you should consider undertaking your study at the catchment or sub catchment scale.

2. The scale of the study will inform whether an LFC could be used to describe the flow objective for the waterbody The presumption is that the LFC will be used to inform the decision at that site.

Data

1. You will need to include time series of ecological monitoring data from the waterbody. This should consider the full range of WFD biological elements as appropriate. You should link these to historical flow time series, which may be gauged, modelled or a combination.

- Modelled historical flow time series allow the use of a wider set of ecological monitoring data compared to restricting ecological monitoring data only to sites paired to gauging stations. In addition, calibration using modelled historical flows can enable a consistent comparison to modelled scenario flows; including an alternative target flow regime, which itself is a scenario.

2. You should consider uncertainties in the hydrological data, whether historical data is observed or modelled. Likewise, you should consider uncertainties in future flow scenarios.

3. For assessment of targets for flow recovery or risk of deterioration statistical models must include both historical ecological data and historical flow data. This is because the ecology responds to actual flow, which is affected both by anthropogenic and natural factors (precipitation and catchment storage). Ignoring the natural factors adds uncertainty.

4. You may represent each water body by at least a single monitoring site but it is beneficial to include water bodies with more than one monitoring site to estimate within-water body variation.

5. You should consider relevant Environment Agency historical ecological monitoring data. In some cases, additional monitoring data may be needed.

6. Studies should follow standard monitoring and data handling procedures used by the Environment Agency, unless a departure can be clearly justified.

7. Statistical models of direct relationships between flow alteration and historical ecological data, which do not include historical flows, are suitable only for screening of existing abstraction impacts, and not appropriate for assessment of targets for flow recovery or assessment of risk of deterioration. This is because the ecology responds to actual flow, which is affected both by anthropogenic and natural factors (rainfall, precipitation and catchment storage). Ignoring the natural component adds uncertainty, which is likely to degrade our overall confidence.

Glossary

Abstraction pressure (on ecology	Abstractions that have or could have adverse effects on the water environment.
Abstraction Pressure gradient	The change of flow or abstraction pressure per unit distance.
Biological quality element	A characteristic or property of a biological element that is specifically listed in Annex V of the Water Framework Directive for the definition of the ecological status of a water body (for example composition of invertebrates, abundance of angiosperms or the age structure of fish).
Designated Sites	These include Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas and Ramsar sites. These sites have designated features, which have various degrees of legal protection.
Good Ecological Status	GES indicates an ecological status that is a slight deviation from reference condition. A primary objective of the WFD is to return all water bodies at less than GES to GES, although it does recognise that this will not always be possible. The WFD defines GES using a range of biological elements that together give an indication of the ecological health of a water body. In England, hydrological status (compliance), defined using the EFI is a supporting element for GES, in recognition that in some cases, river flow may be the limiting element for achieving GES.
Morphology	The form and function or physical structure of the river channel. This defines its ability to allow migration of aquatic organisms and maintain natural sediment transport, and physical features of the channel
Risk of deterioration	The Water Framework Directive requires that none of the quality elements used in the classification of water body status deteriorates to the extent that the overall status is reduced.
Water body	A manageable unit of surface water, being the whole (or part) of a stream, river or canal, lake or reservoir, transitional water (estuary) or stretch of coastal water. A ‘body of groundwater’ is a distinct volume of underground water within an aquifer.
Weight of evidence	A weight of evidence approach integrates results or evidence from several data sources, weighted appropriately, to make risk based decisions

Related documents

- Environmental Flow Indicator: What it is and what it does
- UKTAG (2008). UK Environmental Standards and Conditions. Report of the UK Technical Advisory Group on the Water Framework Directive.http://www.wfduk.org/resources%20/uk-environmental-standards-and-conditions-report-phase-1
- UKTAG (2008). List of reasons for setting alternative objectives.
- Environment Agency (2015): Managing abstraction and flow pressure - implementing hydro-morphological measures (Position statement on implementing hydro-morphological rehabilitation measures where abstraction and flow pressure is identified as not supporting good)
- http://www.wfduk.org/resources%20/list-reasons-setting-alternative-objectives
- AMEC (2013). Environment Agency UKTAG Flow Standards Analysis Project Report. Report to the Environment Agency.

- Acreman, M.C., Dunbar, M.J., Hannaford, J., Bragg, O.M., Black, A.R., Rowan, J.S., and King, J.2005. Development of environmental standards (water resources), Stage 3: regulatory standards. Report to SNIFFER Project WFD48.
- Acreman, M.C., Dunbar, M.J., Hannaford, J., Mountford, O., Wood, P., Holmes, H.T.H., Cowx, I., Noble, R., Extence, C., Aldrick, J., King, J., Black, A., Crookall, D. 2008. Developing environmental standards for abstractions from UK Rivers to implement the EU Water Framework Directive. Hydrological Sciences Journal. 53(6) 1105-1120