DEPARTMENT for ENVIRONMENT, FOOD and RURAL AFFAIRS **CSG 15**

Research and Development

Final Project Report

(Not to be used for LINK projects)

Two hard copies of this form should be returned to:
Research Policy and International Division, Final Reports Unit
DEFRA, Area 301
Cromwell House, Dean Stanley Street, London, SW1P 3JH.
An electronic version should be e-mailed to resreports@defra.gsi.gov.uk

Project title	Automation and appraisal of the FEH statistical procedures for flood frequency estimation
DEFRA project code	**FD1603**
Contractor organisation and location	CEH Wallingford
Total DEFRA project costs	£ 90,000
Project start date	01/09/00
Project end date	23/10/03

Executive summary (maximum 2 sides A4)

This report contains a number of important findings and recommendations that will lead to improvements in the performance of the Flood Estimation Handbook (FEH) statistical method, the principal procedure for flood estimation in the UK. The report also describes how datasets of nationwide flood estimates – now being used by the Environment Agency and the insurance industry as a key input to the next generation of national flood risk maps – have been produced and how they could be further developed.

The FEH statistical method comprises a series of procedures for estimating the flood peak of a specified return period at almost any site, gauged or ungauged, on the UK river network[1]. The performance of the method has been appraised by automating its component procedures and applying them for several return periods at 50 m intervals throughout a large part of the national river system. As well as providing rigorous evidence of the performance of the method, this work has provided comprehensive network-wide flood estimates for England, Wales and part of southern Scotland.

The return periods used were selected to coincide with the requirements of the Environment Agency's programme of Catchment Flood Management Plans, namely 2, 5, 10, 25, 50, 100 and 200 years; this spans the full recommended range of capability of the FEH statistical method. Subsequent applications additionally necessitated the estimation of the 250 and 1000-year floods, reference to which is included in this report.

The effect of automation was assessed at selected locations by comparing the results with those produced by experienced FEH users. The performance of the FEH method was assessed by comparing the automated results with estimates derived directly from observed floods at several hundred gauging station locations, and by checking for internal spatial inconsistencies within the network-wide FEH estimates. The project did not include any comparison with other methods of estimating floods at ungauged sites.

Numerous modifications were made to the procedures during the development of the automated method in order to avoid or reduce the spatial inconsistencies that would have been generated by adhering to FEH rules and guidance. Many of these changes are recommended for use in any future versions of the FEH. They primarily affect the selection and weighting of donor and analogue stations and the selection and weighting of pooling-group members.

[1] The method is not recommended for catchments that are smaller than 0.5 km^2, heavily reservoired or highly urbanised.

Analysis of the results shows that, after the above modifications, the FEH method performs well in most places from the aspect of spatial coherence. Problems occur at a minority of confluences, usually where catchments of very different permeability converge or where there is a change in the set of donor gauges being used, and in the vicinity of gauging stations whose observed median annual flood differs greatly from that predicted by the FEH national equation. The causes of the problems have been analysed and solutions are suggested. Included in the suggestions is a new, additional, procedure for ensuring that flood estimates throughout a river system are spatially coherent.

The incidence of inconsistencies, at individual sites, between flood estimates for different return periods has been investigated and quantified. Changes to the procedures are recommended in order to remove the causes of these inconsistencies.

Pooling-group performance has been investigated in some detail. Several changes to the pooling procedure have been shown to be capable of improving the performance of the method. Some results suggest that uncertainties over the benefits of pooling-groups still exist. Recommendations for further research are made, the most important of which is for an investigation into the use of FEH rainfall growth statistics for defining pooling-groups.

Revisions to the statistics used for quantifying pooling-group heterogeneity and goodness-of-fit have been developed. These have a significant effect in many locations, which may influence the flood estimates obtained by FEH users.

The datasets of automatically produced flood estimates, created during this project, are not everywhere as reliable as the estimates for individual sites that could be made by an experienced user of the FEH, but they are still of value for a number of applications, particularly where estimates are required throughout a region. The report discusses the limitations of these datasets and suggests how they might be improved.

Whilst this report will primarily be of interest to users of the FEH, no prior knowledge of the FEH has been assumed.

Scientific report (maximum 20 sides A4)

An electronic copy of the full report has been supplied to Defra.

The contents list is reproduced below.

CONTENTS

Please press enter