

# Technical summary

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## **The Investigation and Specification of Flow Measurement Structure Design Features that Aid the Migration of Fish Without Significantly Compromising Flow Measurement Accuracy, with the Potential to Influence the Production of Suitable British Standards. Phase 1- Review** R&D Technical Summary W6-084/TS

### Background & Need

The low effective rainfall per capita in England and Wales puts enormous pressure on water resources and the aquatic ecology dependent on it. We therefore need to measure low flows as well as high flows, in order to be able to manage our water resources effectively. Frequently, this requires the use of specific types of gauging weir that, like all weirs, have the potential to compromise the ecological value of the river habitat. In the past, the design and construction of flow measurement structures has sometimes paid little regard to ecological needs, particularly by restricting the free migration of fish between the reaches of river upstream and downstream of the structure. Our improvement in understanding of ecological needs has led us to identify potential impacts, previously unsuspected.

The Agency must meet British Standards for flow measurement, but there are currently significant gaps in the British Standard specifications or other guidance for flow measurement structure design in relation to fish passage, which this project aims to address.

Key issues are:

- The conflict between hydrometric and fisheries needs
- The operational need for higher flow measurement accuracy under low flow conditions
- The multiple factors affecting fish swimming performance, and limited research on the subject

The objective of the overall project is:

To produce guidance or proposed amendments/additions to British Standards design features of flow measurement weirs and compound weir structures to aid the migration of fish without significantly compromising flow measurement accuracy.

### Approach & Findings

Phase 1 of the R&D involved internal and external consultation by means of a questionnaire, a half-day workshop, and individual meetings. This was complemented by an international literature review.

General findings from the Phase 1 review are:

- Within the Environment Agency, there is a general agreement that low to medium flows should be measured with uncertainty levels no greater than +/- 5%.
- There is extensive use of Crump, Flat-V and compound weir structures within the Agency.
- Information on fish swimming capabilities is extensive but not comprehensive or precise. 'Burst' rather than 'cruising' speeds are relevant to passage over or around gauging weirs. Weirs present more of a barrier to freshwater fish species than to salmon or sea trout.
- The most commonly used and appropriate fish pass devices in England and Wales are Pool and Traverses, Denil and Larinier (or derivatives). Such fish passes may be placed in separate by-pass channels, or may be combined with standard gauging structures to form compound structures using a divide wall.
- Adaptations to the downstream face of weirs, the easement approach, also offer potential solutions to the fish passage problem. The solution on the Moors River at Hurn, Dorset, is an example.
- Retrofit solutions are required, in addition to guidance on new structures.
- The problem of trash being caught in fish passes needs addressing.

- Need to consider minimising afflux (the head drop between levels upstream and downstream of a weir), aeration, turbulence and flow convergence and to provide easy approaches.
- Need to attract fish effectively to fish pass entrances, and to protect them at exit from being swept back over the weir.

Phase 1 also developed a prioritised programme of desk and laboratory studies that best serves the Agency's immediate needs for new/revised guidance and design standards for new and reconstructed gauging structures to aid the passage of fish. The highest priority studies proposed for Phase 2 were:

- Desk study on the combined uncertainties associated with the introduction of fish passage aids at standard flow measurement structures
- Desk study to review the problems of trash at fish passes and ways of minimising accumulations
- Laboratory testing of the fundamental requirements for the near-crest arrangements for baffles on the downstream face of a measuring weir
- Laboratory tests to provide an accurate hydrometric calibration of a Larinier (bottom baffle) fish pass
- Laboratory testing of a Larinier fish pass with a submerged orifice upstream intake set alongside a flow measurement structure

#### Implementation

The study proposals above are being taken forward as Phase 2 of this R&D project by HR Wallingford. This will result in a Phase 2 Technical Report that summarises the experiments, provides guidance, incorporates proposed amendments and additions to existing British Standards for gauging weirs or construction guidelines, and gives recommendations for future work.

This R&D Technical Summary relates to information from Phase 1 of the R&D Project W6-084 reported in detail in the following output: -

#### **R&D Technical Report W6-084/TR1**

**The investigation and specification of flow measurement structure design features that aid the migration of fish without significantly compromising flow measurement accuracy, with the potential to influence the production of suitable British Standards.**

#### **Phase 1 - Review**

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Project Manager  
Rachel Tapp, Midlands Region

Research Contractor  
HR Wallingford Ltd, Wallingford

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© Environment Agency  
Rio House  
Waterside Drive  
Aztec West  
Almondsbury  
Bristol  
BS32 4UD

Tel: 01454 624400  
Fax: 01454 624409