Environmental Flow Indicator

What it is and what it does

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The Environmental Flow Indicator (EFI) plays a crucial role in the management of Water Resources in England and Wales. This factsheet sets out how the EFI was developed, how it is used and what assumptions can be drawn from its application.

- **EFIs are used to indicate where abstraction pressure may start to cause an undesirable effect on river habitats and species. They don't indicate where the environment is damaged from abstraction.**
- **Compliance or non-compliance with the EFI helps to indicate where flow may or may not support Good Ecological Status.**
- **The EFI is not a target or objective for resolving unsustainable abstractions. It is an indicator of where water may need to be recovered. The decision to recover water in water bodies that are non-compliant with the EFIs should only occur when supported by additional evidence to provide ecological justification.**
- **In Catchment Abstraction Management Strategies (CAMS) EFIs help to indicate where water may be available for future abstraction without causing unacceptable risk to the environment.**

What is the EFI?

The Environmental Flow Indicator (EFI) is a percentage deviation from the natural river flow represented using a flow duration curve. This percentage deviation is different at different flows. It is also dependant on the ecological sensitivity of the river to changes in flow.

The EFI is calculated within the Resource Assessment and Management (RAM) framework. This assessment gives an indication of where and when water is available for new abstractions. Where the assessment fails a more detailed assessment is required to understand if current abstractions and use of full licensed quantities are threatening the long term health of the river ecology.

Development

Flow standards for the Water Framework Directive (WFD) developed by the UK Technical Advisory Group (TAG) have been adapted to set the EFI. The EFI is set through expert opinion and at a level to support good ecological status. The adaptation was necessary for the Environment Agency to use it within the existing abstraction regulatory regime.

UK TAG (2008) identified the percentage deviation from natural flow (that supports GES) for differing river 'types' and at different flows: low flows (Q95) and flows above Q95. A summary of the outputs from this report is given in Table 1. This was translated for use within the Resource Assessment Methodology to be used in the Environment Agency's Water Resources work.

River type	Flow > Q95		Flow < Q95	
	Mar - Jun	*Jul - Feb*	*Mar - Jun*	*Jul - Feb*
Predominantly clay. South East England, East Anglia and Cheshire plain	25%	30%	15%	20%
Chalk catchments; predominantly gravel beds; base-rich	15%	20%	10%	15%
Hard limestone and sandstone; low-medium altitude; some oligotrophic hard rock	20%	25%	15%	20%
Non-calcareous shales; pebble bedrock; Oligomeso-trophic; Stream order 1 and 2 bed rock and boulder; ultra-oligo trophic torrential	15%	20%	10%	15%
	Oct – Apr	*May – Sep*	*Oct - Apr*	*May - Sep*
Salmon spawning & nursery (not chalk rivers)	15%	20%	10%	15%

Table 1: Flow standards for UK river types for supporting good ecological status given as the percentage allowable abstraction of natural flow (UKTAG, 2008).

Use in Catchment Abstraction Management Strategies

The Catchment Abstraction Management Strategy (CAMS) process has 3 main stages to it:

– Water resource availability assessed using our Resource Assessment Methodology (RAM),
– The licensing strategy,
– 'Measures' appraisal process – that is identifying and delivering things we want to change

Resource availability is expressed as a surplus or deficit of water resources in relation to the EFI. This is calculated by taking the natural flow of a river, adding back in discharges and taking away existing abstractions. This results in a scenario showing both a recent actual and fully licensed river flow. The difference between the fully licensed scenario flow and EFI gives us the amount of water which is available for abstraction and when it is available.

The Environment Agency abstraction regime uses fixed 'hands-off flows'. These give a more effective use of water from the environment by enabling abstraction to cease at set flows, but also enable abstraction from periods of time when more water is available. The EFI is defined for four conditions, ranging from naturally low (Q95) to naturally higher (Q30) flows. To help manage abstraction at higher flows and protect flow variation greater percentages of flow is allowed to be abstracted. Table 2 shows the percentages of flow to be abstracted at three different sensitivities to abstraction (abstraction sensitivity bands) at different flows.

	high flow →			low flow
Abstraction Sensitivity Band	**Q30**	**Q50**	**Q70**	**Q95**
ASB3. high sensitivity	24%	20%	15%	10%
ASB2. moderate sensitivity	26%	24%	20%	15%
ASB1. low sensitivity	30%	26%	24%	20%

Table 2: Percentage allowable abstraction from natural flows at different abstraction sensitivity bands.

Details of all the abstraction licences are recorded in CAMS ledgers (volumes and location and discharges). The ledgers are updated every time a new licence is issued, changed or revoked and are updated to inform future licensing decisions.

The EFI is a fundamental component of how we set out clearly what water is available where and when for potential abstractors. This is detailed in licensing strategies that are developed for each CAMS catchment and are available on the Environment Agency's internet site. The strategies set out the hands off flow and other conditions that will be applied to licence applications. They also include any local constraints that potential abstractors will need to be aware of such as higher levels of environmental protection for designated conservation sites, or where local information has shown that different amounts of water are available in the catchment.

Use in Water Framework Directive

The EFI is used in the hydrological classification for WFD to identify the water bodies where reduced river flows may be causing or contributing to a failure of good ecological status. This is called the compliance assessment. Compliance has been assessed at low flows (Q95) using recent actual scenario.

The compliance assessment shows where specific scenario flows are below the EFI, and indicates by how much. This is used to identify areas where flows may not be supporting good ecological status and target further investigation of what measures are needed to achieve good ecological status.

The degree of non-compliance has been split into three compliance bands, each band indicating the certainty that flow conditions does not support good ecological status. The compliance bands help to prioritise action where the abstraction pressure, and therefore the risk of not supporting good ecological status are greatest. The percentage below natural flow for each compliance band is shown in Table 3.

	Flow adequate to support GES	**Flow not adequate to support GES: Low to Moderate Confidence (uncertain)**		**Not adequate to support GES: High Confidence (quite certain)**
Abstraction Sensitivity Band	***Compliant with EFI***	***Non-compliant Band 1*** (up to 25% below the EFI at Q95)	***Non-compliant Band 2*** (25-50% below the EFI at Q95)	***Non-compliant Band 3*** (more than 50% below the EFI at Q95)
ASB3. high sensitivity	<10%	<35%	<60%	>60%
ASB2. moderate sensitivity	<15%	<40%	<65%	>65%
ASB1. low sensitivity	<20%	<45%	<70%	>70%

Table 3: The percentage difference from natural flows for each compliance band and how this relates to supporting good ecological status (GES). Percentages given are the range below natural flow for the relevant abstraction sensitivity band.

Glossary

Abstraction Sensitivity Bands (ASB)	There are three abstraction sensitivity bands assigned to each water body in England and Wales: ASB1 – low sensitivity; ASB2 – moderate sensitivity and ASB3 – high sensitivity. Each of the ASB has a different EFI associated with it allowing less abstraction in high sensitive sites and more in sites with lower sensitivity. Each of these sensitivity bands was developed from assessment of 3 components: – Physical typology – using river 'types'. – Macroinvertebrate typology – using expected Lotic index for Flow Evaluation (LIFE) scores – Fish typology – using identification of a fish 'guild' expected under particular physical parameters. – Scores and confidence ratings from each component are combined to give the overall ASB for the waterbody.
Good Ecological Status	Good Ecological Status (GES) defines a water body as only being a little way from being in its totally natural state. It is the main objective of the WFD to return all water bodies to this near natural condition, although it does recognise that this will not always be possible. GES covers a variety of elements that give an indication of the health of a water body and its ability to support life. Hydrology is a supporting element for good ecological status - but in some situations, flow may be the limiting element for biology and for achieving good ecological status.
Natural Flows	The river flow that would have occurred without any human influences. This is calculated by starting with a gauged flow/recent actual flow and adding back in the abstractions and taking out the discharges. It can also be calculated from other surface water or groundwater models.
Scenario Flow	The scenario flow that is generated by denaturalising the natural flow taking into account abstractions and discharges operating at their recent actual rate (**recent actual scenario**) or abstractions operating at their full licensed limit and discharges operating at their recent actual rate (**fully licensed scenario**).
Waterbody	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.
WR GIS	The WR GIS uses ArcView. The abstraction, discharge, natural flows and complex impacts information from the CAMS ledgers is uploaded onto this central system. The WRGIS uses this information to calculate the current resource availability for each water body at four flow percentiles.

External References

– UKTAG (2008) UK environmental standards and conditions. Report of the UK Technical Advisory Group on the Water Framework Directive.