



SID 5 Research Project Final Report

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2. Project title
3. Contractor organisation(s)
4. Total Defra project costs
5. Project: start date
end date

6. It is Defra's intention to publish this form.
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In all cases, reasons for withholding information must be fully in line with exemptions under the Environmental Information Regulations or the Freedom of Information Act 2000.

(b) If you have answered NO, please explain why the Final report should not be released into public domain

Not applicable

Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

1. INTRODUCTION

This project represents the **second phase** of research and development to update the FHRC's previous project appraisal Manuals for Flood and Coastal Erosion Risk Management [FCERM]. Those Manual were published in 1977; 1987; & 1992. The **first phase** was undertaken in project **FD 1705** between 2001 and 2003 and resulted in the draft **Multi-Coloured Manual** and **CD** that was finished in December 2003.

During this time Government policy for flood and coastal erosion risk management has changed significantly from that of the 1990s. The Department for the Environment, Food and Rural Affairs (Defra) has superseded the Ministry of Agriculture, Fisheries and Food (MAFF) as the government department responsible for flood and coastal erosion risk management (previously 'flood defence' and before that 'land drainage'). In turn, Defra has developed an important new FCERM policy in the form of 'Making Space for Water' (MSFW) which has significant implications for project appraisal – e.g. balancing national and local priorities – and for government investment priorities.

Making Space for Water: The aim

“To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as:

- *To reduce the threat to people and their property; and*
- *To deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.*

To secure efficient and reliable funding mechanisms that deliver the levels of investment required to achieve the vision of this strategy.”

The rationale of the Manual and Handbook that are the result of this project is to aid and improve investment decision-making so as to try **“To deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles” (see above)**. The relevant decisions are about investment in fluvial flood risk management schemes (including non-structural projects), and at the coast in schemes to manage the risks of both coastal flooding and the erosion of the land by the sea. These decisions should be seen in the context of the modern philosophy of an integrated approach to catchment and coastal zone management.

The Manual and Handbook do not exist in isolation. As indicated in Table 1 (below), they sit alongside Defra and HM Treasury guidance on the appraisal of FCERM schemes and public sector investment generally. The Manual and the associated CD together provide much of the benefit data on which project

appraisals are based, in the context of the theoretical and policy context provided by the other documents.

2. THE PROJECT'S OBJECTIVES

This second phase was designed to provide a new completed **Multi-Coloured Manual** reference work and facilitate the systematic updating of flood damage tables and indices. The background objective was to enable Defra, and others, to allow FCERM decisions to be made based on the most up-to-date information, methodologies and guidance available.

Source	Document	Purpose
HM Treasury	'Green Book'	Identifies the preferred approach to public sector investment appraisal
Defra	PAG series, particularly PAG3, plus addendums	How a project appraisal and CBA should be completed for flood and coastal erosion risk management projects
Middlesex University FHRC	The 'Multi-Coloured Manual ' (MCM)	Gives details of relevant research and detailed guidance on benefit assessment methods and data
Middlesex University FHRC	The 'Multi-Coloured Handbook ' (MCH)	Summarises the guidance in the MCM for easier access

3. THE PROJECT'S METHODS

The methods used included: Web and literature searches; discussions meetings with the owners or managers of non-residential properties; data collection; case studies; interview surveys with those flooded who had received flood warnings; searches of secondary data sources (e.g. for household inventories; benefit transfer datasets); consultations with stakeholders.

4. THE PROJECT'S FINDINGS

4.1 Results. The results from this project are the new **Multi-Coloured Manual**, the **Multi-Coloured Handbook** (2005) and their associated **Multi-Coloured CD**. The main enhancements in the Manual are as follows:

1. An experimental scheme for assessing the impact of data quality on the appraisal process (Ch. 3).
2. A better set of data on flood damages to residential properties, on the MC CD, backed up with a better system for updating that data in the future.
3. Better data on the impact of social class on flood damages with which to base the weighting of flood damages to houses by Distributional Weights (on the MC CD).
4. More data on flood damages to Non-Residential properties, although this data set is by no means as good as the one for residential properties (because of the high variance in the NRP sector).
5. Better data (by a long way) on the damage-reducing effects of flood warnings to residential properties.
6. A significantly better Chapter on the impact of FCERM schemes on recreation (Ch. 8).
7. A new approach to the assessment of the benefits of FRM for agriculture, that is consistent with new Defra policies.
8. An enhanced chapter on the impacts of FCERM schemes on the environment.
9. A report on the economic methods for valuing wetland resources (from the University of East Anglia)

4.2 Conclusions. The principal conclusions from this work are as follows:

4.2.1 As far as residential and non-residential flood damages and other losses are concerned:

1. The potential damage to residential properties is much higher than we had hitherto assessed.
2. The potential flood damage to NRPs is also much higher than we had hitherto assessed.
3. The variance of damages within this NRP sector is large and generalisation and averaging is problematic (i.e. the data is subject to large standard errors).
4. Only in rare cases of extreme floods affecting major utility installations would the impacts be large enough to warrant intensive study of utility impacts within a benefit assessment in a project appraisal.
5. The new approach to appraising the benefits of FCERM to agriculture will result in values that will be higher than hitherto as the subsidies to agriculture are not now included in the calculations.

4.2.2 As far as the Manual/handbook are concerned:

1. The 2005 MCM has been based heavily on the 2003 MCM. The 2003 to 2005 period has been used to “Road-test” the Manual, involving widespread stakeholder consultation.
2. The Manual (and CD) has come through that process successfully, but with numerous changes that should enhance its value to its users.
3. In turn this has made possible the development of the parallel Handbook, which should ease the benefit assessment process considerably.
4. The last major update of this Manual material – before 2003 – occurred in 1992 (now 13 years ago). The evidence from the FD2014 project suggests that a period of less than 10 years between major updates is desirable for the Manual to remain in tune with both Defra policy and its users’ needs.
5. A system for updating the data on the MCM CD and in the MCM in the future needs to be agreed with the Environment Agency.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:
 - the scientific objectives as set out in the contract;
 - the extent to which the objectives set out in the contract have been met;
 - details of methods used and the results obtained, including statistical analysis (if appropriate);
 - a discussion of the results and their reliability;
 - the main implications of the findings;
 - possible future work; and
 - any action resulting from the research (e.g. IP, Knowledge Transfer).

A. INTRODUCTION

This project represents the **second phase** of research and development to update the FHRC’s previous Manuals (published in 1977; 1987; 1992). The **first phase** was undertaken in project **FD 1705** between 2001 and 2003 and resulted in the draft **Multi-Coloured Manual** and **CD** that was finished in December 2003.

This second phase was designed to provide a new completed **Multi-Coloured Manual** reference work and facilitate the systematic updating of flood damage tables and indices. The background objective was to enable Defra, and others, to make Flood and Coastal Erosion Risk Management (FCERM) decisions based on the most up-to-date information, methodologies and guidance available.

The project has been undertaken at a time of change in Defra and the Environment Agency and its outputs will surely not be the last word on this research topic. This is recognised in the **Foreword** to the revised Manual that is one product of this project, written by **Reg Purnell**:

“The Manual’s development has faced challenges set by the emerging policy agenda and the Government strategy Making Space for Water... It is likely that this will lead to further developments in appraisal methodology that will, for example, better identify gains and losses

to individuals and different sectors, and make more use of approaches such as multi-criteria analysis”.

As a summary, the Foreword continues:

“...The Manual, in reinforcing traditional appraisal approaches, is seen by Defra, as a useful document of reference...”.

Given the nature of the project and its aims, a large number of more or less discrete **Objectives** was specified in the contract. This could make reporting here somewhat lengthier than would otherwise be the case, in order to do justice to what has been researched. However, since this SID 5 report is being produced in parallel with two other documents, which set out the research methods used and the full results, this report is restricted to an evaluation of the research and its successes and limitations, rather than a full set of results. The two parallel reports are:

- A **Manual** (250+ pages) of research methods, results and detailed appraisal guidance (Penning-Rowse *et al.*, 2005a) which, *inter alia*, contains some experimental results.
- A **Handbook** (90 pages) which abbreviates and simplifies the research results of the Manual, and presents a step-by-step approach agreed with Defra/EA for assessing FCERM benefits for 7 different 'sectors' or benefit types in 7 separate chapters (Penning-Rowse *et al.*, 2005b).

During the 2004-5 two year FD2014 project the importance of the **Handbook** grew, as Defra were keen to have this precisely represent their position on project appraisal (which some of the FD 2015 results did not). As part of this process, the appraisal position of the Environment Agency (EA) had to be taken on board, in a complex three-way discussion. This was assisted by Defra officials having a major role in drafting Ch. 10 of the Handbook, the contents of which were then “retrofitted” into the parallel Manual Chapter alongside the FHRC results. We acknowledge the assistance from Defra and EA staff in this respect.

B. THE SCIENTIFIC OBJECTIVES AS SET OUT IN THE CONTRACT

B1. Context

Project investment in the public sector continues to be appraised by the application of benefit-cost tests. Academic research has progressed in this area, particularly related to the development of alternative benefit-cost tests (e.g. MCA) and the enhanced quantification of flood damages. Public sector investment is also influenced by new research and changes to policy guidance. By actively seeking and incorporating these changes, where appropriate, the outcome of our research should reflect the current, and changeable, state of knowledge. The strategy to be developed for subsequent updating will continue this tradition to ensure that the FHRC Handbook and Manual consistently reflect advances in scientific understanding and policy guidance.

Given the significant role for project appraisal guidance in the delivery of effective flood risk management policy, it is both timely and necessary that Defra are now provided with an updated and coherent reference source to help to ensure that the methods used in the appraisal of FCERM schemes are consistent and that thereby available funds are appropriately allocated.

B2. The scientific objectives (abbreviated from the CSG7)

A total of 16 scientific objectives were specified in the FD2014 contract, as follows:

1. Filling crucial gaps in the Non-Residential Property (NRP) database as a result of previous work undertaken on project FD1705.

Further data gathering is necessary to ensure that the data already available in the **FD1705 Project Report** is made more representative of (a) the distribution of the most frequently occurring NRPs within the floodplain, (b) developments in new technologies, and (c) current and future trends in commercial and retail property markets. It is, therefore, anticipated that 20 additional discussion meetings will be held in the following sectors: warehousing (particularly food storage), general offices, retail services (including restaurants and showrooms), public buildings and small to medium sized industrial premises.

2. Provide additional standard evaluation of losses to public utilities.

Project FD1705 did not cover utilities (water; electricity; telecoms, etc). Through the analysis of Met. Office research results and Autumn 2000 utility outages the relevant 'Red Manual' section on the standard evaluation of losses to public utilities will be re-drafted incorporating up-to-date results where possible. This new data will then be made available in the FHRC **Handbook** and **Manual**.

3. Revise FD1705 Project Report in light of HM Treasury Green Book.

The text and data in the **FD1705 Project Report** will be altered to reflect, where appropriate, the recommendations in the revised HM Treasury Green Book. This will require a review of the Green Book in order to develop a strategy for the inclusion of new material in the FHRC **Manual** and **Handbook**. The considerations anticipated are as follows:

- Adjusted economic values or other options for residential flood damages to take account of recommended distributional weightings.
- Enhancements to the current methodology and investigation of alternatives to the current use of expected values with recommendations of where this approach can be improved to take account of risk aversion in line with the draft Green Book and other accepted methodologies.
- The consequences of the changed discount rates on recommended project appraisal periods and priorities within the investigations for future costs and benefit estimation (e.g. more or less attention to O & M costs)

4. Provide draft text for an updated version of FCDPAG3.

This objective will up-date the text in **FCDPAG3** to reflect changes in policy and academic understanding that have occurred since its original publication. Such changes include, for example, changes to discount rates and any possible changes resulting from the implementation of the Water Framework Directive. It is important that this is conducted in parallel with the updating of the FHRC **Manual** and **Handbook** to ensure consistency between these two items of guidance provided by Defra. This work will ...include the reworking of the standard spreadsheets and the related examples in a way that is compatible with the revised text.

5. Provide guidance on environmental transfer values.

Having conducted an analysis of recent international data sets on transfer values for environmental values (e.g. <http://www.evri.ec.gc.ca/evri/english/default.htm>), this will then be compared with the latest Yellow Manual type case study data used in the **FD1705 Project Report**. The results of this may then lead to the development of a possible new standard data set on environmental transfer values, which will be included in the FHRC **Manual** and **Handbook**.

6. Develop methods and recommendations for the easy identification of residential property types and social class allocations.

To increase project appraisal consistency it will be advantageous to develop methods and recommendations for the identification of residential property types, social class and income band allocations. As it presently stands, the user is required to conduct field observations to determine dwelling types in any location using the photographs and floor plans provided. However, determining the age of the property may involve subjectivity unless planning departments can provide mapped information. Unfortunately, also, the social class variable derived from the Census data relates to the enumeration district (ED) as a whole and not to the individual dwelling. To overcome this, objective 6 will develop an alternative identification system, based on secondary sources (e.g. the EXPERIAN database) relating to property types and social class, based on postcode areas.

7. Seek, systematise and analyse end-user feedback comments on the FD1705 Project Report

This objective aims to secure the following:

- The compilation of commonalities in the analysis of feedback forms provided in the **FD1705 Project Report**;
- The application of up to 25 follow-up discussions with end-users to explore specific issues in the feedback process; and
- A final **Handbook** that is easy to use and addresses the needs of users whilst still adhering to accepted principles of appraisal for publicly funded projects.

This approach ensures that the evaluation process is both Middlesex and end-user driven (to) result in a comprehensive FHRC Manual that will meet end-user requirements thus making both the Handbook (in particular) and the Manual more accessible and user-friendly than its predecessors.

8. Develop a new database to support damage valuation and future updating.

The Fortran software system and its compiler used in the production of the FLAIR tables have reached its capacity for the addition of any new house types. This (and the lack of support for its software in the modern Microsoft world) means that it is now redundant and no future up-dates will be possible. This data is critical for the standardised depth-damage calculations required for the assessment of residential flood damage

calculations. Therefore, to ensure that this valuable data remains available to project appraisal decision-makers it must be transferred into a Windows-based system incorporating all of the logical operations, data and output tables. This is essential for any future updates to be achieved and at reasonable cost (which has been a major barrier to previous up-dates).

9. Consolidate outputs from MCA, FD2005 and FD2007

To ensure that the FHRC **Handbook** and **Manual** reflect current state of knowledge in the field, objective 9 will seek to incorporate research findings and outputs from on-going related projects. This includes the work on Intangible Human Impacts (FD2005), proposed work on Multi-Criteria Analysis and the project on public awareness and understanding (FD2007) (subject to Defra and other stakeholders).

10. Consolidation of recreation values

Through drawing together all the available studies (both in the UK and internationally) on the recreational values associated with flood and coastal protection schemes, and through analysis and critical review of the results, this objective aims to derive and consolidate the most appropriate and acceptable 'standard values' that can be applied to most flood and coastal risk management projects. It will seek to identify, for example, whether any conclusions can be drawn to link recreational values with the state of defences or the coastal or river environment. It will also seek to identify whether there are situations for which insufficient recreational value data are not available to allow the use of standard data and present recommendations for these circumstances that will yield good data at least cost.

11. Developing data sets for the Broad scale

In order to interface better with broad scale modelling of flood risk and response at a catchment scale in other Defra/EA R&D projects and for operating authorities, a set of data and techniques needs to be developed that facilitate this. The focus will be on catchment level and coastal cell level indicators of risk and hazard, by developing broad scale data sets from the existing fine-scale flood damage and loss data from the **FD1705 Project Report**. This data set will therefore 'sit' between the NAAR/RASP high level national datasets and the fine-scale project appraisal-relevant flood damage and loss results. As well as presenting methods of high level analysis for (the) long term ... the aim will be to recommend high level approaches that can achieve reasonable levels of compatibility between high level and detailed studies within the limitations of the levels of analysis that are feasible at the higher levels.

12. Make changes to the FD1705 Project Report

The re-drafting of the **FD1705 Project Report** chapters in light of feedback analysis, discussions with the Advisory Group and input from Defra and EA specialists. The **Handbook** will be as brief as possible (e.g. 75 pages, plus CD) whereas the **Manual** will be more discursive.

13. Developing flood warning data set

The high policy priority accorded by Defra and the EA to effective flood warning systems is not matched by good data on the benefits (or costs) of these systems. Some very rudimentary work was undertaken by FHRC in 1991, but this is now very out of date. The objectives here are:

- To examine, and further develop as necessary, the model of the economic benefits of flood warnings set out by FHRC researchers (CNS Scientific and Engineering Services, 1991), in the light of recent research.
- To review and refine methods for collecting data on damage reducing actions taken by households associated with flood events and warnings.
- To carry out research to produce a new data set to be used to calibrate the model.

14. Develop strategies for future updating of damage tables and indices.

To ensure that decision-makers are provided with the most comprehensive and up-to-date figures and indices in their project appraisals it is critical that a strategy is developed (in conjunction with Defra) for the future updating of flood damage tables. This will include the investigation of potential indices that might better reflect the real change in damages between future revisions. This strategy will form the basis of a one-off trial update, which will culminate in a report to Defra of the strategy feasibility and recommendations for future updates. Subject to the outcome of this work, appropriate methods for interim updating by users may be included in the **Handbook** and **Manual**.

15. Final production of the FHRC Handbook and Manual.

The production of the FHRC Handbook and Manual will require the co-ordination of all re-drafted chapters, the inclusion of any changes relating to objectives 1-14 above, the re-formatting of text for consistency and the updating and formatting of data on CD-ROM.

Once completed, Chapter 1 of the **FD1705 Project Report** will be redrafted to reflect any changes. Defra will be provided with a copy of the text, the data on CD-ROM and a list of summary tables for Defra's web site. Middlesex will seek academic publication of the FHRC Manual (see above).

16. Make recommendations for any consequent changes to other Defra and EA guidance.

Other Defra and EA guidance will be analysed for consistency with the FHRC **Handbook** and **Manual**. Where appropriate, recommendations for changes to this 'other' guidance will be compiled and provided to Defra.

17. Variation Order (agreed August 2005)

In addition to this work, above (1-16), a Variation Order (VO) added some other elements, largely to do with the changes brought about in the environment chapter (Chapter 10) owing to discussions with Defra and the EA, and in the agricultural field (Chapter 9) after major policy changes concerning agricultural support in the UK in 2005:

- Chapter 10 Incorporating Defra/EA's Chapter 10 into the Handbook
- Chapter 10 Manual: a re-write of Ch. 10 after the Handbook's Ch 10 was agreed
- Chapter 10 Manual: a re-write of Ch. 2 after the Manual Ch 2 was agreed
- Chapter 9 Re-writing the Manual's chapter on agriculture
- Chapter 9 Producing the Handbook Chapter from the Manual chapter on agriculture
- PAG 3 Producing a short user guide for the newly developed PAG3 spreadsheets

18. UEA Wetland economics report

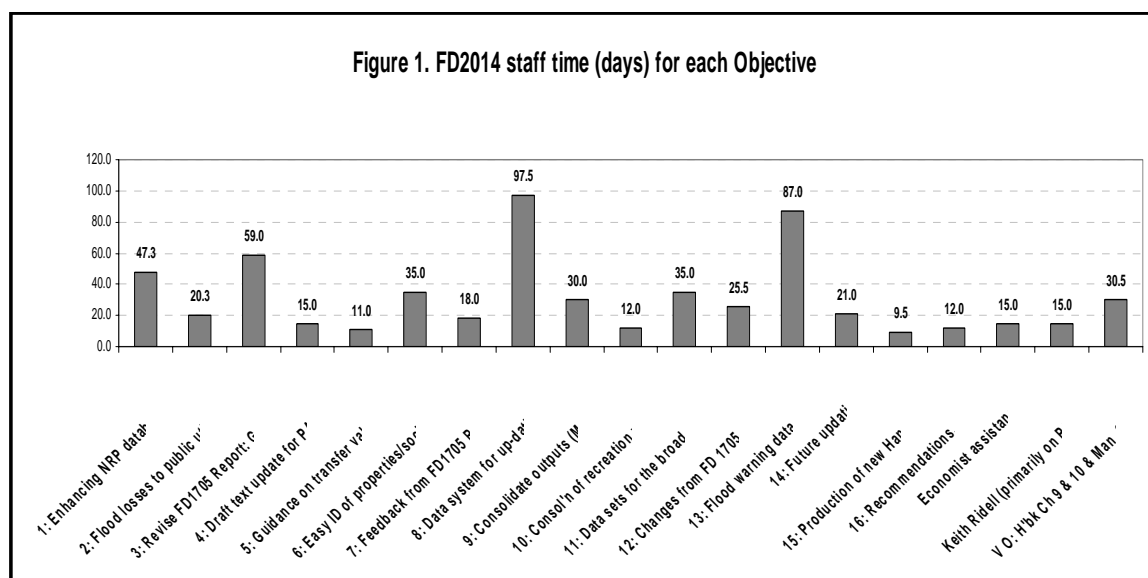
In addition to the above, resources were provided through Middlesex University to the University of East Anglia (UEA) to provide a report on the economics of wetland resources. The report was produced and seen by the Advisory Group and of its general conclusions were used in the development of Ch. 10 of the MCM.

B3. Resources

Information on the resources available in this project serve also as contextual background to this report. The diagram below summarises these resources in terms of staff time. What this shows is the following:

- Three large items (Objectives 3, 8 and 13: more than 58 days each over the two year period)
- Four medium sized items (Obj. 1, 6, 11 and the Variation Order: >30 days each over the two year period)
- Twelve smaller items (less than 30 days over the two year period).

In the event, Objective 13 took even more time than this, as did Objective 15, but Objective 6 and 11 were undertaken in less time than anticipated, thus evening out the balance between resources use and availability.



C. THE EXTENT TO WHICH THE OBJECTIVES HAVE BEEN MET

C1. Summary

The table below summarises the situation at the end of the research project in relation to the contract details. What this shows is that some Objectives were “more than” completed. Others just met their Objectives. There were cases where (a) the full specification was not attainable (Objective 2) or where less effort was needed to achieve the desired result (e.g. Objective 6).

Obj.	Task	State of 'completion' *	Comments
1	Filling crucial data gaps in NRP database	150%	We did more 'discussion meetings' than was suggested in the contract (32 rather than 20).
2	Flood losses to public utilities	100%	One survey was not successful, but it was done.
3	Revise FD 1705 Project Report material in light of new Green Book	100%	The Manual has now gone to the Printers following Defra review.
4	Draft text update for PAG3	100%	More work was done on the spreadsheets than the contract foresaw.
5	Provide guidance on transfer values	100%	There still remain large gaps in the data sets of monetised environmental values to use in benefit transfer approaches.
6	Easy identification of properties/social class	100%*	The field surveys became redundant as a result of the method that we developed.
7	Systematic feedback from FD 1705 Project Report	100%	A large number of questionnaires were received and analysed, and this led to changes in the Manual from the 2003 version.
8	Data system for subsequent up-dating	100%	The new Excel version is far better than the old Fortran version.
9	Consolidate outputs (MCM + MCA etc)	100%	Full integration of MCA and BCA was not achievable with the scope and budget of this contract, and indeed was not an intention of this project.
10	Consolidation of recreation values	100%	There still remain large gaps in the data sets of recreational values to use in benefit transfer approaches.
11	Developing data sets for the broad scale	100%	An approach based on combining flood damage and flood probability data (to produce risk data) was developed.
12	Making changes from FD 1705 Project Report	100%	Approximately 30% of the 2003 (draft) Manual was re-written.
13	Developing flood warning data set	100%	300 interviews completed and the data analysed. Academic report produced and sent to Defra on December 20 th 2005
14	Future updating of damage tables/indices	100%	Report produced and sent to Defra on December 20 th 2005
15	Final production of new Handbook	150%	Went to printers 22.11.05 following Defra review.
16	Recommendations, etc	100%	This time was allocated to various tasks within the project to ensure that quality results were obtained.
17	Variation Order tasks	100%	Completed in November 2005.
18	UEA Wetland report	100%	Report prepared and received by the Advisory Group.

* In relation to the contract specification less work was done, but the work was completed and is judged to have met the Objective's aims.

Milestones were specified in the contract (primary and secondary) and these were used to monitor progress during the contract. Given the state of completion recorded above (i.e. 100% across all Objectives) the milestones are not reported on here.

C2. Discussion

The most difficult Objectives to deliver turned out to be 1, and 5, 9 and 10 (the last three as a group) and 15. This was because the Non-Residential Property data (Objective 1) is beset with sampling problems (which Head Offices to visit?; which properties within a large range to survey? etc). Also cooperation is never perfect and setting up meetings with busy industrialists is never straightforward.

Objective 15 was difficult because our budget was small (just 9.5 days!) but the task grew in importance during the FD2014 project. Defra was handing over responsibility to the EA for project appraisal (with the block grant systems) and appeared to want the appraisal process to be more ordered than it actually can be. The Handbook was one of the vehicles for Defra defining the appraisal process, but at the same time simplifying it. In the end the Objective used three times the resource that we had in the budget (i.e. about 30 days). We used some of the resources “spare” in Objective 16 to fill some of this gap.

D. METHODS USED AND RESULTS OBTAINED

These are tabulated below, in abbreviated form. Much more detail is in the Multi-Coloured Manual (MCM). We do not give exhaustive citations to reports to the Advisory Group overseeing this work because many of those reports were statements of interim results and users would not be well advised to consult them.

Obj.	Task	Methods used (summary)	Results obtained and where they are located in the Manual (MCM) and/or Handbook (MCH) and CD (the 'MC CD')
1	Filling crucial data gaps in NRP database	Discussion meetings with the head offices of the sample premises	Chapter 5 in both MCM and MCH. All the data that the appraiser needs is on the MC CD.
2	Flood losses to public utilities	Interviews with utilities managers (SE England); case studies (S Wales).	Interview results reported to the Advisory Group [and then not pursued further]. Case study results given in MCM Section 6.2 including 3 Tables (6.1, 6.2, 6.2)). Not featured in MCH (see footnote to MCH Ch. 6).
3	Revise FD 1705 Project Report material in light of new Green Book	New data gathering. Data adjustment. Data updating. Completion of the Manual and CD	The whole of the MCM and MCH are now geared up to the new Green Book. Social class related flood damage data in Ch. 4 (MCM) and HMT weights given, and all this data on the MC CD.
4	Draft text update for PAG3	Writing new text; developing amended spreadsheets	Text provided. Spreadsheets provided. Report on spreadsheets still in preparation.
5	Provide guidance on transfer values	Literature and web reviews.	We found no new 'magic' source of transfer values to use, other than those reported in the 2003 MCM. All the useful transfer values are published in the MCM (Ch. 8 and 10). These data tables are also reproduced on the MC CD.
6	Easy identification of properties/social class	Investigating alternative data sources/methods. Trialling the new Census output areas.	Results in a section of Chapter 4 which recommends the use of ONS census data for the new Output Areas, which are smaller than Enumeration Districts used previously, meaning that the result will be more accurate.
7	Systematic feedback from FD 1705 Project Report	Survey of all 300 of those who received copies of the 2003 MCM; discussions on the telephone of a sample of 26 of these respondents.	All the results reported to the Advisory Group (meeting of the 28.4.2004). Not reported in the MCM or MCH but taken on board in their revisions.
8	Data system for subsequent updating	Converting the Fortran program into a series of interconnected spreadsheets; trialling this systems; debugging; etc	The result is that we now have a system that allows for much more cost-effective up-dating. This is not available to users, because it depends on a vast 1 million + item database of ownership and susceptibility data (raw data) held at FHRC.
9	Consolidate outputs (MCM + MCA etc)	Reviewing the MCA results; Incorporating the conclusions of the MCA project into Manual Chapters 2 and 10.	With the 2003 MCM (in its CD) we reproduced a report on the MCA work that FHRC undertook with RPA. We refer to MCA in the 2005 MCM and MCH, and of course provide methods for environmental and social equity analysis in both. We also incorporate the results of the "Intangibles" project with RPA (the £200 per house per year figure for health effects). MCA and BCA need integrating, but that is a much larger task than this (NB: 30 days allocated in FD 2014 to this Objective).
10	Consolidation of recreation values	Literature and web reviews. Comparison with Yellow Manual data.	The results are consolidated in the MC Handbook Chapter 8.
11	Developing data sets for the broad scale	Developing sector and category averages for residential and NRP data sets; analysis of flood probability and damage data sets for a range of FRM schemes; synthesising the results into a set of Weighted Annual Average Damage data.	The results are presented as (a) high level averages for the relation between depth and damage for land use sectors (e.g. residential) and (b) data on weighted annual average damages (WAAD) that incorporate flood probability. These are given in MCM and MCH Chapters 4 and 5, and on the MC CD.
12	Making changes from FD 1705 Project Report	Re-writing at least 30% of the MCM. Changing all the tables where they contain financial/economic data; updating the CD with a completely new "look and feel".	The draft was presented to the Advisory Group on 24 th October 2005. Final text sent to printers 25.11.05 following Defra review.

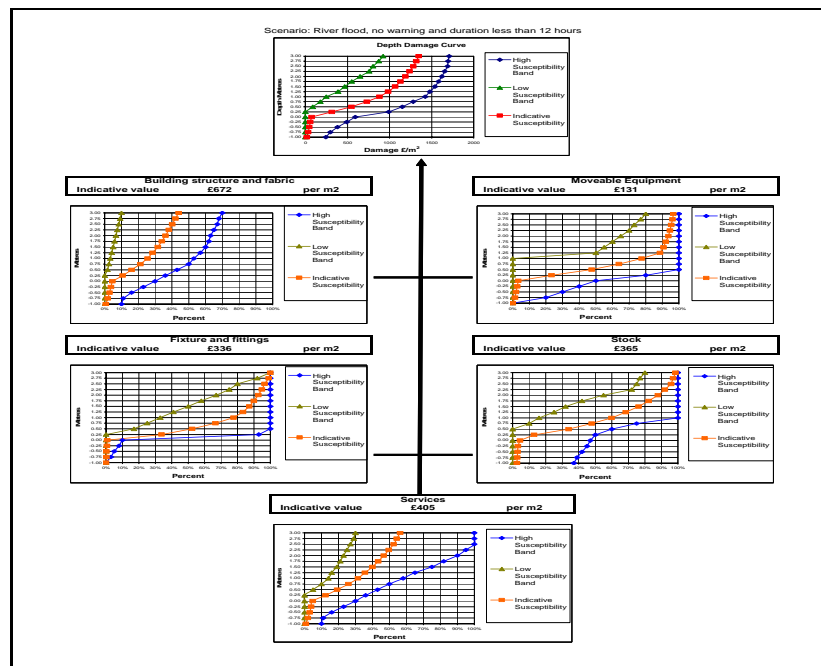


Figure 2.

NRP Data analysis system and results: one example for sub-category 211 (High Street shops). Scenario: river flood, no warning and duration less than 12 hours (interim results).

We consider these results to be **reliable**, especially the first (because it was based on a recent flood and extensive contacts with utility managers, whereas the second result is based on scenario analysis).

The **conclusions** from this work are as follows:

1. Only in rare cases of extreme floods affecting major utility installations would the impacts be large enough to warrant intensive study within a benefit assessment in a project appraisal.
2. That this result is no different from found previously (and published in the “Blue Manual” in 1977).
3. That this topic would not be covered in the MC Handbook, because the 2nd case above is unlikely to be found in “routine” benefits assessments for which the Handbook is designed.

Objective 3. Revise FD 1705 Project Report material in light of new Green Book

The **results** were reported to the Advisory Group from this Objective (2.2.2004) and showed:

1. By no means all the MCM data and techniques were affected by the Green Book changes (see the Table 2 below).
2. The major effect was on residential flood damages, where a system needed to be developed to incorporate Distributional Impact (DI) weights.
3. The recreation chapter should at least address DI matters, but determining the nature of the population on which to use the weights will not be easy.
4. The same procedure could be applied to road traffic disruption benefits, with the same caveat.

We consider these results to be **reliable** because they were discussed with the Advisory Group without dissent. The **conclusions** from this work are that the Green Book changes will have a significant effect on the appraisal of FCERM schemes, with greater allocation of these resources to the less well off flood and erosion victims, and that the changes to the discount rate will have a profound effect on scheme benefits and should give greater emphasis to those schemes that have a large O&M element in their recurring costs (because with a lower discount rate these have higher present values than hitherto).

Objective 4 Draft text update for PAG3

The **result** from this Objective was the revised text. In addition we have reworked of the standard spreadsheets and the related examples in a way that is compatible with the revised text and provided the results to Defra. We

Table 2. Multi-coloured Manual – Revisions in light of the Treasury Green Book
(modified from paper to Advisory Group)

Chapter	Page	Note
1		Flag up changes as a result of new Green Book.
2		This requires significant re-writing to take account of the changes. Given the problems of creating the text for this in the first place, this is difficult. Discounting needs some minor revisions to take account of the change in discount rate and the increased time scale of the analysis. Some text on costs should be added, specifically covering O & M costs because the reduction in discount rate has made these costs more influential in the decision. A section on the distributional aspects needs to be added as does one on risk management leading into optimism bias and sensitivity analysis (including pulling existing text together).
3	31	Some minor changes to Figures to match PAG3, but not Green Book changes
	38	Ditto
4		When the approach has been agreed with Defra, a section needs to be added on distributional weights and how to use them.
5		No change
6		No change
7		In principle, distributional weights also need to be applied to house prices.
8		No change, although in principle, distributional weights also need to be applied to recreation benefits
9		No change
10		No change
Appendices		No change

consider these results to be **reliable**, because they have been accepted by Defra in support of their work with the EA to update appraisal guidance and policy statements, as set out in MSFW. A user-related report on the spreadsheets is in preparation. There are no other conclusions from this work.

Objective 5 Provide guidance on transfer values

The **results** from this Objective (reported extensively to the Advisory Group on 2.2.2004) showed:

1. There was less data suitable for use as transfer values than many commentators suppose.
2. Some of the data that was cited that might be useful was not suitable.
3. Data that might be suitable for use as transfer values was often not suitable because of the site specific nature of many FCERM benefits.

We consider these results to be **very reliable**, because we conducted exhaustive searches for suitable data both in the pre-2003 and the post-2003 period of research.

The **conclusions** from this work are as follows:

1. Seeking to use transfer values in FCERM benefit assessments is no panacea.
2. Transfer values need to be applied to specific FCERM projects with considerable caution to make sure that the data is suitable.

Objective 6 Easy identification of properties/social class

The **results** from this Objective showed:

1. It was possible to use the national census to determine the average (social) character of its Output Areas (OAs) in FCERM benefit areas.
2. This approach is better than the previous ("Blue Manual") system of using census Enumeration Districts (EDs), because the OAs are smaller.
3. The small fieldwork 'tests' envisaged in the contract were unnecessary, given the good census data that we used.

We consider these results to be **very reliable**, because they are based on the national census rather than a commercially available data set of unknown reliability.

The **conclusions** from this work are as follows:

1. Commercially available databases (e.g. those from EXPERIAN or ACORN) are no better than census data for determining the social class of the occupants of residential property and are of unknown reliability because they include data that is not in the public domain.
2. The smaller Output Areas for which the census data is now produced are smaller than the old Enumeration Districts (about half the size) so the identification of the social class of the occupants of houses is made more accurate by the recommended approach.
3. This approach should be used to determine the social class composition of FCERM benefit areas, in order to apply the Treasury's Distributional Impact weights to the potential flood damage data allocated to those areas.

Objective 7. Systematic feedback from FD 1705 Project Report

The **results** from this Objective were reported to the Advisory Group and showed that:

1. The 2003 Multi-Coloured Manual (MCM) was in general well received (especially the CD).
2. The 2003 MCM was not found to be very user-friendly, and needed much attention in this respect.
3. Individual chapters had different levels of criticism, and needed a 'hand-stitched' approach to their revision.
4. That there were errors and omissions that needed attention.

We consider these results to be **reliable**, since they were obtained from 34 responses to the 300 questionnaire that we circulated with the 2003 MCM which, in turn, were followed up by up to 26 telephone and other interviews.

The **conclusions** from this work were that the proposed Handbook was indeed necessary, to improve user-friendliness overall, and that the MCM itself needed some attention, to make it more accessible.

Objective 8 Data system for subsequent up-dating

The **results** from this Objective showed:

1. The old Fortran system contained errors that were distorting results.
2. The old datasets on which the old Fortran system ran contained errors.
3. The new Excel-based system is more transparent (hence the picking out of previous errors) and easier to use.

We consider these results to be **reliable**, because they have been the subject of many tests and the result has been found to be robust.

The **conclusions** from this work are as follows:

1. In both short (<12 hours) and long (>12 hours) duration floods there has been a significant increase in potential-damages at all depths of flooding over the pre-2003 dataset(s).
2. For short duration flooding, the 2005 values represent a 7-fold increase in sector average damages for floods of shallow depth (0.1m), a 5.2-fold increase for medium depths (0.3m) and a 3.5-fold increase for deeper floods (1.2m).
3. For long duration flooding the comparative figures are 3.9, 3.3 and 2.2 respectively. This suggests that although long duration floods still produce greater total damages (£32,754 and £26,105 at 0.3m for long and short, respectively), the duration is no longer as significant as once it was assumed.

These figures are also indicative of the increased damage potential of floods of shallow depths with the greatest increase observed at 0.1m and 0.05m depths. At 0.05m, for example, the damages have risen 9.2-fold for a short duration flood and 5-fold for a long duration flood.

Objective 9 Consolidate outputs (MCM + MCA etc)

The **results** from this Objective showed that we do not yet have a methodology that integrates MCA and BCA, yet this is badly needed. We refer to MCA in the 2005 MCM and MCH, and of course provide methods for environmental and social equity analysis in both.

We consider these results to be **reliable**, but in essence it is a negative result: we cannot yet integrate MCA and BCA, yet this is an implicit aim of *Making Space for Water* (MSFW).

The **conclusion** from this work is that far more effort is needed in this area before we can integrate MCA and BCA in an operational way.

Objective 10 Consolidation of recreation values

The **results** from this Objective were reported to the Advisory Group and showed:

1. There were very few cases of FCERM schemes where monetary assessments of recreation gains/losses have been made that we did not know about already and which were reported in the 2003 MCM.
2. Where new data has become available, it has been incorporated into the 2005 MCM's Chapter 8.
3. No relationship was found between recreation values and the state of defence except in coastal situations where defences are demonstrably failing.
4. Many cases where recreation gains and losses have been assessed for non-FCERM schemes have results that are not readily transferable to FCERM schemes.

We consider these results to be **reliable**, as our searches for additional monetary assessments of recreation gains/losses have been exhaustive.

The **conclusions** from this work are as follows:

1. There still remain relatively few studies that give recreational gains/losses data that are relevant to FCERM scheme appraisal.
2. Until this situation is rectified, the 'standard' data in the MCM will be limited and there will continue to be a need for site-specific CVM studies.

Objective 11 Developing data sets for the broad scale

The **results** from this Objective showed:

1. It was possible, as before (all previous Manuals), to produce 'high level averages' of depth/damage curves that could be used in strategy studies such as CFMP analyses.
2. It was also possible to develop data on weighted annual average damages (WAAD) that incorporate flood probability, representing 'risk' (i.e. probability and consequences), based on a synthesis of the results from a large number of case studies.

We consider these results to be **moderately reliable**, in that the WAAD figures are based on case studies only, mostly in the English Midlands, which cannot be typical of all UK floodplain situations.

The **conclusions** from this work are as follows:

1. More work needs to be done in this field to develop a data set of really good WAAD data.
2. This needs to be applied to all benefit categories, not just residential properties.

Objective 12 Making changes from FD 1705 Project Report

The **result** from this Objective is the new Multi-Coloured Manual (2005). The main enhancements to the Manual over its 2003 predecessor are as follows:

1. An experimental scheme for assessing the impact of data quality on the appraisal process (Ch. 3).
2. A better set of data on flood damages to residential properties, on the MC CD, backed up with a better system for updating that data in the future.
3. Better data on which to base the weighting of flood damages to houses by Distributional Weights (on the MC CD).
4. More data on flood damages to Non-Residential properties, although this data set is by no means as good as the one for residential properties (because of the variance in the NRP sector).
5. Better data (by a long way) on the damage reducing effects of flood warnings to residential properties.
6. A significantly better Chapter on the impact of FCERM schemes on recreation (Ch. 8).
7. A new approach to the assessment of the benefits of FRM for agriculture, that is consistent with new Defra policies.
8. An enhanced chapter on the impacts of FCERM schemes on the environment.

The '**reliability**' of these results is not really an appropriate matter to address here. Use of the Manual by appraisers will determine that over the next few years.

The **conclusions** from this work are as follows:

1. The 2005 MCM has been based heavily on the 2003 MCM. The 2003 – 2005 period has been used to "Road-test" the 2003 Manual.

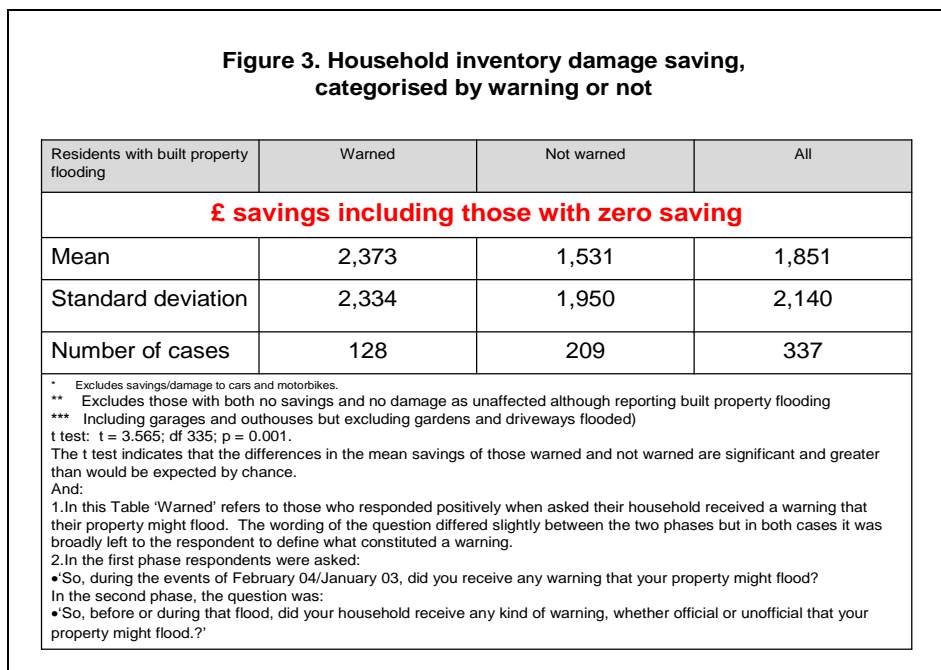
2. The Manual (and CD) has come through that process with numerous changes that will enhance its value to its users.
3. In turn this has made possible the development of the parallel Handbook, which should ease the benefit assessment process considerably.
4. The last major update of this Manual material – before 2003 – occurred in 1992 (now 13 years ago). The evidence from the FD2014 project suggests that a period of less than 10 years between major updates is desirable for the Manual to remain in tune with both Defra policy and its users' needs.
5. A system for updating the data on the MCM CD and in the MCM needs to be agreed with the Environment Agency.

Objective 13. Developing a flood warning data set

The **results** from this Objective showed several important findings:

1. Many people – indeed the majority - consider that they do not receive a warning. There is evidence that some of them do receive a warning but do not consider it to be a warning.
2. That flood warnings do result in damage savings, but that damage saving also occurs when residents receive what they consider to be no warning.
3. Damage saving with warning is significantly less than double the damage saving when there is no warning (Figure 3).
4. A large number of factors explain the incidence of damage saving (or not), the main ones being the availability of people to respond, and the effectiveness of that response.
5. The aggregate damage saving as a result of > 8 hours warning is only c. 10% of maximum potential damage. This appears to be an even lower figure than found in previous research.
6. Standard errors in this area are large.

We consider these results to be **reliable**, because we obtained a large sample, although there continue to be acute methodological difficulties with this research area (mainly related to defining “warning” and quantifying damage saving). These are discussed in the report on this Objective (December 2005).



The overall ‘headline’ **conclusions** from this work are therefore as follows:

1. Warnings are not very effective at saving flood damage.
2. Saving damage through warnings could probably be improved significantly, by better arrangements for receiving the warnings (specifically better targeting) and better capability to save damage through enhanced assistance to those at risk.
3. More research is needed on damage saving through warnings to Non-Residential Properties (NRPs), which this Objective did not consider. Our discussion meetings under Objective 1 showed that respondents found this area difficult to address, and had little good data to offer.

Objective 14. Future updating of damage tables/indices

The **results** from this Objective showed that:

1. Year-to-year updating should be done with the Consumer Prices Index for most categories of FCERM benefit
2. Flood loss in non-residential properties should be updated using the appropriate industrial/commercial inflation indices (e.g. the index of industrial production) available from the Dti or the ONS.
3. Longer term inflation trends should be updated by repeating some of this research.

We consider these results to be **reliable**, in that the updating indices recommended are highly regarded government statistical series.

The **conclusions** from this work are as follows:

1. In the period 1992 to 2003, flood losses grew more or less in line with the growth of the economy as a whole.
2. Traditional up-dating indices (e.g. the RPI) did not track these changes, with the result that potential flood losses came to be under-recorded. This meant that FCERM schemes that were in reality cost-beneficial were not recorded as such.
3. This mistake should not be repeated in the future.
4. A system for regularly and properly updating the data on the MCM CD and in the MCM needs to be agreed with the Environment Agency.

Objective 15. Final production of new Handbook

The **result** from this Objective is

1. A 90 page Handbook that has been extensively reviewed by many staff in Defra and the Environment Agency.
2. That review has been exhaustive, thanks particularly to the assistance of Defra FM staff in assisting with Chapters 1, 2, 9 and 10.
3. Together we have trod the fine line between too much detail swamping the appraiser and too little detail implying that the appraisal process is more straightforward than it actually is.
4. A step-by-step procedure is embodied in the Handbook, designed to clarify the appraisal process.
5. A Chapter 10 on the impacts of FCERM on the environment (created cooperatively between Defra, the EA and FHRC) that encourages appraisers to assess these impacts more systematically than hitherto, in line with MSFW and Defra sustainability policies contained there.

We consider these results to be **reliable** because they have been the subject of extensive stakeholder consultation.

The **conclusions** from this work are as follows:

1. It is possible to simplify usefully the description of the appraisal process and that this should help to develop better project appraisals.
2. The division between the Handbook (for most users most of the time) and the Manual (which includes the research back-up) appears to be a sensible one.
3. The development of the Handbook graphically revealed to FHRC that over time our Manuals had become too "dense" to be easily and efficiently used by appraisers.
4. There is much more to do in this area, but that is for future projects.

Objective 16 Recommendations, etc

The **results** from this Objective are not the same as those for the other Objectives. This "Objective" was in effect a "contingency" allocation (12 days) to allow for matters being dealt with as they arose. As indicated above this time (12 days) was spent in a variety of ways during the project, e.g.:

- Extra time on the PAG3 spreadsheets.
- Extra time on Objective 1.
- Extra time on Objective 15.
- More time on meetings than the contract allowed.
- Time spent linking the MCM and MCH into the new *MSFW* policy framework.

We consider the results from this work to be **reliable**, in that had not this extra time been available the quality of the work would have suffered. There are no other **conclusions** from this work.

Objective 17. Variation Order tasks

The **results** from this Objective were:

1. A revised version of Chapter 9 (agriculture) that met with Defra approval and matched their new policies, written by Professor Morris (Cranfield University).
2. A revised version of Chapter 10 (environment) that matched the equivalent Handbook Chapter which in turn had met with Defra approval (not least because they drafted most of that Handbook Chapter).

We consider these results to be **reliable** because they have been approved by Defra FRM staff and are based on material that we had discussed with them extensively.

The **conclusions** from this work are as follows:

1. The new approach to appraising the benefits of FCERM to agriculture will result in values that will be higher than hitherto as the subsidies to agriculture have been stripped out of the gross margin values because the extent of direct output-related subsidies is now very small indeed.
2. A satisfactory method remains to be developed that leads to the integration of the three pillars of sustainability: environment; economy; social justice aspects. MCA may help, but it is certainly no panacea because it does not indicate what investment levels are sustainable. This is an area for further R&D in the future.

Objective 18. UEA Wetland economics report

The **result** from this Objective was a comprehensive 170-page report on the valuing of wetland resources from a functional standpoint. We consider these results **very reliable** because they have been produced by acknowledged experts in the field, and the report has been scrutinised by the Defra/EA Advisory Group.

The main, highly abbreviated, **conclusions** (from more than a dozen key points) are:

1. Cost benefit analysis, extended as per Treasury 'Green Book', should continue to be deployed, adjusted as necessary to include multiple decision criteria, perhaps resulting in multi-criteria analysis of the more complex wetland management contexts;
2. Monetary evaluation of a range of wetland goods and services is a practicable and viable exercise, within limits;
3. A simple typology of wetland goods and services should suffice to guide assessment and appraisal;
4. The type of economic methods to be used will depend on the type of changes envisaged to each wetland system;
5. Representative values should be sought, in a pragmatic way;
6. Only a survey based contingent valuation (WTP) methods will gauge aggregate values of whole wetlands;
7. A "whole landscape" catchment scale perspective should be adopted;
8. Double counting is an ever-present danger.

F. THE MAIN IMPLICATIONS OF THE FINDINGS

F1. Increased flood damage and loss values

The increased flood damage and loss values reported in the project will mean that many more FCERM schemes will be seen to be cost-beneficial in the future than in the past. This may raise public expectations that these schemes will be implemented.

F2. The beneficial effects of warnings

Flood warning systems as currently designed and implemented appear not to save much flood damage. Given that Defra and the EA are part-way through a £300 million investment programme, justified in terms of damage saving as well as public safety, this is worrying. More work needs to be done to ensure that flood warning systems do result in greater damage saving.

F3. Handbook; Manual and CD: their use needs to be monitored.

Both the MCM and the MCH are important documents that help implement Defra and HM Treasury policy. Their use needs to be monitored to ensure that they continue to meet those and user needs. Clarification is needed on how future practical guidance for users is to be developed and funded, in the light of MSFW.

G. POSSIBLE FUTURE WORK

G1. Further technical research

1. Many gaps in the database of non-presidential property (NRP) flood losses remain, and new methods are needed to pursue this important work in the future.
2. More work needs to be done to develop a data set of really good weighted annual average damages (WAAD) data; this applies to all benefit categories, not just residential properties.
3. More research is needed on damage saving through warnings to Non-Residential Properties (NRPs), since our research suggests that these are worryingly low.
4. From pre-2003 research (reported in both MCM and MCH) a case study of the Autumn 2000 floods has demonstrated that emergency costs add c. 10.7% to direct flood damages. More work is needed to determine how appropriate is this figure is for a wider range of circumstances than were represented in the single case study.
5. More research is needed on environment benefits, and their transferability as benefit transfers.

G2. Possible *Making Space for Water* (MSFW) R&D needs

6. Far more effort is needed before we can integrate MCA and BCA in an operational way as envisaged in *Making Space for Water*.
7. In the light of MSFW adopting a portfolio approach to FCERM project design, incorporating flood warning as a vital component, more work needs to be done to ensure that flood warning systems do result in greater damage saving (see above) and determine how effective flood warnings are within a portfolio of responses.

H. ACTION RESULTING FROM THE RESEARCH

H1. Publication

The MCM and the MCH will be published in December 2005. The latter is assisted by a bulk purchase from Defra; the former is a commercial publication by the Middlesex University Press. Research papers are contemplated, particularly on the rise in flood damages in the last decade or so and the policy implications that flow from this.

H2. Other dissemination

The MCM and the MCH contents will be used in our EA Foundation Course and other EA training programmes (e.g. our course on Flood Warning and Response).

The MCH and MC CD will be disseminated on the Defra Intranet. The MCM may be disseminated in similar fashion after commercial sales have met Middlesex University Press targets.

H3. Training for take-up

It is likely that we will run at least one training programme on the MCM/H for the EA, local authorities and Defra staff. In the past we have run these courses annually, but have not done so for a few years. It is likely that this course will be revived for 2006.

H4. Updating.

We anticipate that the CD will be updated annually and the updates made available to purchasers of the MCM/H on a preferential basis. A system for regularly and properly updating the data on the MCM CD and in the MCM needs to be agreed with the Environment Agency.

References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.
 - Edmund Penning-Rowsell, Clare Johnson, Sylvia Tunstall, Sue Tapsell, Joe Morris, John Chatterton and Colin Green (2005a). *The Benefits of Flood and Coastal Risk Management: A Manual of Assessment Techniques*. London: Middlesex University Press.

- Edmund Penning-Rowell, Clare Johnson, Sylvia Tunstall, Sue Tapsell, Joe Morris, John Chatterton and Colin Green (2005b). *The Benefits of Flood and Coastal Risk Management: A Handbook of Assessment Techniques*. London: Middlesex University Press.
- Edmund Penning-Rowell and Theresa Wilson (In press 2006). 'Gauging the impact of natural hazards: the pattern and cost of emergency response during flood events'. ***Transactions of the Institute of British Geographers***.