

Department for Environment, Food and Rural Affairs

Floods and Reservoir Safety Revised Guidance for Panel Engineers

1. Introduction

- 1.1 In late 1999, CEH-Wallingford published its Flood Estimation Handbook (FEH) which contained a new methodology for the estimation of return period floods in the United Kingdom. The FEH indicated that it was designed to estimate rainfalls up to a return period of 2,000 years, but could with caution be used to extrapolate estimates up to 10,000 years.
- 1.2 After a short period of use, the reservoir profession in the UK started to express concern about the results being obtained at high return period rainfalls. In some cases, it was being found that the 1 in 10,000 year rainfall depth was greater than the probable maximum precipitation (PMP) assessed from the Flood Studies Report 1975 (FSR).
- 1.3 In view of these concerns, the Department of Environment, Food and Rural Affairs (Defra) commissioned Babtie Group, in association with CEH-Wallingford and Rodney Bridle Limited to undertake a brief study into the use of the FEH rainfall methodology for reservoir flood assessments. The resultant report was published on the Defra website in November 2000, under the title "Floods and Reservoir Safety – Clarification on the use of FEH and FSR Design Rainfalls". Chapter 5 of that Report gave "Interim Guidance for Panel Engineers", pending the results of more detailed research which was recommended.
- 1.4 Since the publication of the Babtie report, Defra has commissioned Sir David Cox of Nuffield College, Oxford to assess the appropriateness of the extrapolation techniques adopted in the FEH for the higher return period rainfalls. His report entitled "Some comments on 10,000 year return period rainfall" was submitted to Defra in 2003. It is now available on the Defra website.
- 1.5 Defra now feel it appropriate to issue revised guidance to Panel Engineers based on the findings of the Cox Report. This guidance is contained in Section 2 of this note and has been prepared by the Reservoir Safety Working Group (RSWG) of the Institution of Civil Engineers. It should still be regarded as interim guidance as the Cox Report makes recommendations for further research, which Defra is keeping under consideration in terms of the implications for programme period and funding. However, the Section 2 guidance should give clearer direction to Panel Engineers when considering floods and reservoir safety.

2. Revised Guidance

- 2.1 The FEH should not be used for the assessment of 1 in 10,000 year return period rainfall. Further research on this will be undertaken but as the results may not be available for a number of years, the design rainfall values provided by Volume 2 of the FSR should continue to be adopted until this research is completed.
- 2.2 For 1 in 1,000 year return period rainfall, assessments should be undertaken for both the FEH and FSR methodologies. The more extreme of these design rainfalls should be used for flood assessment. However, it should be noted that the research recommended into the FEH extrapolation may result in further revision to rainfall assessment at this return period, as some concern has been expressed that 1 in 1,000 year rainfall may be over-estimated by the FEH.
- 2.3 The FEH should be used for the assessment of the 1 in 193-year return period rainfall (suitable for the estimation of the 1 in 150-year return period flood event).

3. Other Matters

- 3.1 Defra is aware that there is some confusion as to whether or not elements of the FEH, such as FEH catchment descriptors, can be used with the FSR methodology. The following is offered as guidance to individuals or organisations undertaking reservoir flood studies:
- (a) For PMF studies, it is recommended that the FEH catchment descriptors should replace the FSR catchment characteristics in the derivation of $T_p(0)$ (instantaneous time-to-peak), PR (percentage runoff), and BF (baseflow) for use within the general methodology outlined in the FEH when appropriate gauged data is unavailable. There will be occasions where the 1 in 10,000 year return period rainfall depth assessed using the FEH methodology is greater than the PMP. However, this should not be used as a substitute for the PMP.
 - (b) For 1 in T-year studies, the FEH catchment descriptors should replace the FSR catchment characteristics in the derivation of $T_p(0)$ (instantaneous time-to-peak), PR (percentage runoff), and BF (baseflow) for use within the general methodology outlined in Volume 4 of the FEH, when appropriate gauged data is unavailable.
 - (c) Volume 5 of the FEH recognises and draws the attention of the reader to the fact that in some cases the FEH software may incorrectly estimate the catchment area. This is associated with the accuracy of the digital terrain model (DTM) within the software. It is understood that CEH-Wallingford will be producing a revised version of the software towards the end of 2004. Nevertheless, as a matter of good practice, it is recommended that manual checks be made on catchment areas and their drainage networks assessed using the FEH software, particularly where there are apparent differences from those calculated by other methods and information which may be contained in the Prescribed Form of Record.
- 3.2 Research into the rainfall-runoff model at lower return period events is being undertaken currently as part of the Environment Agency's flood defence programme. In due course, this may impact on reservoir flood study methodology. The Reservoir Safety Working Group is aware of this work and one of its members also sits on the Steering Group for the rainfall-runoff research. Defra will issue guidance on this to reservoir engineers at an appropriate time and will consider the need for further research into rainfall-runoff modelling at greater return periods.
- 3.3 The research project into "Integration of Floods and Reservoir Safety" recommended that in the long term, estimation of floods should move away from the concept of probable maximum precipitation and probable maximum flood towards a fully probability based approach. Professor Cox has recommended that research should look at an approach combining both frequency based and PMP methodologies, illustrating this in the Appendix to his report. Defra is keeping this under consideration in terms of the research required and consequential implications for programme period and funding.

4. Risk Assessment for Dams

- 4.1 By following a risk assessment approach, it is possible that Panel Engineers may find that additional expenditure on spillway upgrading is not justified in terms of the benefits it will give in reducing potential loss of life in the event of a dam breach. Most Panel Engineers should be aware that "An Interim Guide to Quantitative Risk Assessment for UK Dams" will be published during 2004 following research funded by Defra. This will introduce the concept of QRA for reservoirs in the UK.

- 4.2 Panel Engineers may wish to consider the benefits of undertaking a risk assessment prior to requesting any measures in the interests of safety solely related to the need to improve flood handling capacity at a reservoir.

Reservoir Safety Working Group
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