EXECUTIVE SUMMARY YEAR 2

Contract No. EVG1-CT-2001-00037 ***Reporting Period***: Year 2: Dec 2002- Nov 2003
Title: IMPACT – Investigation of Extreme Flood Processes and Uncertainty

Objectives:
The IMPACT Project comprises work packages investigating breach formation, flood propagation and sediment movement under extreme flood conditions as well as the effectiveness of using geophysical techniques for assessing flood defence embankment integrity. Each of the 'process' areas have been identified as contributing significantly towards uncertainty in flood condition prediction (flood risk management). A fifth area of research combines science from each of the process areas, through consideration of uncertainty within the modelling or prediction process.

Research work on breach formation has been divided into four areas: field modelling, laboratory modelling, numerical modelling and identifying breach location. The latter is scheduled for analysis in Year 2/3. Test programmes for field, lab and numerical modelling are tiered so that data from the field work links with the lab tests and both are used in a numerical modelling programme that is designed to compare existing model performance and allow model validation and development. Key objectives for Year 2 are to undertake remaining (3 of 5) large scale field tests (failure of embankments up to 6m high), 13, laboratory scale tests (relating to the field tests) and to continue a programme of numerical model comparison.

Flood propagation research divides broadly into two areas: investigation and modelling of flow through urban areas and modelling of extreme floods along real valley topography. The latter is schedule for months 18-36 only. Research objectives for Year 2 include completion of work investigating numerical modelling of flow through urban areas and initiation of work investigating flood propagation over natural terrain. The latter includes collation of extensive data for the 'combined' project case study for demonstration of state of the art modelling of breach, flood propagation, sediment movement and uncertainty analysis.

Investigation of sediment movement divides into two areas of work, namely near field processes (sediment entrainment and movement) and far field processes (river morphology under extreme flood conditions). Near field conditions are being investigated in Years 1-2, far field in Years 2-3. Therefore, for this Year 2, work in both areas has been progressed.

Uncertainty analysis is recognised as an important component of effective flood risk management. Provision of uncertainty information with best estimates of flood conditions (whether water level, time to flooding, bed level changes etc.) allows the risk manager to make a more informed decision. Assessment of potential approaches and techniques resulting in a position statement for application to extreme flood modelling was undertaken.

Scientific Achievements:

<u>Breach Formation</u>
Following 2 tests in Year 1, 3 remaining large-scale field tests have been completed during Year 2. These comprised failure by overtopping of a composite embankment structure (moraine core, non-cohesive fill) and failure by piping of a homogeneous bank (moraine material) and a composite structure (moraine core, crushed rock fill). Data collected includes flow, water levels, breach growth and extensive photo and video footage.

A further 13 laboratory tests were undertaken in support of the field tests. Eight tests on overtopping failure of a homogenous, cohesive embankment (1:10 scale to field tests) were undertaken. Two pipe initiation tests at 1:7.5 scale supported development of field pipe initiation work. Three pipe formation tests on samples of real earth (cohesive) embankment material provides a comparison between laboratory and real field conditions.

Processing of field and laboratory data precedes more extensive application and development of numerical models – now scheduled for Year 3.

Flood Propagation
Work comparing the accuracy of different approaches for simulation of urban flooding (i.e. 1D, 2D, flow resistance etc) was completed. Analysis of model predictions of flow around single obstructions (buildings) was also completed allowing an assessment of typical modelling accuracy and consistent errors or features. Considerable work was undertaken to investigate, identify and collate real case study data appropriate for use as the overall IMPACT case study. Efforts eventually focussed upon the Tous Dam failure (Spain and the catastrophic flooding of Sumacárcer. This data will be used to demonstrate flood propagation prediction, breach model prediction and overall uncertainty analysis.

Sediment Movement
Data for benchmark (BM) 1 (dambreak flow over a moveable bed) has permitted comparison of 1D model performance. Collation of data under BM1 for BM2 highlighted the need for different flume facilities. These have been constructed ready for testing in Year 3. Model development (both 2D-V for near field and 2D-H for far field) has been initiated and preparatory work undertaken for BM4 which will focus on the far field effects of dambreak flow on graded (bimodal) sediments. Efforts have also focussed upon collection of data for the overall IMPACT case study. Lake Ha! Ha! (Canada) has been selected as a good example for analysis of sediment movement.

Uncertainty Analysis
During Year 1 initial ideas and concepts for uncertainty analysis were considered. During Year 2, these were developed further through a series of concept notes and workshop discussion sessions. A position statement was reached outlining the extent of analysis and approach to be adopted for application during Year 3 of the project using the overall project case study data (Tous Dam failure and / or Lake Ha! Ha! failure).

Monitoring and Case Study Data
Initial data collection (breach formation) in both Czech Republic and Hungary has been undertaken and continues into Year 3, before analysis is undertaken.
A second phase of field monitoring work (geophysics) has been implemented in Czech Republic, with initial results (comparison against 1st phase data) indicating some potential correlations between geophysical approach and embankment condition (and hence performance). Detailed analysis of this data and conclusions for geophysics application in this area will proceed in year 3.

Socio-economic relevance and policy implications:

Research under the IMPACT Project contributes towards improved knowledge and understanding of extreme flood processes and in the development of tools for flood risk management. Widespread flooding across Europe during the summer of 2002 once again demonstrated the severe social and economic impacts that such flooding can bring. Through contributing towards improved flood risk management IMPACT helps to reduce these impacts on society.

Conclusions:

Year 2 has seen the expansion of the IMPACT project to include 2 additional East European partners focussing on breach formation field data collection and analysis, and the application of geophysical techniques for embankment integrity assessment. Work in the existing 5 theme areas has progressed, with the emphasis of work shifting from field and lab data collection towards numerical model analysis, comparison and development. Year 3 will see completion of the model application, assessment and development allowing conclusions and recommendations for practical implementation to be made.