ARMI Trigger Level Setting Guide

1. Background

An ARMI 'trigger level' score is agreed between ARMI Monitors or Co-ordinators and the local EA Ecology Contact. The purpose of the trigger level score is normally to act as a threshold below which a pollution incident is indicated. In setting the trigger level, the aim should be to strike a balance between detecting real events, and avoiding false alarms.

ARMI scores may be affected by other factors such as season, flow conditions, and hydromorphological pressures (e.g. flow, sediment, habitat modification). There may be limited scope for addressing some factors relating to human activity (e.g. modification for flood risk in urbanised catchments), which can make the detection of pollution incidents more problematic.

Different approaches have been taken to setting trigger levels. None appears inherently more valid than another, and therefore a single standardised approach is not recommended. Principally, a trigger level that has been set by a reasoned approach which can be explained to volunteers, and is reviewed as necessary, is likely to produce the best outcomes.

This document sets out some of the options for trigger level setting, along with some related advice and best practice tips.

2. Who is this document aimed at?

This document is aimed at anybody involved in setting trigger levels or interpreting ARMI results, including EA Ecology Contacts, ARMI Monitors, and ARMI Co-ordinators.

3. Approaches to setting trigger levels

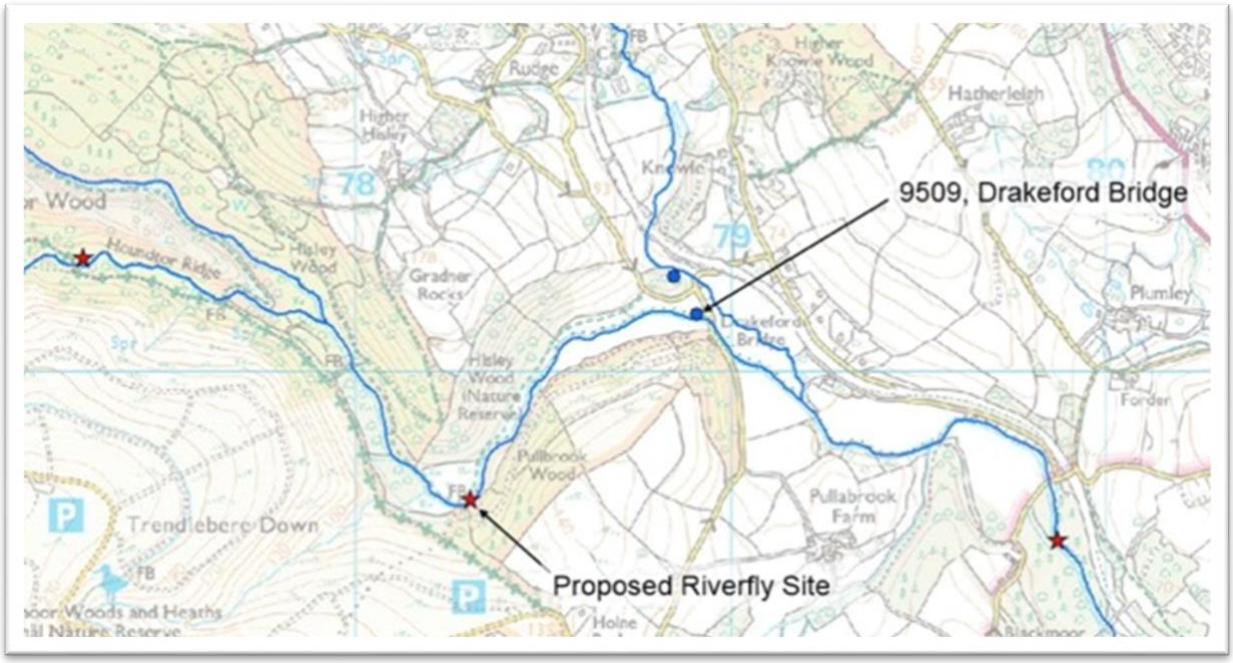
3.1 The Lincolnshire and Northamptonshire approach

1. See if a run of invertebrate data exists for a point at or near to the volunteer's sampling point. If not, find one on a similar site nearby on another river. The longer the run of data, the better and try to ensure that it covers all conditions of season, drought or flood.
2. Calculate the ARMI scores and plot them versus date. LARDAT will do this for you.
3. By eye, fit a line that represents a transition-point between 'good' scores and 'less good' ones. This is your trigger value. If you are aware of a plotted point where a known incident occurred, this must, of course, lie below the trigger point.
4. Regularly review the score generated by your volunteer versus the trigger. If it feels too low, revise it up. If it is constantly breaching for no reason other than

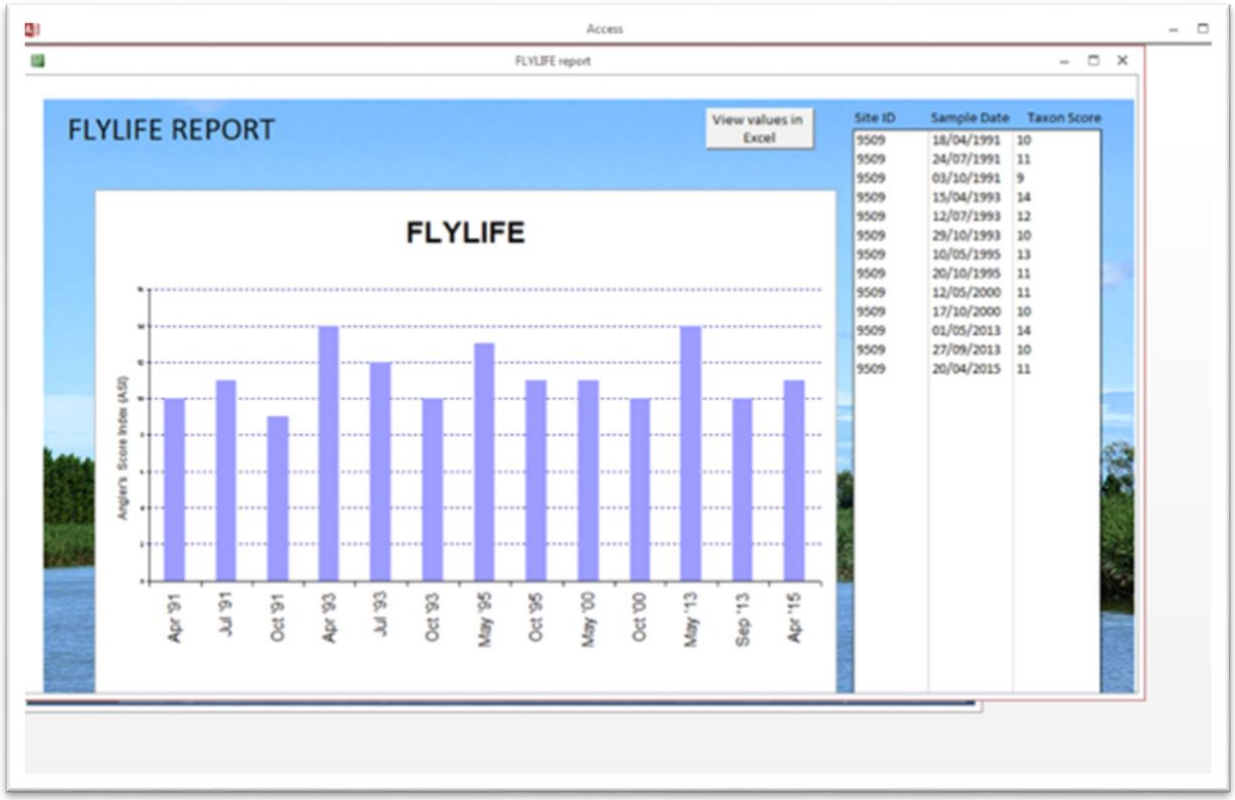
a general known malaise, you may consider revising it down, but this is not the most desirable option.

3.2 The Devon and Cornwall approach

1. Look for a nearby EA monitoring site with similar characteristics to the ARMI site for which a trigger level is to be set. This could be on the same watercourse, or a similar watercourse within the region.



2. Select the site on LARDAT (Logger and Routine Data Appraisal Toolkit), and then use the ‘Flylife’ option to calculate the historical scores for the site (NB – it is now possible to generate Extended Riverfly scores).



3. Copy the dataset into Excel.

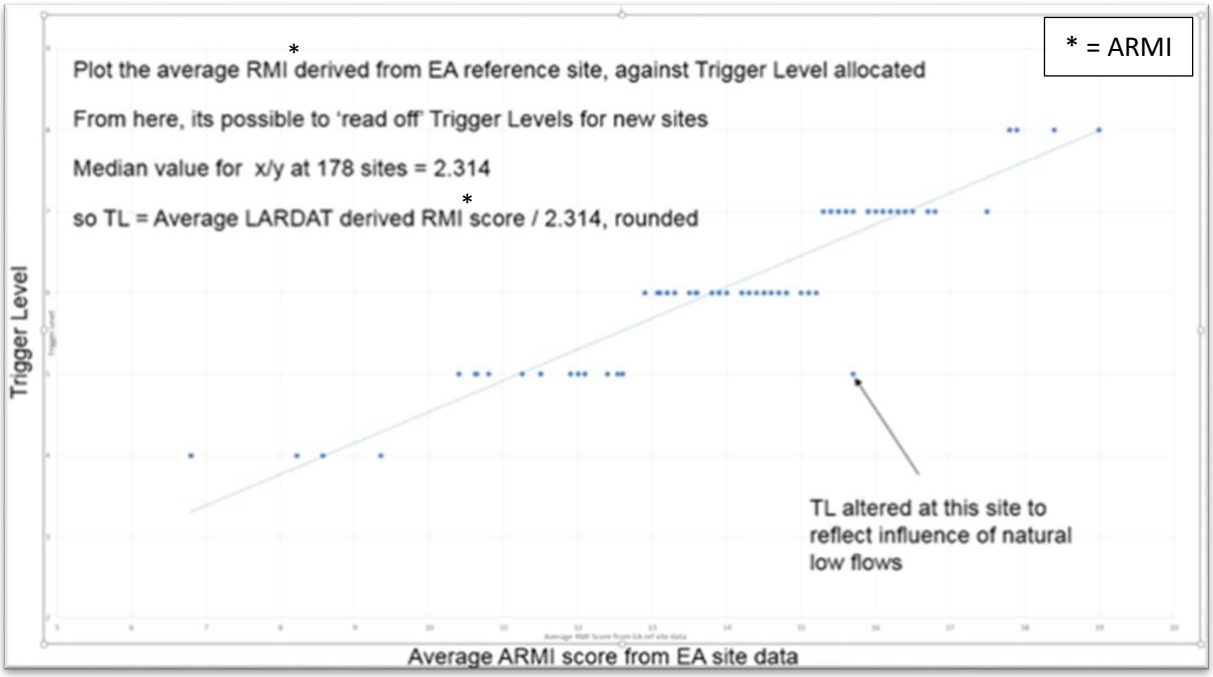
4. Remove any data points thought to have been affected by pollution.

5. Calculate the mean and standard deviation of these scores.

	A	B	C	D	E	F	G	H	I	J
1	SITE_ID	9509	9509	9509	9509	9509	9509	9509		
2	FLYLIFE group	BWO (Ephemerellidae)	Cased caddis	Caseless caddis	Flat bodied (Heptageniidae)	Freshwater shrimp	Olives (Baetidae)	Stoneflies		
3	18/04/1991		2	2	2		2	2		10
4	24/07/1991	2	1	2	1	1	2	2		11
5	03/10/1991		2	2	1		2	2		9
6	15/04/1993	1	2	3	3	1	2	2		14
7	12/07/1993	2	2	2	1	1	2	2		12
8	29/10/1993		2	2	2		2	2		10
9	10/05/1995	1	2	2	3	1	2	2		13
10	20/10/1995		3	2	2		2	2		11
11	12/05/2000	1	2	2	2		1	3		11
12	17/10/2000		3	1	2		2	2		10
13	01/05/2013	1	2	2	2	2	2	3		14
14	27/09/2013		1	2	1	2	2	2		10
15	20/04/2015	1	2	2	2	1	2	1		11
16										
17										
18										
19									MEAN	11.23
20									SD	1.59

6. Apply a ‘fudge factor’ to allow for the increased likelihood of missing taxa or underestimating abundance in the field. This can either be informed by judgment, or by using existing sites where meaningful trigger levels have already been set by following the steps below.

    i) Plot the average ARMI score against the trigger level for each established site. Add a line of best fit.
    ii) It should then be possible to ‘read off’ future trigger levels if you have generated an average ARMI using the Flylife function in LARDAT. In Devon and Cornwall, the average TL = Average LARDAT derived ARMI score / 2.314, meaning that the average trigger level is slightly below half the average LARDAT-derived ARMI score.



7. Divide the average ARMI score by the ‘fudge factor’. Round the resulting score up or down as considered appropriate to the nearest whole number.

8. Consider the standard deviation calculated from the EA data to inform you as to how naturally variable the ARMI scores are likely to be, and adjust your trigger level accordingly.

9. Consider whether there are any additional factors which may necessitate moving the trigger level up or down, such as catchment geology or known stressors.

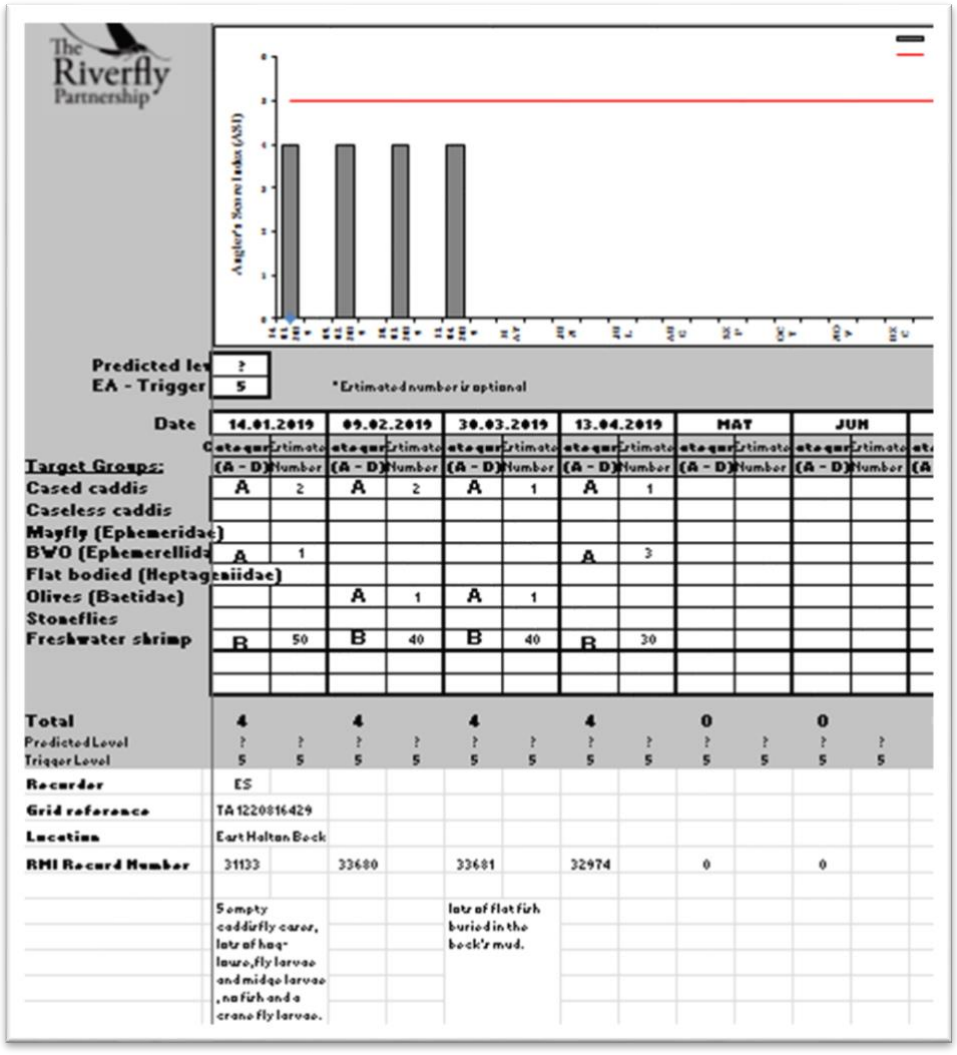
3.3 Minimum trigger level of 5

In some circumstances, trigger levels have been set very low, meaning that incidents could go undetected and volunteer effort may be wasted. One proposed solution is to set a default minimum trigger level for all sites. Based on initial discussions, a minimum trigger level of 5 may be suitable for a broad range of river types. Ideally, this would only be moved upwards if a more ambitious target is needed.

However, there are mixed views on this approach, and it is therefore only recommended where it is understood and agreed between the EA Ecology Contact and ARMI Coordinator and/or Monitor.

Some sites with ongoing issues may consistently fail to achieve this minimum level. The justification of setting a more ambitious target for such sites is to emphasise that in most cases it should be possible to achieve this level if remedial measures are taken. If this approach is used, this must be effectively communicated to those involved in monitoring. ARMI Monitors and Co-ordinators would need to understand the need to look beyond the raw scores and appreciate changes which indicate an incident. Such changes may include the sudden drop in abundance of a type of invertebrate, which cannot be attributed to seasonality or normal patterns for a site.

In the example below from Lincolnshire and Northamptonshire Area, the ARMI score consistently fails to achieve the desired trigger level. However, it can also be seen that it is relatively stable, both in terms of invertebrate types and the overall score. This is indicative of a scenario where the invertebrate community is influenced by background pressures such as modification. In such a case, there is even greater emphasis on looking at changes in individual invertebrate groups to indicate an incident, such as the sudden loss of *Gammarus*. In cases such as this, the minimum trigger level can act as a target which may be achieved if action is taken to improve a watercourse.



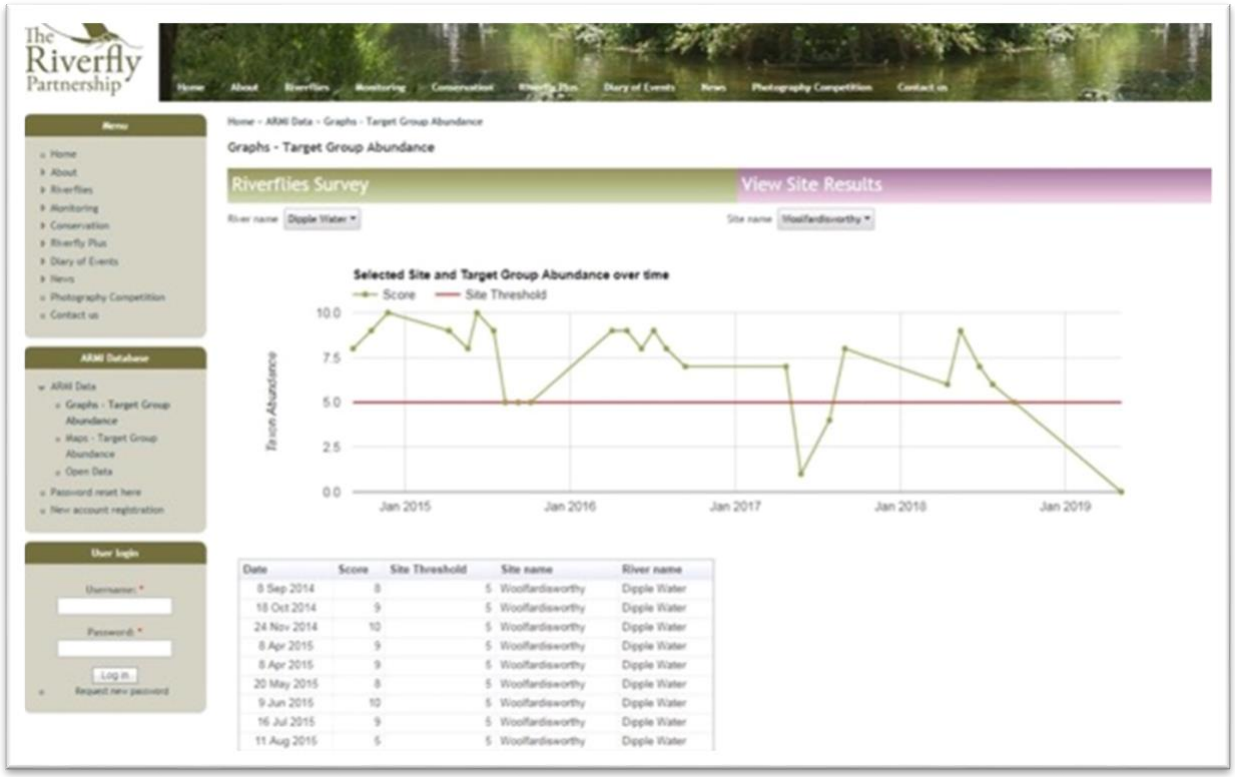
4. Reviewing trigger levels

It is good practice to periodically review trigger levels, particularly for newer sites with relatively little associated data.

Reviewing of trigger levels should ideally be prompted by the ARMI Monitor or Co-ordinator; however there is an expectation that the local EA Ecology Contact should provide all necessary support to ensure a meaningful trigger level is set.

Example – trigger level reduced

In the example below, the trigger level was reduced from 7 to 5 following an investigation which identified proximity to source, watercourse size and natural low flows as natural influences on the invertebrate community, as well as a known pollution point source. With these known factors, a reduced trigger level was found to be more useful in indicating additional ecological stress to be investigated. As can be seen, gross pollution events in 2017 and 2019 were still evident in spite of these other factors.



5. Interpreting a trigger level breach

When trying to decide whether ARMI data indicates a pollution incident, it is important to look beyond the raw scores at the specific community changes.

The freshwater shrimp *Gammarus* sp. is a key example. *Gammarus* can be highly susceptible to pesticides, and their sudden disappearance can provide key evidence of this pressure.

ARMI scores are often suppressed in the winter months (December to February), due to the behaviour and life cycles of river invertebrates, or difficulty in sampling. Due caution should

be applied when interpreting ARMI results collected in the winter as lower scores will naturally be expected. Pollution events may still be indicated, particularly if severe enough to affect a range of invertebrate types. However, without additional indications of pollution (dead fish, sewage fungus, odour), it may be necessary to review scores in spring.

In certain catchments, particularly those which are rain-dominated and flashy, natural low summer flows may suppress ARMI results. It may be possible to discern a pollution impact from the data, but local understanding will be critical in making this distinction. In contrast, scores are likely to be more consistent across the seasons in chalkstreams.

Part of the EA Ecology Contact's role is to help volunteers understand their own rivers, including such seasonal effects.

6. Best practice summary

EA Ecology Contact

- Attend initial training days and refresher days, and take the opportunity to discuss trigger level setting with volunteers in person.
- If possible, attend a first site visit with volunteers to embed their learning and establish a co-operative relationship.
- Document site specific trigger levels and their justification, and be prepared to share and discuss your reasoning with ARMI volunteers and co-ordinators.
- Set a trigger level which strikes a balance between detecting real events, and avoiding false alarms. If unsure, consider a trigger level of 5 and revise if necessary.
- Upon request from the ARMI Co-ordinator or volunteer, review site-specific trigger levels after a minimum of monthly data from April to September has been collected.

ARMI Co-ordinator/volunteer

- Expect lower ARMI scores in the winter, and be aware that you may need to re-check a site in the spring.
- Get to know the normal seasonal patterns in your watercourse. For example, blue-winged olive numbers tend to peak for a short period of time in the year, whilst *Gammarus* numbers may be fairly stable throughout most of the year.
- Don't just focus on the overall ARMI score. Look for unusual changes in the invertebrate community, such as the sudden drop in abundance of a type of invertebrate which cannot be reasonably attributed to seasonality. This is especially true of *Gammarus*, as they can be uniquely sensitive to certain pollutants such as pesticides, though other groups may be susceptible to other pressures.