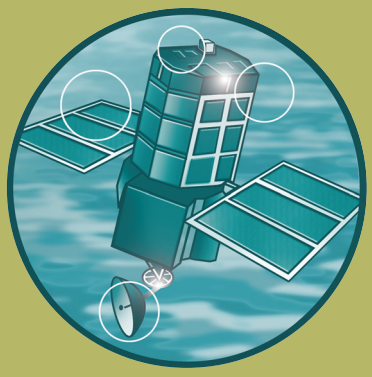
Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme

Post Event Appraisal - Questionnaire Survey Monitoring, recording and analysing events

R&D Project Record: FD2012/PR2



Environment Agency

defra
Department for Environment Food and Rural Affairs

Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme

Post Event Appraisal - Questionnaire Survey Monitoring, recording and analysing events

R&D Project Record: FD2012/PR2

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Statement of Use:
The project documents provide guidance to identify the need and scope for the development of a working “pilot” post event appraisal “system” to inform subsequent policy, strategy and decision-making processes, engineering design, managerial and operational procedures and performance evaluation. Primary responsibility for incorporating this into internal operations systems lies with the Environment Agency and, where appropriate, other operating authorities.

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Contents

List of tables

List of figures

Abbreviations

Defra	Department for Environment Food and Rural Affairs
EA / The Agency	The Environment Agency
FDCPAG	Flood and Coastal Defence Project Appraisal Guidance
GPS	Global Positioning System
JBA	Jeremy Benn Associates Ltd.
LiDAR	Light Direction and Ranging
NCEDS	National Centre for Environmental Data and Surveillance
NFCDD	National Flood and Coastal Defence Database
OPW	Office of Public Works (Eire)
QA	Quality Assurance
R&D	Research and Development
SAR	Side Aperture Radar
SEPA	Scottish Environmental Protection Agency

Appendices

1. Introduction

1.1 Study objective

In April 2002 Bullen Consultants were appointed by the Department for Environment Food and Rural Affairs (Defra) to undertake a Research and Development project into post event appraisal. JBA Consulting were named as a sub-consultant to Bullen for the project. The objectives of the study were:

1. To examine the effectiveness of the monitoring and recording procedures currently employed by the operating authorities and Defra to collect data on events compared to best practice in other industries and emergency services;

2. To evaluate the usefulness of existing parameters being monitored compared to best practice in other industries and emergency services and by overseas flood management agencies;

3. To examine how current monitoring and recording procedures are used in post event appraisal to:

    - Develop strategies and policies for flood and coastal defence
    - Improve managerial and operational practices and procedures
    - Review forward and emergency plans
    - Improve dissemination to, and communications with, the general public
    - Evolve systems of monitoring and data collection in relationship to flooding and erosion events
    - Evaluate scheme (including flood warning, emergency response and maintenance regime) performance
    - Assess the achievement of national, corporate, regional and local targets;

4. To prepare a best practice guide for recording event data in a consistent way for application throughout England and Wales.

JBA's main involvement with the project was to produce and distribute a questionnaire to interested parties concerned with post event appraisal. JBA were also responsible for analysing the responses to the questionnaires. This report describes the questionnaire and the manner in which the responses were assessed.

1.2 Report structure

The report is laid out in four chapters. Chapter 1 is a brief introduction to the project. In Chapter 2 the questionnaire is described. A brief analysis of the categories of people who responded to the questionnaire is also presented. A detailed analysis of the responses to the questionnaire and the respondents'

view of post event appraisal are given in Chapter 3. Finally in Chapter 4 the main conclusions drawn by Bullen and JBA from the questionnaire survey are described.

2. Questionnaire Survey

2.1 Questionnaire

A questionnaire concerning monitoring, recording and analysing events was drawn up during Phase 1 of the project. The questionnaire was designed to establish:

- The extent of current monitoring, recording and appraisal
- How any data and results are disseminated
- Perceived and actual shortfalls in current practice
- Requirements for additional data and analyses
- Where ongoing research may address any shortfalls

The questionnaire (a copy of which may be found in Appendix A) was split into five parts:

- Respondent details
- Post event appraisal
- Data (monitoring and recording)
- Management of process
- Ongoing research and final comments

The purpose of each question is explained in the following sections. The nature of the questionnaire was to invite the respondents to identify data topics for post event data collection and appraisal. Consequently the analysis of the questionnaire inevitably led to the production of lists of requirements.

2.1.1 Respondent details

This section was designed to establish contact details and the degree of expertise (Q1) to which the respondent is involved with the monitoring, recording and appraisal processes.

2.1.2 Post event appraisal

The purpose of this section was to determine the scope of post event appraisals. The aim of the questions was to determine:

- Whether any standards are applied to appraisal exercises (Q2)
- The extent to which post event appraisals are undertaken in particular areas (Q3)
- The extent to which appraisals are disseminated (Q4)
- Suggestions for areas in which appraisals could be improved (Q5)

2.1.3 Data (monitoring and recording)

This section dealt with the issue of what data are collected during a post event exercise. The aim of the questions was to determine the:

- Extent and usefulness of the data collected (Q6)
- Availability and relevance of the data collected (Q7)
- Recipients of any data collected (Q8)
- Planning associated with data collection exercises (Q9)

2.1.4 Management of process

Issues concerning the management of the appraisal process from data collection through appraisal to dissemination were considered in this section. The following issues were considered:

- Resourcing (Q10)
- Standard specifications for data collection and storage (Q11)
- Improved methods for collecting data (Q12)
- Costs of data collection and appraisal exercises (Q13)
- Benefits of data collection and appraisal exercises (Q14)
- Targets for data collection and appraisal exercises (Q15)

2.1.5 Ongoing research and final comments

Finally, the questionnaire asked about the respondents' awareness of ongoing research that links with the current project and any comments the respondents thought would be helpful.

2.2 Consultees

During Phase 1 of the project a list of consultees was drawn up (see Appendix B). The list covered staff from across The Environment Agency, Central Government, Local Authorities, R&D Theme Leaders and Project Managers, the insurance industry, selected academics and overseas flood agencies. This broad but selected list of consultees was designed to allow canvassing of the full range of stakeholders and enable any identified shortcomings to be matched with stakeholder group needs.

Questionnaires were posted or e-mailed to the consultees who were invited to either reply by post, e-mail or complete the questionnaire over the internet.

2.3 Respondents

In all there were 31 responses to the questionnaire. The respondents represented the following organisations:

Category	Organisation
The Environment Agency	National Team Thames Region North East Region Midlands Region National Flood Warning Centre National Centre for Environmental Data and Surveillance
Government / Local Government	Defra Flood Management Division Leeds City Council Mid Sussex District Council Scarborough Borough Council Lewes District Council Isle of Wight County Council Waveney District Council
Academia	Middlesex University University of Glasgow UMIST
Police	West Mercia Police Portishead Police HQ
Insurance Industry	Norwich Union NFU Mutual Insurance Congregational and General Insurance plc Co-operative Insurance Society Ecclesiastical Insurance Group
Others Organisations	Risk and Policy Analysts Ltd. Enviro Centre Ltd. WS Atkins HR Wallingford Ltd.
Overseas	SEPA Office of Public Works (Eire) Bureau of Meteorology (Australia)

The respondents were categorised as follows:

- Insurance Industry - 5 responses;
- Policy and Strategic Organisations - 11 responses. This category included staff from Central Government, at Regional and National level in The Environment Agency, senior Local Authority staff and Academics;
- Emergency Response Organisations - 3 responses. Unfortunately few of the respondents fell into this category. The three replies were from the Police (2) and one Local Authority emergency planner. Efforts were made

to chase up further respondents from this category so that conclusions could be based on a wider sample;

- Operations and Design - 9 responses. This category covered staff involved with response to flood events and the design of flood alleviation schemes. The respondents came from The Environment Agency (including flood warning and flood defence staff), Local Authorities and engineering consultants;
- Overseas - 3 responses from Australia, Ireland and Scotland.

The split was designed to reflect the different interests in the process.

Question 1 – On average how often do you (or your organisation) need to appraise, monitor, record or receive data or results of appraisals during or from a flood or erosion event?

Figure 2.1 shows the manner in which the respondents answered Question 1.

In general, the majority of the respondents within each category are frequently involved with all aspects of the process (e.g. appraisal, monitoring, recording data, receiving data and receiving appraisals). Within the Policy and Strategic category a significant proportion of the respondents were never involved with monitoring, recording, receiving data or receiving appraisals. However, these generally represented the responses from Central Government and academics rather than strategic staff in The Environment Agency or Local Authorities.

In the emergency response category, there was a tendency to receive appraisals rather than have a great deal of involvement in the appraisal or data collection processes. However because this observation is based on a sample of three responses it may not reflect the true situation.

All of the respondents from the insurance industry were frequently involved with all aspects of the process. However, it should be recognised that data collected and appraised for the insurance companies will probably be different from that required by flood defence engineers, planners and Agency managers.

3. Questionnaire responses

3.1 Post event appraisal

Question 2 – Do you or your organisation undertake post event appraisals following flood and erosion events?

Table 3.1 summarises the responses to question 2. The majority of respondents in each category responded to the question.

Within the insurance category, most respondents did not apply particular standards to the data collection or appraisal process. Where standards were applied they were internal standards applicable to a particular insurance company. The appraisal results were related to claims and then may be passed on for underwriting purposes and the setting of premiums.

A range of responses was received from the Policy and Strategic Organisations. Within the Agency there is a national standard for post event data collection. This was written by Thames Region of the Agency and deals with floods (not erosion), the latest update being produced in October 2001. The standard deals with issues about how to collect data rather than what data to collect, and how to target resources in such an exercise. This standard is supposed to be applied within all regions.

As suggested, John Garrod (Operations Policy Manager for the Agency at Head Office) was contacted. John is responsible for the implementation of AMS (Agency Management System). The system is designed to specify the way Agency staff work and so ensure a consistent response by staff across the broad range of the Agency activities. So far the work has concentrated on the inspection and maintenance of assets. Little work in relation to Emergency Response and Emergency Management has been undertaken so far. However, these are issues that will be considered in the next year. Consequently there is no guidance in relation to Post Event Appraisals at a National level apart from that produced by Thames Region.

The Agency are starting an internal project on Incident Management. The study will consider how the Agency responds to major national emergencies such as the November 2000 floods and Foot and Mouth Disease. The project will include a study of resourcing such events including the role of the emergency workforce. During Summer 2003 there will be a major emergency exercise called Operation Triton. The exercise will test out the Agency's Operational Response and Media Response during major national events.

Appraisals are stored in a variety of ways including hard copies of reports and electronic versions. There are some initiatives underway within the Agency which are being lead by Ian Meadowcroft and NCEDS (Twerton). Both were contacted and responded to the questionnaire and follow up enquiries concerning ongoing research (see 3.4).

Within the operations and design category there was some awareness of the Agency national standards. However this was not widespread and did not extend to consultants who are often employed by the Agency to undertake data collection exercises. Storage of appraisals was in a variety of formats including:

- Written reports (Paper)
- Internal filing systems
- Digital storage (MS Word / Excel, GIS, Photographs and Adobe Acrobat)
- Archive (used by consultants for particular studies) (Electronic or paper depending on medium)

A similar picture was given by the Overseas category with no definite standards in place and results stored in an ad-hoc manner.

Question 3a – On average, how often do you (or your organisation) undertake post event appraisals to guide decision making in the following areas?

Figure 3.1 shows the overall response to question 3a. Approximately half the respondents undertook appraisals frequently or sometimes in all of the areas identified. Additional areas of investigation were highlighted including: development control, restoration of services, landslide monitoring and development studies. The responses indicated that although more respondents undertook policy/strategic and data monitoring appraisals than for flood forecasting none of the areas was considered particularly more important than another.

Figure 3.2 splits the response to the question down by category of respondent. This analysis showed that appraisals are undertaken in particular areas depending on the category of respondent. Table 3.2 summarises the most important appraisal areas for each category.

Table 3.2 Key appraisal areas undertaken for each category

Category	**Key appraisal areas**
Insurance	Flood inundation Data monitoring
Policy and strategic organisations	Policy and strategic Scheme performance Communications
Emergency response organisations	Policy and strategic
Operations and design	Scheme design
Overseas	Data monitoring

Question 3b – On average, how often do you (or your organisation) use the results of post event appraisals covering the following areas?

Figure 3.3 shows the overall response to question 3b. More respondents use the results of appraisals rather than undertaking appraisals themselves. The responses indicated that more respondents used policy/strategic and data monitoring appraisals than those for flood forecasting.

Figure 3.4 splits the response to the question down by category of respondent. This analysis showed that particular appraisal areas are considered more important than others for each category of respondent. Table 3.3 summarises the most important appraisal areas for each category.

Table 3.3: Key appraisal areas used by each category

Category	Key appraisal areas
Insurance	Policy and strategic Flood inundation Data monitoring
Policy and strategic organisations	Policy and strategic Scheme performance Communications
Emergency response organisations	Policy and strategic
Operations and design	Scheme design Operational procedures
Overseas	Data monitoring
Note: In this context "Data monitoring" is the appraisal of data collection procedures and their relative success or otherwise as part of the appraisal process	

Question 4 – Do you disseminate or receive appraisal results to/from either internal or external parties?

Table 3.4 shows the responses to question 4. Within the insurance category appraisals are not disseminated to external parties and appraisals are received from within the insurance industry. For the policy and strategic organisations appraisal results are disseminated to local authorities, the Environment Agency and politicians (both local and national). Policy and strategic organisations receive appraisal results from emergency planners, the Environment Agency and consultants appointed to carry out such exercises. The emergency response category disseminates the results of appraisals within the emergency services and receives results from the Environment Agency. Within the operations and design category the appraisal results are passed between local authorities and the Environment Agency. A similar picture is apparent in the Overseas category.

Question 5 - Could appraisals be improved in the following areas? If yes indicate briefly how

Table 3.5 shows the answers given to question 5. Two out of three of the respondents identified ways in which post event appraisals could be improved. Several methods for improving appraisals were identified and in several cases these were applicable to most of the appraisal areas and were identified across the range of categories. The following paragraphs describe these issues in more detail.

It was recognised that there was a need for a National Standard and that continuous improvement should be guided by Defra Policy and R&D. Such an approach would feed the way post flood exercises are undertaken and reflect

public opinion. However such a standard could not be static because after each event lessons should be learnt, good practice shared and post flood action plans updated. The benefits of such an approach would be:

- The sharing of good practice nationally;
- A wider understanding of the issues;
- More effective targeting of resources;
- Systematic post-flood actions plans that have been agreed by all relevant agencies;
- More effective use of data collected;
- Improved forecasting and focus on flood risk areas.

The operational and design category identified particularly the information that should be collected. These data need to be defined more closely depending on the type of appraisal. Such data requirements will change with location and should be defined prior to an event. Particular data needs include:

- Specific water levels collected at locations so one event can be compared with another. This implies pre-event planning of what data should be collected and how appraisals should be undertaken;
- Data on extreme event sensitivity;
- More comprehensive monitoring and data improved analysis techniques;
- Effectiveness of flood warnings to confirm that current policy and strategic directions are optimum (e.g. warnings issued/ warnings received/ response to warnings/ what flooded);
- Water levels, flows, timing, locations, flow gauging, inundation limits and the rate of rise of flood water;
- Flood paths, speed of currents and depth during flooding (important for emergency planning);
- Operation and performance of flood defence structures (e.g. pumping stations, flood gates, overtopping of embankments). Specific information on relevant design parameters and monitoring of performance during more extreme loading conditions;
- The extension of data collection to ordinary watercourses.

There should be greater recognition of risk-based techniques in scheme design. Scheme designs should include standards of service that can be compared with actual response/impact to allow the success or otherwise of works to be judged. The collection of such data would lead to a better understanding of scheme performance and so better future design.

Post event appraisal does not pay enough attention to the human impact of flooding, communications with the public and emergency planning issues. Improvements could be made by:

- Better provision of advice to the public before, during and after an event;
- Provision of information the public can understand;
- Improved feedback mechanisms from the public;

- The identification of stakeholders who are questioned following events. The Agency and/or local authorities collate information from those affected by flooding but often the information is not shared;
- Post event communications with flood warning recipients to assess level of the flood warning service;
- Feedback to the public concerning successful events.

Emergency planning could also be improved. The following areas were identified:

- The integrated management group should meet on a regional basis to discuss all aspects of contingency planning, including flood management;
- Better provision of advice to emergency planners before during and after an event;
- Local authority emergency plans give information on what people should do during an event but lack information on flood extent, flood depth, rate of rise;
- Detailed planning of emergency response, evacuation etc.;
- A better understanding of risk and the impact of complacency.

Data collection could be improved by the use of modern technology during surveys and the processing of data. The use of hand-held GPS systems linked to palm top computers could improve the efficiency of data collection during walkover surveys. However, the practical application of such technology under extreme conditions has still to be proved. Having collected the data there is a need to develop techniques to automate the processing of field data into floodplain maps and other deliverables such as databases.

3.2 Data monitoring and recording

Question 6 – If you undertake monitoring and recording, what data and information do you collect during a flood or erosion event?

Table 3.6 shows the information that is collected for each data topic by the respondents from each category. Overall, more people collect information concerning the weather experienced, areas inundated, the causes of flooding, the locations/ numbers of properties affected and the costs.

Within the insurance category, more people collect data concerned with the locations/ numbers of properties affected and the causes of flooding than for any other topic. For the policy and strategic category most people collected information concerning assets, emergency response and public feedback. In the operation and design category, most people collected information concerning areas inundated, assets and near misses.

Question 7 – If you do not carry out monitoring and recording , what data and information do you require about flood or erosion events?

Table 3.7 shows the information that the respondents from each category consider is available for each data topic following an event. Generally more information is available concerning the causes of the event and the areas, properties and infrastructure affected, rather than information concerning the people affected and the response of the authorities (e.g. insurance status of victims, resourcing, inter agency response, media issues and reporting) to the event.

Table 3.8 summarises the most important data topics for each category of respondent. Tables 3.9 to 3.13 provide more detail than the table below showing the relative importance of all the data topics for each category of respondent. In these tables the data topics have been ranked.

Table 3.8: Key data topics needed by each category

Category	Key Data Topics
Insurance	Weather experienced Causes and sources of flooding Areas inundated Costs Flood warning delivered
Policy and strategic organisations	Causes and sources of flooding Near misses Weather experienced Locations and numbers of properties & businesses flooded Major infrastructure and utilities flooded / disrupted Asset inspection
Emergency response organisations	Weather experienced Areas inundated Major infrastructure and utilities flooded / disrupted Emergency response Public feedback
Operations and design	Causes and sources of flooding Asset inspection Major infrastructure and utilities flooded / disrupted Weather experienced River flows and levels experienced Locations and numbers of properties & businesses affected Design standard of defences
Overseas	Telemetry performance Flood forecasting performance Properties flooded – not warned River flows and levels experienced Areas inundated Causes and sources of flooding

Table 3.14 summarises the ranking within each data category for all of the data topics. Table 3.15 shows the perceived importance of each data topic accounting for responses from all of the data categories.

Question 8 – Who are the main recipients of the data and information collected?

Table 3.16 shows the responses to question 8. Within the insurance category the recipients of data collected are involved in the insurance process (e.g. claims managers, underwriters, loss adjusters, solicitors and suppliers). No one in this category reported providing information to parties external to the process. The information passed on related to areas/properties affected and costs. Presumably these costs relate to damages.

The policy/strategic organisations reported passing information on to Defra, The Environment Agency, Consultants (both fluvial and coastal), Water Companies, Coastal Groups, Emergency Planning Sections and the public. The information needs varied with the recipient and were often described in general terms such as “where necessary”, “all” or “relevant”. Emergency planning required information related to areas affected by flooding, actions taken during the event, evacuations, inter-agency response, media issues and the impacts on people.

The emergency response category reported passing information to emergency planning officers/partners and The Environment Agency. The information needs to be related to inter-agency response, reporting, media issues and feedback (both public and professional).

For the operation/design category, information is passed on to elected representatives (councillors/MPs), the Environment Agency (development control engineers, flood defence staff, catchment strategy managers and river modellers), council departments and consultants. The information needs vary but mainly relate to the causes of the event, the performance of flood warning systems and defences and the impact on property/infrastructure. Elected representatives also required information on the human consequences of the event.

In the overseas category the recipients of the data are similar to those in England and Wales (e.g. local authorities, emergency planners and services and flood warning teams).

Question 9 – Do you have plans for monitoring and recording information identified in Q6 during and immediately after a flood or erosion event?

Table 3.17 shows the responses to question 9. A minority of the respondents have plans in place for the monitoring and recording of information during and immediately after a flood or erosion event. However, the plans only cover a limited number of the data topics. These include areas relating to the weather conditions experienced before and during the event, the effect of the event (areas inundated, properties affected), the performance of defences and warning systems and costs. Where the plans have been applied there has been some success but there is room for improvement.

Examples of existing plans include:

- Pre-prepared maps showing locations where flood levels should be collected;
- Contact numbers for contractors able to undertake aerial photography during events;
- Agreed contractual arrangements with framework consultants for deployment of staff at short notice ;

Plans could be improved with reference to the following issues:

- Pre-event planning - preparation of a clearly defined specification, (when should data be collected, who should collect data, format of data, equipment), staff training, prioritisation of data collection issues;
- Event organisation - preserve continuity from previous events, maximise the data collection opportunities during initial site visits, improved liaison between the Agency and surveyors during an event, de-briefing of surveyors;
- Post event processing - quality assurance of data, definition of deliverables and associated formats, dynamic feedback.

3.3 Management of process

Question 10 – Have you identified the resources required to collect data and information concerning flood and erosion events?

Approximately half the respondents have identified the resources required to collect data and information concerning flood and erosion events (see Table 3.18). Approximately half of these have identified external resources that could be used and have in place some form of contractual arrangements for their deployment. However in some cases these arrangements have not been put to the test. Internal resources may be deployed from across The Environment Agency and so non-flood defence staff may be used during an event.

From the responses the degree of training given varies with organisation, generally ranging between 50% and 100%. The training is generally based on local standards though two respondents mention national standards that apply. In some cases it is assumed that staff experienced in flood and coastal defence issues are aware of the needs of data collection and appraisal exercises. The frequency of the training provided is varied. Some respondents identified training as being ongoing or frequent.
None of the respondents in the emergency response category have identified the resources required to collect data during or after an event.

Question 11 – Does your organisation have prescribed methods for recording and collating information gathered during or immediately after a flood or erosion event?

Table 3.19 shows the responses to question 11. Only one respondent identified a national standard for post event data collection exercises and this has only been used for major events like Autumn 2000. Otherwise any standards applied to the process are mainly local ones.

None of the respondents collated the data collected for dissemination externally though several disseminated the information within their organisation.

Apart from for hydrometric data, no formalised QA procedures are applied to data and information gathered during post event data collection exercises.

Question 12 – Could the methods of data and information collection be improved?

Table 3.20 shows the responses to question 12. The majority of respondents in most categories identified areas that might benefit from modern technology. The main areas identified related to areas of inundation, properties/infrastructure affected, hydrometric data and assets. Several respondents identified the need for establishing a GIS database and better mapping. One of the insurers is producing their own flood risk map. The Agency's plans for NFCDD may go some way to addressing this issue.

Further areas where improvements could be made relate to collection of survey data using hand held data loggers with GPS. The Agency has undertaken a research project on the issue called Project Checkmate. The use of hand held systems was primarily assessed with a view to use during asset inspections. However, it was recognised that there will be other benefits such as during post flood data collection exercises. Various different types of equipment were tested including tablet style computers (PaceBlades), palm top devices and iPAQ's. The use of portable GPS and digital cameras linked to the devices was also tested. The study has not come to an official conclusion because the intention is to link it through to NFCDD but this has not yet been finalised. However, at this stage it is not anticipated that the system will incorporate a GIS for use in the field. Flood extents could also be measured using remote sensing techniques such as SAR (Side Aperture Radar), aerial video and LiDAR.

Most respondents reported that data are held in a mixture of paper and digital formats. In all but the policy/strategic category the majority of the data are stored in paper format. This may reflect a desire about what ought to happen rather than indicating what actually happens in practice!

Question 13 – Do you monitor the cost for undertaking post event data collection and appraisal exercises?

Only four out of a total of 30 respondents monitor the costs of undertaking post event data collection and appraisal exercises (see Table 3.21). These four were evenly split between the policy/strategic and the operations/design categories. Three of the respondents were prepared to share information about the cost of undertaking such exercises. However, of these three respondents, two were involved with specialised areas of post event appraisal (human impact

surveys running up to several months after an event and sophisticated remote sensing techniques such as LiDAR and SAR) and such information would not be applicable across the wide range of post event activities. The remaining respondent represented the flood warning function of the Environment Agency.

Question 14 – Do you consider that undertaking post event data collection and appraisal exercises are worthwhile?

The majority of respondents in all categories considered undertaking post event data collection exercises worthwhile (see Table 3.22). In fact only one respondent (from the insurance category) did not consider such exercises worthwhile. For the insurance category, the benefits mainly relate to an improved understanding of risks associated with such events.

Within the other categories, data collection exercises were considered to enable organisations to learn from experience, gain a greater understanding of the causes of events and identify flood risk areas. Processing of the data allows easy access to information from the event, creates a permanent record that can be compared with previous events and with the predicted performance of schemes. Storage of the data and appraisal mean that long-term trends can be identified and provides information to justify future decision making and planning.

Question 15 – Are there defined targets for post event appraisals?

A minority of the respondents set targets for post event appraisals (see Table 3.23). However the targets are only set for a limited number of data topics and appraisal areas. In England and Wales, the targets described relate to flood warning and dissemination performance and the frequency of inspection for defences in accordance with Defra guidance.

Looking overseas to Australia, targets are set for user satisfaction and warning effectiveness. These are set at a national and regional level.

3.4 Ongoing research

Question 16 – Are you aware of any ongoing research or other developments that may overlap with the scope of this project or address any issues you identify?

The responses to question 16 are shown in Table 3.24. Within the insurance and emergency response categories none of the respondents were aware of any ongoing research. The following paragraphs describe the projects that were identified by respondents in the policy/strategic and operation/design categories.

Performance evaluation concerted action
This Defra funded project being undertaken by HR Wallingford (Contact: Jonathan Simm) is due for completion in December 2002 with a review report

due in September 2002. The study is concerned with the management of flood and coastal defence assets and is considering three issues: value for money audits of the assets, improving best practice for management of assets and learning lessons in order to inform future management of assets. The project will lead to the production of FDCPAG6. The scientific objectives are[1]:

- Develop definitions, framework and guidance for performance evaluation to ensure consistent approaches, recognising that the 'definition' of performance will need to reflect the aims and objectives of different actors. The methodology will apply to policies, plans and schemes, and will include flood forecasting and warning, engineering design and construction, and operations and maintenance. The methodology should include performance of existing/ ageing flood and coastal defences as well as 'post project' evaluation of new schemes;
- Develop a range of performance measures and associated criteria in order to provide a foundation for future performance evaluation studies;
- Develop and test strategies and mechanisms for feedback of performance evaluation results in order to influence future policy and practice;
- Identify data needed for performance evaluation in order to influence data and information policy, including possible centralisation of performance databases.

Risk uncertainty and performance review

HR Wallingford are undertaking this project (Defra /Agency Project Manager: Ian Meadowcroft). A review report, SR587, was produced in January 2002. The report provides comprehensive terminology, tools and approaches to risk assessment and decision-making. The following issues were reviewed (HR Wallingford, 2002):

- Principles of risk, performance and uncertainty;
- Issues surrounding flood and erosion management from a risk and performance perspective;
- The application of risk, performance and uncertainty principles in decision-making practice;
- The need to move towards a more integrated risk-based decision making framework;
- The risk tools and techniques that may help the flood and coastal defence community to achieve best value and demonstrate areas of success and failure.

Failure on demand of flood defence scheme components[2]

This research will exploit data and experiment with a range of components to provide a basic database of failure. It will give estimates for likelihood (and consequences) of failure 'on demand' of discrete operated components elements such as gates, culverts and flaps, to provide data for design, appraisal and management of flood defence systems on the reliability of these

[1] A3 Scientific Objectives – Risk Evaluation and Understanding of Uncertainty Theme
[2] A3 Scientific Objectives – Risk Evaluation and Understanding of Uncertainty Theme

components. The research is due for completion in March 2003 and is being undertaken by RMC Consultants (Contact: Alan Allison).

Environmental change indicators for flood and coastal defence
The objectives of this research are to identify, define and select a range of indicators relevant to flood and coastal defence that are likely to be representative of changes in the environment and to develop mechanisms for monitoring, analysing and interpreting findings. This will provide the basis for gathering empirical evidence for the rate and nature of environmental change impacts on future flood and coastal erosion risk, supporting all areas of policy development and implementation. Preference will be given to indicators that have historical records enabling short-term conclusions to be drawn.

Flood extent monitoring using airborne SAR
This project is being undertaken by the NCEDS (Twerton) in conjunction with Thames Region of the Agency. Initial work has been undertaken to set-up the project which is now awaiting a flood within Thames Region in order to test out SAR. This work is also tied in with an internal NCEDS (Twerton) project for developing airborne SAR capabilities.

Guidance on floodplain management and emergency planning
The aim of this research undertaken by HR Wallingford was to produce a Floodplain Management Manual for the UK. As a starting point HR took a similar manual that had been produced in Australia and adapted it for UK use. The draft report from the study was produced in May 2002. The manual provides guidance to planners on how to account for floodplains and produce Floodplain Management and Emergency Plans. In this respect, the guidance has a broader scope than PPG25 which the work will integrate with. Floodplain and Emergency Plans have a similar broad scope to Catchment Management and Shoreline Management Plans in that they cover social, environmental and engineering issues.

SEPA National Flood Warning Development
SEPA are at the start up stage in developing their flood warning systems. They have identified the need for post flood event analysis and are considering a number of the issues. For SEPA, post flood event analysis/appraisal is considered to be an ongoing project.

Strategic Monitoring Survey of Southern English Coastline
The three coastal groups in the Defra south-east region have applied for a Defra grant for a strategic monitoring survey of the coastline from the North Kent coast to Portland Bill. The study is understood to be close to approval. The project is initially scheduled to last for five years but it is hoped that the work will be extended. Data will be collected to a standard specification and will be held in a central location. The survey has been designed on a risk assessment basis so that there is a higher density of data collected at some sites compared to others. It is anticipated that the following data will be collected:

- Aerial survey with photogrammetric profiling (annual survey);

- LiDAR survey of certain areas, low lying land and soft cliffs (3-yearly survey);
- Beach profiling surveys;
- Hydrographic surveys (5-yearly survey);
- Installation of wave rider buoys and tide gauges.

The study allows for post event surveys in the form of post storm profiles. Contractual arrangements will be in place to allow the deployment of surveyors at short notice. These surveys are anticipated to be undertaken for extreme events (Contact: Dr. Andrew Bradbury New Forest DC).

3.5 Final comments

Question 17 – Please add any comments you wish to make about monitoring and recording flood and erosion events, appraisal practices and their value

Several of the respondents took the opportunity to comment on post event appraisals. Although post event appraisals are regularly undertaken, they tend to concentrate on the hydraulic and hydrological issues (e.g. extent of flooding, peak water levels, causes of flooding and prevailing weather conditions). Less emphasis is placed on the needs of victims, emergency response and long-term recovery.

One respondent from the Agency suggested that information on many of the data topics is reported but not collected in a formal manner. For instance the Agency may have information on properties/businesses flooded and major infrastructure disruption but this knowledge is often incomplete. Activities outside the remit of the Agency such as evacuations and actions by other operating authorities will be reported on, if known, but not formally collected. Following the Autumn 2000 event, efforts were made to collect these data but that is not routine. Information on insurance issues, vulnerable people and health impacts are not readily available within the Agency.

Where data collection exercises of hydraulic and hydrological data are undertaken, there is a need for clear guidance on what data are needed. The data should be collected to a high and common standard and the information needs to be made widely available.

One respondent commented that the data collected are difficult to access, often incorrect and of poor quality. The concern was expressed that the Agency rely too heavily on digital records, ignoring historical data in paper format that were collected prior to computer records. Access to paper records is time consuming and often relies on the knowledge of experienced Agency staff who are not always available. The same respondent also commented that maps held by the National Flood Warning Centre are inaccurate, quite often showing properties as flooded when they have not, and vice versa.

There was a suggestion from one respondent, that a standing team for post event data collection and appraisal exercises should be set-up. Floods are an annual event and such a team could build up a pool of expertise in the field. This would go some way to addressing issues such as inconsistent data collection methods and the lack of staff experienced in post event data collection exercises.

A number of respondents did not see that the questionnaire was relevant to their particular organisation or area of expertise. This was surprising considering the care that was taken in drawing up the list of consultees. However such a response may indicate the need for sharing information and for practitioners in the field of flood and coastal defence to view their work in a wider context.

4. Conclusions

4.1 Summary of findings

The main findings from the response to the questionnaire survey are:

- Methods of collection or analysis are based on local practice. Where a "national" procedure has been established it is not widely used;
- Records are kept in a variety of formats and media and mostly there is poor exploitation of new technology. A number of initiatives will improve information gathering, storage and access. These include the NFCDD and the Flooded Properties Database;
- Post event data collection and analysis is heavily weighted to technical interests. Little regard is given to the human and social dimension of flooding and erosion events;
- No information on the numerical assessment of the benefits of post event appraisal has been identified;
- Overseas practices are no further developed than in the UK.

The majority of respondents consider that there are great benefits in undertaking post event data collection exercises and appraisals. However, all of the benefits are described in quite general terms. No information on the numerical assessment of the benefits of post event appraisal has been identified. The benefits include:

- Learning from experience, greater understanding of the causes of flood events and the identification of flood risk areas;
- Processing of the data creates a historic record of the event allowing comparison with other events and the predicted performance of schemes;
- Storage of the data and appraisal mean that long-term trends can be assessed and provides information to justify future decision-making.

The following sections describe the findings of the questionnaire with reference to the study objectives (see 1.1.1).

4.2 Effectiveness of monitoring and recording procedures

Post event monitoring and recording procedures are most effective for the following data topics:

- River flows and levels experienced
- Weather experienced
- Areas inundated

Data is also often collected for the following data topics:

- Locations and numbers of properties/ businesses affected;
- Causes and sources of flooding;
- Major infrastructure and utilities flooded/ disrupted;
- Costs.

However this information is not comprehensive and often incomplete.
The monitoring and recording procedures do not pay enough attention to the human impact of flooding, communications with the public and emergency planning issues. Improvements in the effectiveness of these procedures could be made by:

- Improved feedback mechanisms from the public;
- The identification of stakeholders who are questioned following events;
- Better provision of advice to emergency planners before during and after an event;
- The sharing of information between operating authorities.

Although appraisals and data collection exercises are widely undertaken there is no consistent approach to this issue. It was widely recognised that there was a need for a National Standard to improve the effectiveness of post event monitoring and recording procedures. Thames Region of the Environment Agency has produced a specification for such exercises but it would appear that it is not widely used.

If a National Standard was adopted and applied it could not be static because after each event lessons should be learnt, good practice shared and post flood action plans updated. The benefits of such an approach would be:

- The sharing of good practice nationally;
- A wider understanding of the issues;
- More effective targeting of resources;
- Systematic post-flood actions plans that have been agreed by all relevant agencies;
- More effective use of data collected;
- Improved forecasting and focus on flood risk areas.

The effectiveness of data collection procedures could be improved by the use of modern technology during surveys and the processing of data. The use of hand held GPS systems linked to palm top computers would improve the efficiency of data collection during walkover surveys. Having collected the data there is a need to develop techniques to automate the processing of field data into floodplain maps and other deliverables such as databases.

4.3 Usefulness of existing parameters monitored

A variety of information across most topic areas, particularly that relating to hydrological and hydraulic factors, is collected although some of this may not be gathered in a formal manner. The information gained from such exercises may be disseminated among organisations within similar categories of responsibility. However the data are not generally distributed more widely. Data are also not held centrally allowing easy access to information. Consequently the usefulness of the data is devalued.

The respondents require, to a greater or lesser extent, all of the data topics identified at the outset of the project. The most needed topics varied according to the category of respondent. Overall the following topics were judged to be most important. The topics have been grouped according to the number of respondents who reported collecting such data even though it may be incomplete.

Frequency of data collection	**Data collected**
Data most often collected	Weather experienced Causes and sources of flooding Areas inundated Locations and numbers of properties & businesses flooded Major infrastructure and utilities flooded / disrupted Public feedback Costs
Data sometimes collected	Flood warnings delivered Near misses Asset inspection Emergency response Telemetry performance Flood forecasting performance Properties flooded – not warned River flows and levels experienced
Data least often collected	Health impacts (affected population) Vulnerable people Aftercare provisions Evacuation (success/refusals/problems) Self-help actions Performance of defences compared with design standard

In order to gain most from a post event data appraisal it was recognised that the data needs should be more closely defined. This would depend on the type of appraisal being undertaken and would change with location. Such issues should be planned for prior to an event. Some respondents reported having plans in place for undertaking post event exercises. However these plans may

not have been applied and if so are thought to be in need of some improvement.

Particular data needs include:

- Specific water levels collected at locations so one event can be compared with another. This implies pre-event planning of what data should be collected and how appraisals should be undertaken;
- Data on extreme event sensitivity;
- More comprehensive monitoring and improved data analysis techniques;
- Effectiveness of flood warnings to confirm that current policy and strategic directions are optimum (e.g. warnings issued/ warnings received/ response to warnings/ what flooded);
- Water levels, flows, timing, locations, flow gauging, inundation limits and the rate of rise of flood water;
- Flood paths, speed of currents and depth during flooding (important for emergency planning);
- Operation and performance of flood defence structures (e.g. pumping stations, flood gates, overtopping of embankments). Specific information on relevant design parameters and monitoring of performance during more extreme loading conditions;
- The extension of data collection to ordinary watercourses.

There is little data gathered in relation to the impact of events on victims and the performance of emergency procedures. Consequently, post event appraisal does not pay enough attention to the human impact of flooding, communications with the public and emergency planning issues. These are issues that are of particular importance to elected representatives and the emergency services. Improvements could be made by:

- Better provision of advice to the public before, during and after an event;
- Provision of information the public can understand;
- Post event communications with flood warning recipients to assess level of the flood warning service;
- Feedback to the public concerning successful events;
- The integrated management group should meet on a regional basis to discuss all aspects of contingency planning, including flood management;
- Local authority emergency plans give information on what people should do during an event but lack information on flood extent, flood depth, rate of rise;
- Detailed planning of emergency response, evacuation etc;
- A better understanding of risk and the impact of complacency.

The data storage and manipulation of information could be improved by the use of GIS and database systems. At the moment much data from post event exercises are only stored in paper format though it is apparent there are moves

to address this issue. The Environment Agency is in the process of developing the NFCDD.

4.4 How current monitoring and recording procedures are used in post event appraisal

Almost all the respondents considered undertaking post event data collection exercises to be worthwhile. The data collected during exercises are used within post event appraisals to guide decision-making across a wide scope.

In general terms, data collection exercises enable organisations to learn from experience, gain a greater understanding of the causes and impacts of events. Processing the data allows easy access to information from the event, creates a permanent record that can be compared with previous events and with the predicted performance of schemes. Storage of the data and appraisal mean that long-term trends can be identified and provides information to justify future decision-making and planning.

4.4.1 Policy and strategic decision making

At the policy/strategic level data collection and post event appraisal is used to:

- Increase the general understanding of the natural process and catchment dynamics;
- Identify the flood risk area;
- Quantify the risk of events;
- Determine long term trends and assess the impact of climate change;
- Provide indicators for change;
- Justify expenditure and improve budget preparation;
- Allow a measured response to events.

4.4.2 Improve managerial and operational practices and procedures

For operating authorities, data collected during post event exercises are considered vital to improve management of flood and coastal defences. The data are used in the appraisal process to:

- Learn lessons in order to guide planning for future events;
- Allow the strengths and weaknesses of defences to be assessed;
- Identify the causes of flooding and erosion events;
- Create a permanent record of the event, preventing reliance on hearsay.

4.4.3 Review forward and emergency plans

Post event appraisals of emergency responses and long-term recovery are less common than appraisals of the weather and flooding experienced. However, where they are undertaken they allow:

- The development of action plans for future events;
- The prioritisation of competing demands during events;
- The development of best practice in response to an emergency .

4.4.5 Improve dissemination to and communications with the general public

Nearly half of the respondents collect data concerning public feedback. However, few reported the successful dissemination of information back to the general public. This is probably due to the manner in which data are processed and collated.

4.4.6 Evolve systems of monitoring and data collection in relationship to flooding and erosion events

Recent post event data collection exercises have identified several areas in which the conduct of future studies can be improved. It is anticipated that future post project reviews will evolve improved methods of data collection. Particular areas that have been identified include:

- Pre-event planning - preparation of a clearly defined specification, (when should data be collected, who should collect data, format of data, equipment), staff training, prioritisation of data collection issues;
- Event organisation - preserve continuity from previous events, maximising the data collection opportunities during initial site visits, liaison between the Agency and surveyors during an event, de-briefing of surveyors;
- Post event processing - quality assurance of data, definition of deliverables and associated formats, dynamic feedback.

4.4.7 Evaluate scheme performances

Post event data collection exercises enable scheme performance to be assessed under extreme conditions. Such data are used to:

- Check the actual response of a scheme compared with that predicted and the scheme design;
- Determine the causes of flooding and erosion events;
- Drive performance review evaluation;
- Assess expenditure for maintenance of schemes;
- Determine budgets for future schemes.

4.4.8 Assess the achievement of national, corporate, regional and local targets

The questionnaire responses indicate that few targets are set for post event appraisals. Where targets are set they relate to a limited field of activities:

- Flood warning and dissemination performance
- Frequency of inspection for defences in accordance with Defra guidance.

5. References

HR Wallingford 2002 *Risk Performance and Uncertainty in Flood and Coastal Defence*. Report SR587. 2nd Draft. January 2002.

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