

**APPENDIX 1: RO STATEMENTS AND WORK PLANS OF THE
FOUR THEMES**

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

Strategy and Policy Development Theme – RO Statement

Programme vision

This SPD programme will cover areas of strategic national interest and areas of developing policy. Currently the main developing policy areas are those identified in the Making Space for Water Implementation Plan, although these will change with time and there is a need for a broader horizon-scanning role to consider longer-term requirements. In general, once a policy line and the underlying case for adoption is established then it is expected that further research to support or improve delivery would pass to one of the other theme areas (or in some cases to another Division in the Department).

The programme will, therefore:

- Support Evidence and Innovation (E&I) to all key policy areas covered by the 'Making Space for Water' (MSW) implementation programme.
- Review strategic level E&I needs of other linked policy areas.
- Commission evidence work to meet identified requirements from both R&D and consultancy budgets, as appropriate
- Use longer term horizon scanning to support research needed for policy development 2010-2020.

Overall objective	Beneficiary groups	Baseline/evaluation criteria
Risk from flooding and coastal erosion is managed in a way which furthers sustainable development.	The people, communities and businesses in or adjacent to areas of flood and coastal erosion risk and others who benefit from an effective and efficient programme of risk management; EA FRM Policy, Process and Operational teams; Local Authorities, Drainage Boards, other operating authorities and Emergency Services.	From a baseline of some £1.2 billion of annual economic residual damage, the aim is to support programmes of sustainable flood risk management with effective guidance, appropriate knowledge and information and sound decision making techniques. Proposed evaluation criteria are described against individual objectives below.

Specific objectives	Officials responsible for benefit delivery	Baseline (B)/ Evaluation criteria (EC)
1. Development of Environment Agency strategic overview taking account of influence of changing attitudes, demographics and economics on FCERM governance.	MSfW HA1, SRO (Defra)	B: 2005/6 governance systems EC: Changes in governance arrangements by 2008/9 that are soundly based on evidence/trials and take account of predicted socio-economic/other changes

<p>2. A more integrated approach to urban flood issues: Reconciling the needs of multiple players, managing flood risk in relation to other issues, integrated urban drainage planning, strategic approaches to flood resilience and urban sub-catchment run-off.</p>	<p>MSfW HA2, SRO (Defra)</p>	<p>B: Generally fragmented delivery with isolated examples of good collaboration. EC: Through pilot trials (separately funded) and supporting research, identify, by 2008, a framework and route map for adoption of more integrated approaches to urban flood risk management</p>
<p>3. Improved understanding of groundwater flood risk with clearer allocation of responsibility and public understanding of both the level of risk and the feasible solutions that are likely to be available.</p>	<p>MSfW HA4/5, SRO (EA)</p>	<p>B: No clear responsibility for groundwater flooding EC: Any supporting policy research completed by 2008 (modelling and mapping developments will be supported through the MAR theme and forecasting through IMCE).</p>
<p>4. Improved understanding of the impacts of land management on flood risk elsewhere, including the effect of reducing levels of agricultural flood protection on areas downstream, impacts on the Agricultural industry, the effectiveness of funding mechanisms and other land use policy levers.</p>	<p>MSfW HA6, SROs EA + Defra)</p>	<p>B: Diverse opinions on effectiveness of different measures EC: Convergence of views between key stakeholders based on improved evidence and understanding through pilots, trials and supporting policy and social research (also dependent on modelling and process studies supported by MAR)</p>
<p>5. Identifying the barriers & incentives to deliver better environmental & social outcomes: Taking into account WFD, impacts of climate change.</p>	<p>MSfW SA1, SRO (EA)</p>	<p>B: Stakeholder perception of significant barriers in current guidance and practice. EC: Revised guidance supported by sound evidence to reduce perceived barriers.</p>
<p>6. Development of 'Adaptation Toolkit' covering novel forms of coastal erosion risk management that can improve acceptability of sustainable coastal management practices that result in property and land loss</p>	<p>MSfW SA2, SRO (Defra)</p>	<p>B: Concern at inequity of decision making system EC: Development of widely accepted 'toolkit' that is practical and affordable in national policy terms with acceptable explanation of remaining limitations</p>
<p>7. Broadening outcome definition and risk management tools and guidance: To improve economic appraisal methods and other economic methods to account for changing demographics/economics, societal values and preferences</p>	<p>MSfW SA3, SRO (Defra)</p>	<p>B: Current guidance to be updated in light of subsequent research and enhanced expectations raised through MSfW consultation. EC: Continuing improvements in the comprehensive assessments of flood risk at national, regional and local levels. Soundly based policy guidance on appraisal issued by Defra in 2007 with subsequent updates as required and supported by compatible Agency guidance on practical implementation.</p>
<p>8. Review recommended approaches to Climate Change: Determine the impact of climate change on flood flows, sea level, surges and waves and review existing indicators and FCERM standards and practises, defining new ones where required.</p>	<p>MSfW SA5, SRO (Defra)</p>	<p>B: Current recommended allowances (2004) EC: Improved guidance available in 2007 (with SA3) and subsequent updates at no greater than 3 year intervals based on sound</p>

<p>Research at national and regionalised level is required.</p> <p>9. Building stakeholder and community engagement: Consultation (methodology) and communication with all those affected by FCERM is required to determine what level of risk is acceptable and to determine the most effective way of maintain a level of public awareness.</p> <p>10. Land Use Planning (Defra/ Environment Agency inputs): Including development and flood risk, and the integration of FCERM and spatial planning.</p> <p>11. Encouraging and incentivising increased resilience to flooding: Improving resilience in urban flood protection and the use of temporary defences for individual properties</p> <p>12. Horizon scanning and long term policy needs</p>	<p>MSfW SA6, SRO (EA)</p> <p>MSfW SA8(pt), SRO (Defra)</p> <p>MSfW RR1, SRO (Defra)</p> <p>Defra FM Policy and SPD TAG</p>	<p>interpretations of wider climate change research.</p> <p>B: Stakeholder consultation arrangements as set out in MSfW initial response, 2005. EC: Identification and wider adoption of more inclusive and accepted engagement processes.</p> <p>B: PPG25 EC: Revised PPS25 in 2006 with evidence-based input to any subsequent guidance, as required</p> <p>B: No national policy for resilience and limited use of temporary defences for communities. EC: Sound evidence for appropriate policies on resilience and take-up of measures. Clear policies for use of temporary defences in appropriate situations.</p> <p>B: SPD research programme largely focussed on current policy concerns. EC: Programme that appropriately balances work on current concerns with investigations relevant to the next decade and beyond.</p>
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<p>Links with other programmes</p> <p>Modelling and Risk (MAR) theme</p> <p>Sustainable and Asset Management (SAM) theme</p> <p>Incident Management and Community engagement (IMC) theme</p> <p>Making Space for Water Implementation Programme</p>
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Others with any interest in this R&D only	Comment
<u>Defra links</u> Environment DG Science Group Marine science Liaison Group	Knowledge sharing forum
Policy areas: Water Marine Global Atmosphere Soils Agricultural practice EPE Social policy Unit	Defra Economics expertise Social Science expertise
<u>External R&D linkages</u> Office of Science and Technology	The 2004 OST Foresight Report 'Future Flooding' provided a major horizon scanning exercise for the sector and this will be reviewed and updated as required.
Research Councils NERC, EPSRC, SSRC	Defra works in collaboration with the research sectors wherever possible in developing research programmes to address problems in flood risk management.
Meteorological Office (MO)	Defra has an interest in MO research and uses the MO to carry out specific FCERM research aligned with the objectives outlined above.
NERC (Pol and CEH)	Both organisations contribute to R&D and also play a part in monitoring activity that contributes to FCERM policy definition via FDGIA contributions.
SE-ERAD (SNIFFER)	
ODPM Planning	
LGA TAG	
UKWIR	

Rationale

Risk from flooding and coastal erosion managed in a way which furthers sustainable development. The first response towards a new strategic direction for flood and coastal erosion risk management in England was set out in March 2005 (insert reference) following the Making Space for Water consultation in 2004. The aim of this Government strategy is:

'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.'

This work falls under the Strategic Priority: Climate Change & Energy, the strategic outcome is: We will manage flood and coastal erosion risk so as to contribute to sustainable development, including minimizing loss of life and improving the standard of protection for at least 100,000 households [in the period 2005/6-2007/8] using efficiency savings to maintain outputs at equivalent levels to 2005-6.

Work also relates to outcomes measures and ABI SoP. Natural Resources and Protection, Emergency preparedness, PSA targets 1, 2 & 3; and the Evidence & Innovation Strategy.

Defra's role in addressing the problem is Policy leadership through close engagement with the Environment Agency as main delivery body, Coast protection authorities (through LGA), the Association of Drainage Authorities (ADA) and other Government Departments and Agencies.

Climate change and changes in socio-economic consequences of flooding are major future pressures influencing flood risk. Work carried out within the Joint Defra/ Environment Agency FCERM R&D Programme supports moves to holistic approaches to sustainable flood risk management. This move places increased emphasis on risk management strategies, coordination of approaches across different aspects of flood risk, influencing behaviour, appropriate development policies, effective planning for extremes and other policy areas.

New directions will include the development and demonstration of sustainable solutions optimising economic, environmental and social benefits. Finding ways of developing governance and funding arrangements to better engage those affected, incorporate their preferences and aspirations and provide systems for a better sharing of costs and benefits between those who create risks with those who benefit from the risk management measures and the wider tax-paying community.

In addition, there is a mature understanding of the ongoing efforts and processes needed to keep the evidence and innovation needs of flood risk management aligned with the pressures and opportunities created by the principal drivers for change of flood and coastal erosion risk, namely climate change and socio-economic pressures.

FRM can also make a major contribution to water-related biodiversity and conservation goals. There are often significant amenity and access issues at stake in implementing management measures as these are an integral part of all river and coastal management activities.

External drivers

Contextual drivers:

- EU Directives (Water Framework Directive, emerging Floods Directive)
- other EU Directives (Groundwater, Landfill)
- Emerging UK science agenda:
 - EPSRC Flood Risk Management Research Consortium (FRMRC)
 - ESRC/BBSRC/NERC Rural Economy and Land Use (RELU) programme
 - Office of Science and Technology Foresight Future Flooding programme
 - NERC Flood Risk from Extreme Events (FREE) programme
 - Regional Spatial Strategies, Planning Policy Guidance review e.g., PPG25
- European research projects:
 - FLOODsite
 - EUROSION
 - Co-ordination of Research in Europe (CRUE)

Internal drivers

- Making Space for Water
- Defra Evidence and Innovation Strategy
- UK Government sustainable development strategy
- Rural Strategy 2004
- England Rural Development Programme
- UK Climate Change Programme

Defra / Environment Agency Flood & Coastal Erosion Risk Management
R&D Programme



Strategy and Policy Development (SPD) - Theme Work Plan, 2005-2010

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1. Introduction

This Work Plan sets out the planned and completed activities that have been, or will be, carried out to develop and undertake R&D within Strategy and Policy Development (SPD) Theme of the Joint Defra / Environment Agency Flood and Coastal Erosion R&D Programme. For the purposes of the SPD workplan such activities will not be limited to studies funded solely by the R&D programme. Key supporting documents are located in the annexes, referenced documents that are available on the website have their links included.

The Strategy and Policy Development Theme was one of the four new themes formed following the recommendations of the independent review of the thematic research programme. The Theme Work Plan identifies a 5 year work programme which sets out priority work packages and a schedule for delivery. It shows how we will respond to the business drivers and objectives defined in the Theme RO Statement. The work plan is a working document for use by those involved in managing, advising, reviewing and evaluating the Programme. It is available, along with details of SPD projects, on the Defra website¹. Theme work plans will be updated and issued annually. In the SPD theme it is particularly difficult to predict future requirements for a five year period because policy drivers move so quickly, and so the document is designed to retain a degree of flexibility to so that the theme can to respond to urgent, emerging needs as may arise over the five year period.

2. Achieving the ROAME aims and objectives

The ROAME statement contains a full outline of the specific objectives of the workstreams that apply to the SPD theme. It identifies the beneficiaries of each workstream, a baseline (dated 2005) and an evaluation criteria against each objective. It should be noted that the objectives were drafted in 2006 and over time they may not all result in specific research requirements.

The SPD programme of work is primarily shaped by the cross-government Making Space for Water (MSW) programme that is the prime vehicle for development of policy on flood and coastal erosion risk management. The outcome map overleaf illustrates how the R&D contributes to the Flood risk management outcome, and the changes in policy that could occur as a result of the R&D. The outcome stated is based on MSW and is likely to remain a prime driver during the 5-yr period of this workplan. During 2006 Defra introduced a broader underpinning framework based on the WWF concept 'one planet living'. The principle is that policy development should promote change that would enable everyone to live sustainably within the renewable resources within this single planet rather than the equivalent of three planets that current living rates of consumption in countries like UK would require. For Defra key aspects of this have been identified as avoiding dangerous climate change and maintaining and enhancing the natural asset base. The relation of key Flood Management activities to this framework is illustrated in Annex A.

The main initial focus of the new SPD theme will be to provide the supporting research to areas of policy being developed within the MSW Implementation Plan. The theme will also have a broader horizon-scanning role to consider longer-term 20-50 year requirements beyond the MSW implementation plan. In most cases once sufficient evidence is obtained to support any policy change through the SPD

¹ www.defra.gov.uk/enviro/fcd/research/default.htm

programme then further research to support or improve delivery would pass to one of the other theme areas (or, in some cases, to another policy area).

The theme programme will, therefore:

- Support Evidence & Innovation to all key policy areas covered by the 'Making Space for Water' implementation programme, in particular,
 - New approaches to risk and appraisal
 - Developing a holistic approach, including a portfolio of measures
 - Improving sustainability, including social issues
 - Climate change impacts on policy;
- Review Evidence and Innovation needs of related policy areas,
- Commission evidence work to meet identified requirements from both R&D and consultancy budgets, as appropriate, and
- Use longer term horizon scanning to support research needed for likely directions of policy development 2010-2020 (i.e. beyond MSW).

Outcome system map for Flood management R&D

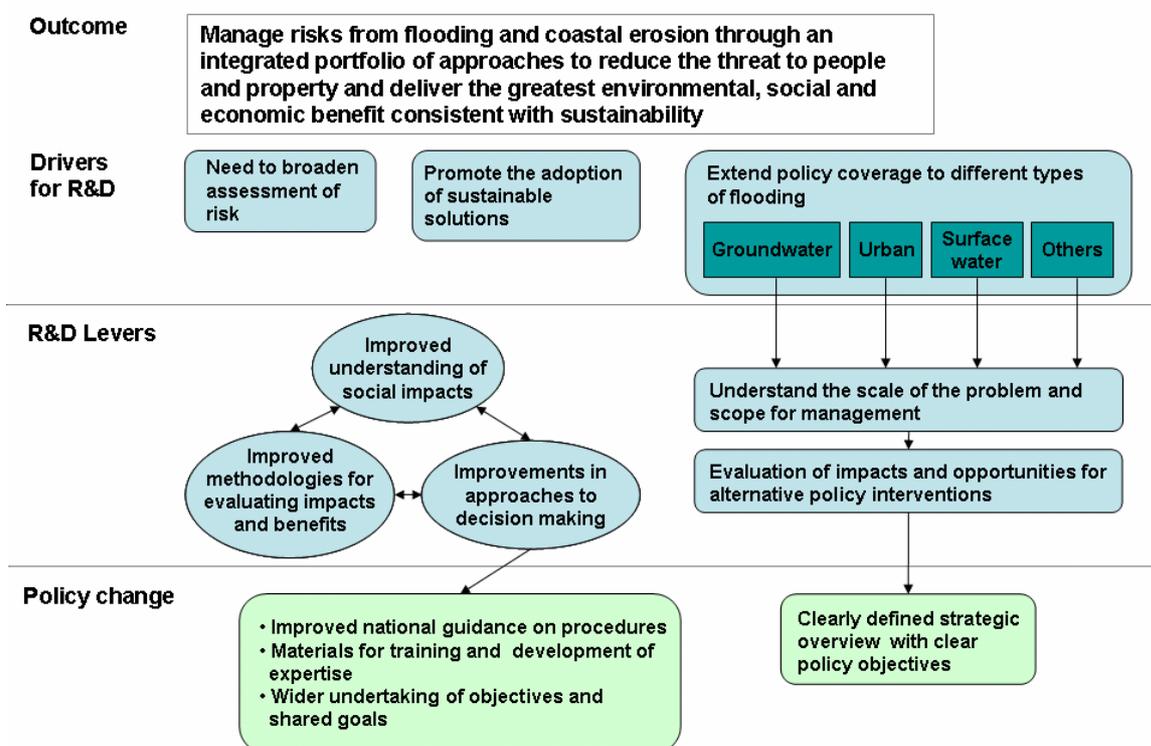


Figure 1: Outcome system map for Flood risk management R&D

2.1 Theme Coverage

The theme will cover Horizon scanning and policy development through;

- Strategic objectives
- Integrated approaches² to all forms of flooding (links to MAR and IMC themes)

² Integrated approaches are those that aim to bring together the various parties with responsibility for aspects of water or land management that impact on flood risk and its alleviation. For example in many urban areas local authorities, water companies, highway authorities, the environment agency and property owners may all have a responsibility for management of some part of the system that

- Land management (links to MAR theme)
- Broadening environmental and social outcomes
- Better understanding of adaptation tools³
- Reviewing and development of risk assessment⁴ and guidance
- Responding to, or taking account of future change, including climate change (link to MAR theme)
- Building stakeholder and community engagement (link to IMC theme)
- Land Use Planning (Defra/ Environment Agency inputs to DCLG policy area)
- Encouraging and incentivising increased resilience to flooding
- Horizon scanning and long term policy needs

2.2 Five-year outline plan for achieving the ROAME aims and objectives

Figure 1 outlines the R&D drivers and levers required to change policy and the Specific objectives are stated in the ROAME, the diagram below indicates the anticipated years in which it is possible that R&D requirements might arise. The current project to draft a strategy for social science in the research programme will help embed social science within the wider context of FCERM, it is consistent with the objectives to finding holistic solutions to flooding issues.

Specific objective	MSW project	05/06	06/07	07/08	08/09	09/10
Strategic objectives	HA1					
Integrated approaches to all forms of flooding	HA2, 4 & 5					
Land management	HA6					
Broadening environmental and social outcomes	SD1					
Better understanding of adaptation tools	SD2					
Reviewing and development of risk assessment and guidance	SD3					
Responding to, or taking account of future change, climate changes science	SD5					
Building stakeholder and community engagement	SD6					
Land Use Planning (Defra/ Environment Agency inputs)	SD8				?	
Encouraging and incentivising	RR1/RR2					

could lead to flooding. Integrated solutions aim to provide a framework for effective collaboration and clarity for all stakeholders.

³ Adaptation tools: tools, techniques and methodologies that provide solutions to enable individuals and communities to be able to adapt and respond effectively to future change, such as predicted future coastal erosion.

⁴ Risk assessment: all aspects of the evaluation of risks (i.e. both probability and consequence) of flooding and/or coastal erosion, including estimation of the way risks are likely to change over time.

increased resilience to flooding						
Horizon scanning and long term policy needs	n/a					

Figure 2: Lighter shading indicates less certainty of need/timing

Note: The HA2 project shown is the programme of integrated urban drainage pilots funded from a special allocation of the Defra FM programme budget. Other research and evidence requirements related to this area is not yet defined though some are likely to be modelling based and hence will be carried out under the MAR theme.

2.3 Benefits

Broadly speaking research undertaken by the theme will result in:

- Soundly based policy changes
- Convergence of stakeholder views based on sound evidence
- Revised guidance based on tried and tested approaches
- Extended 'toolkits' that are proven to be practical and affordable
- Clear understanding and basis for climate change adaptation and appropriate levels of precaution in recommended guidance

More detailed information about capturing benefits is outlined in the Programme management, section 3.

3. Programme Management

The overall structure and organisation of the Joint programme is set out in the Programme Definition Document ⁵(PDD). Each theme has a Theme Manager, who has day-to-day responsibility for the theme programme, a Theme Champion who provides overall direction to the theme and a Theme Advisory Group (TAG) who provide input and review for the programme. The TAG members are listed at Annex B.

3.1 Project Area Steering Groups

These groups provide and review project proposals for TAG. They are flexible groups which can be dissolved and reformed as the emphasis of the programme changes. Wherever possible existing project groups, especially the MSW project teams, will act as steering groups this is consistent with the assumption that all projects will relate to a particular business area and therefore there will be a natural responsibility for these groups to adopt the Steering group role. By adopting this basic principle there should be relatively little effort required to identify the Project Officer and Steering group and through these the business end-user will be embedded in the project from start to finish.

For MSW-related projects within the SPD theme the MSW project team, or subset of, will take on the PASG role, for example any projects that relate to economic appraisal methods will be steered by the Project Appraisal Advisory Group, this group is a subset of members from the MSW SD3 workstream.

⁵ www.defra.gov.uk/environ/fcd/research/RandDProgCon/PDDDecember06.pdf

3.2 Links to other themes

The Programme management infrastructure provides ample opportunity for Theme representatives to engage and develop their Theme programmes. Theme Managers will, with the appropriate Dissemination Advisor, monitor the programmes of other themes and identify overlaps, duplication and possibilities of joint promotion and co-operation.

Where SPD research leads to a change of policy there will often be a requirement for further research to support development and implementation, such work is expected to be carried out within the appropriate MAR, SAM or IMC theme.

The SPD Theme is strongly linked to other Themes/Programmes as indicated in paragraph 2.1:

- Modelling & Risk theme (MAR)
- Incident Management and Community engagement theme (IMC),
- Strategic Asset Management theme (SAM),
- Making Space for Water Implementation Programme, as outlined in the Introduction.

The Programme Management team held a workshop in January 2007 to identify cross-cutting issues in the individual R&D Programme Themes and their respective five-year work-plans. This will be repeated at appropriate intervals as the programmes develop.

3.3 Links established with External Scientific and Technical Organisations

The SPD theme has many links to organisations through the MSW project workstreams, Joint Programme team contacts (via collaborative research programmes) and its projects.

3.3.1. Links to the Research councils (EPSRC and NERC) are established at a Programme level, Theme Champions and Managers pay close attention to relevant projects contained within such programmes at a detailed level.

Current Funded Research Council work

- **EPSRC**, Flood Risk Management Research Consortium (FRMRC): Stakeholder Engagement: Research Priority Area 7. There are links to **ERSC** resources through this Consortium, however Defra has other mechanisms for engaging with ESRC that the SPD theme will explore during the period of this work plan.
- **NERC** establishments, such as Centre of Ecology and are funded via individual projects in the SPD theme.

Non-Defra/EA funded Research Council work

- **NERC**: FREE

3.3.2. The SPD theme is particularly interested in the following elements of the EU funded FLOODsite project that will run for the duration of this workplan; Vulnerability (tasks 9, 10 and 11, theme 1.3), pre flood measures (tasks 13, 14 and 17, theme 2.1) and integrated framework for long term planning (task 18, theme 3) and their application within the case study work.

3.3.3 Links have been established with other EU national research funders via the **CRUE ERA-Net** project, the SPD theme is currently administering three of the pilot common call projects.

3.4 Theme development

The annual theme programme will be discussed by the TAG and managed by the Theme Manager in accordance with the Programme Definition Document. The budget and headroom will be determined annually between the Programme managers and the Programme Board, this document will record project plans and actual expenditure only.

Horizon-scanning: This theme will investigate and exploit opportunities to monitor and predict potential new areas of policy interest, discuss gaps in the supporting research and evidence base and to look further ahead. The result of discussions at the June 2006 workshop fed into the development of the 2007/08 plans. It is thought that such a fora might also be utilised to contribute to future development of the Defra Strategy.

3.5 Annual statement of outputs and benefits

An annual statement of achievements will be compiled each year and assimilated into the Programme Managers annual statement to the Joint Programme Board. The Theme Manager will maintain a log of all significant project activity, including information such as project title, procurement type, contract value, start/finish times, outputs, dissemination events, benefits and other relevant Defra studies will be used to compile the annual statement.

3.6 Evaluation of Theme progress

From March 2007 there will be an annual review progress against RO objectives and evaluation criteria, where appropriate. The review will identify gaps, areas where Theme is ahead of or behind schedule, and major risks.

All projects will be monitored and evaluated as outlined in section 4 and 5 of the PDD, and captured in the Annual report. Project Area Steering Groups will be formed and reviewed to match any new portfolios should they arise. The work plan will be reviewed annually and adjusted as necessary in response to new policy drivers.

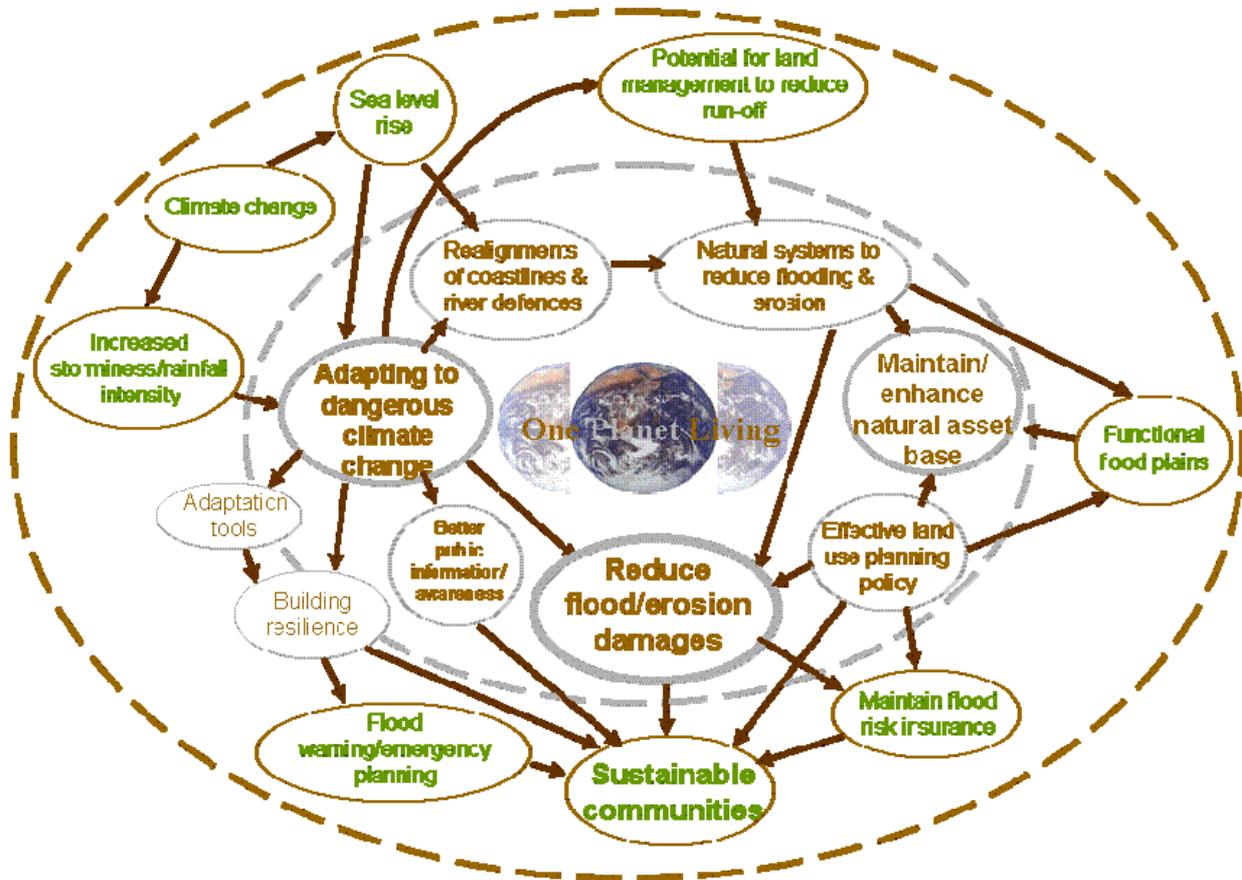
3.7 Resources

The theme is run on the basis laid down in the PDD, Linda Aucott⁶ is the Theme Champion and Sue Antonelli the Theme Manager. The SPD theme resources are integrated into the Defra policy area, both the above roles are undertaken as part of wider FM Evidence and Innovation Programme activities. The work of the theme is supported by other specialists who are Project Officers, Dissemination Officers or Procurement administrators.

⁶ David Richardson was Theme Champion from 2005 to June 2007.

Resources for management of the programme will be recorded and reported annually, the figures will include all but the Project Officer roles listed above. Defra includes Project Officer activity as a MSW workstream resource.

Annex A – Flood management and one planet living



Flood Management and One Planet Living

Note: In general the Level of FM influence increases towards the centre of the diagram

Key aspects of 'One planet living' for Defra:

- Avoiding dangerous climate change
- Maintaining and enhancing the natural asset base

This diagram aims to link some of the key aspects of flood risk management policy to these wider Departmental objectives.

Annex B – Theme Advisory Group Membership

Chair -	David Richardson (or alternate from Defra Policy team)
Theme Manager -	Sue Antonelli (Defra)
Defra representatives –	Martin Roberts (MSW) Paul Murby
Environment Agency representatives –	Richard Horrocks (Regional Mgr) Peter Bye (EA Board member)
Other representatives -	Peter Bide (Dept. Communities and Local Government) Tim Collins (Natural England) Jane Milne (Association of British Insurers) LA representative?
External appointees -	Rob Cunningham David Ramsbottom Ian Townend
Corresponding members -	Nigel Miller (Defra, EPE) Alison Baptiste (EA)

Changes:

2006: Tim Collins becomes Natural England Rep taking over from Richard Leafe (English Nature rep).

No LA representative has yet accepted the request to be involved despite requests to LGA and selected members.

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

Modelling and Risk Theme – RO Statement

Programme vision

Defra and the Environment Agency are adopting a risk-based approach to flood and coastal erosion risk management (FCERM). Proposed policies in 'Making Space for Water' (MSfW) and the Environment Agency's 'Strategy for Flood Risk Management' define a new approach to decision-making and delivery of FCERM. This approach is in part a response to the Foresight Future Flooding project, which found that flood and coastal risk could rise markedly unless new approaches were adopted, while the proposed new European Directive to tackle flooding is likely to call for improved flood risk mapping.

Flood and coastal risk management will need to be economically, environmentally and socially sound, taking into account both the probability and the consequences of flooding. Solutions will be developed from integrated portfolios of both structural (e.g. asset management) and non-structural (development control and flood incident management) responses. This integrated approach promises to deliver more efficient and sustainable solutions that are better adapted to the needs of particular localities.

To implement these changes, decision-makers will need better data, information, and models. A risk-based approach must predict, and plan for, events that have not necessarily occurred before. This relies heavily on data analysis, prediction and modelling over a range of physical, social, environmental and economic domains. Decision-makers also need to be able to communicate and engage with stakeholders in these important decisions.

Good science, new tools and improved data will be needed to assess current and future risks, detect changes and trends, and to decide on the best way to manage risks. This must support the development of national policies and processes, and their delivery through operational practice.

So the MAR Theme will support Defra and the Environment Agency in their aims of managing and reducing risk effectively efficiently. The Theme will develop tools and models to improve our understanding of the sources, pathways and receptors of flood and coastal erosion risk. This will include the physical processes, environmental extremes, system responses, vulnerabilities, and uncertainties. The science will be practical and based on the best available data, and information, and give the most appropriate mathematical and numerical representations of the problem or solution. The Theme will develop and promote a 'risk based' framework. The Theme will have clear view of who the appropriate business sponsors and beneficiaries are. For all projects and programmes, the benefits will be identified and there will be a clear plan to ensure that the benefits are realised.

To achieve this vision the MAR Theme is divided into 3 Sub-themes, representing the outstanding issues and challenges:

- **Cross cutting risk based knowledge and methods** to produce information and knowledge to develop tools, techniques, frameworks and models and to support decision making and delivery of all aspects of flood and coastal erosion risk management.
Example topics to be researched in the Sub-theme are: data, information, knowledge and software; climate change and extremes; risk, reliability and uncertainty methods; methods for sustainability
- **Spatially-based processes and models**, to Improve our understanding and model the physical, social and economic processes of flooding and coastal erosion to help us to manage the risk in a more sustainable way
Example topics in the Sub-theme are: catchment urban flood risk; coastal and estuary processes; resilience and other non-structural approaches.

- **Integrated catchment and coastal models and applications**, to manage flood and coastal erosion risk at national, regional / catchment and area / local levels.

Example topics are: tools for national risk assessment; catchment level strategic planning, scheme appraisal; asset management and flood incident management; tools for risk and hazard mapping.

In planning the programme the MAR theme will build on the work of the first five years of the Joint Programme. It will also continue to work in partnership with the research councils and the EU on such projects as the FRMRC, FREE and Floodsite where these provide clear and identified added value for users. MAR will work closely with other themes in the Joint Programme.

Overall objective	Beneficiary groups	Baseline
<p>The overall objective of this theme is to develop and enable better risk assessment and management in FCERM. The Theme will improve decision-making and management of flood and coastal risk. This will be achieved by improved process understanding, new methods and models and integrated impact assessment, taking into account future uncertainties.</p> <p>The R&D in this Theme will provide underlying knowledge and tools to FCERM users, to other Themes and relevant science programmes for further development or full implementation.</p>	<p>The people, communities and businesses in or adjacent to areas of flood risk Defra / Environment Agency policy and process developers; EA operational teams; Local Authorities and Emergency Services; The financial services industry; Other parts of the Joint R&D Programme</p>	<p>Without this programme, Defra / Agency will fail to deliver flood risk management to the appropriate standards, as the UK climate and land use changes. This will lead to unacceptable increased human and financial impacts as a result of floods and coastal erosion, and mis-allocation of investment.</p>

Specific objectives	Named Beneficiaries	Baseline
<p>All assessment tools and models of flood and erosion impacts and responses will be built on good scientific understanding of processes, systems, uncertainty and sustainability, within a risk framework.</p> <ol style="list-style-type: none"> 1. To assist Defra/Environment Agency to implement in a sustainable and cost-effective way the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management' by developing more integrated FCERM models and tools. 2. To do this by allowing Defra/EA to better understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management including land use planning within the context of the Water Framework Directive, through the development of open-interface multi-purpose tools. 3. To increase the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change. 4. To enable improved flood and coastal erosion risk management by continuing to develop system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses. 5. To developing methods for modelling, appraisal decision support, and risk communication aimed at encouraging integrated risk management using both structural and non-structural measures 6. To promote the development and use of consistent risk and uncertainty modelling techniques and to support other Themes in specific topic areas. 	<p>The above beneficiary groups</p>	<p>Defra / Agency will fail to deliver flood risk management to the appropriate standards as the UK climate and land use changes. This will lead to unacceptable increased human and financial impacts as a result of floods and coastal erosion.</p>

Key (Agency) Beneficiaries	Key Agency Users	Comment
Agency FRM Policy	Flood Risk Policy Manager - Strategy, Planning & Risk Head of Flood Risk Management Policy Policy Advisor - Flood Data, Mapping and Modelling Policy Advisor - Flood Risk Planning Policy Adviser - Urban Flooding	
Agency FRM Processes	Technical Manager – Flood Risk Mapping & Data Management Technical Manager – Strategic Planning & Development Control Head of Flood Risk Management Process Technical Advisor - Risk Mapping & Data Management Process Technical Advisor – Strategic Planning Process Technical Advisor – Development Control Process	
Science and Projects	Theme Manager – Sustainable Asset Management Theme Manager – Incident Management and Community Science Manager - Climate Change Science Manager - Integrated Catchment Science Science Manager – Sustainable Resource Use Science Manager – Tools and Technology Science Manager – Ecosystem Science Manager – Environment & Human Health Science Science Manager – Risk and Forecasting Project Managers - Making Space for Water Project Managers - Flood Risk Mapping Project Managers - TE 2100 and other Internal Projects	
CIS and Legal	Strategic Programme and Strategic Development Managers Enterprise Architects and Legal Advisors	
Investment and Capital Works	Head of Investment and Funding Head of NCPMS / NCPMS Appraisal – Strategy Team	
Agency's Region/Area	Regional / Area Flood Risk Managers	

Key Beneficiaries	Key Users – Government Departments/Agencies and Operating Authorities	Comment
Defra	Policy - Flood and Coastal Erosion Risk Management Science - Theme Manager – Strategy and Policy Development	The department responsible for FCERM
Other Operating authorities	Local Authorities / Coastal Authority (Coastal Groups) Internal Drainage Boards Water Companies Maritime Local Authorities	Operating authorities for ordinary watercourses, urban and coastal flooding Operating authority for coastal erosion
Other Government Departments/ Agencies	ODPM, Welsh Assembly Regional planning and development agency's / bodies Highway's Agency English Nature(Natural England) English Heritage OST / Dti	A role in shaping key infrastructure and planning decisions on development in flood-prone areas Partner organisation in determining the best solutions for environment , for archaeology and ancient monuments; responsible for management of national and international designated sites FCERM science, Technology / foresight

Other Beneficiaries (Researchers and Consultants)	Comment
<p>Research Councils NERC, EPSRC, SSRC</p> <p>SNIFFER (Scottish and Northern Ireland Forum for Environmental Research)</p> <p>UKWIR (UK Water Industry Research)</p> <p>European Research (<i>FLOODsite, CRUE, etc</i>)</p>	<p>Agency has been a key stakeholder alongside Government, EU, business/industry, NGOs and research sectors in developing research programmes to address problems in flood risk management.</p>
<p>Framework Consultants / Framework Contractors</p>	<p>Responsible for the development of FRM strategies, appraisal and design of schemes</p>

Other Beneficiaries (General Public and other)	Comment
<p>The people, communities and businesses in or adjacent to areas of flood risk</p>	<p>Will benefit from improved risk management</p>
<p>National Flood Forum</p>	<p>NFF was set up with Agency R&D funding and provides a focus for community initiatives in flood response</p>
<p>Developers and other commercial organisations with a stake in flood-plain development</p>	<p>The private sector has an extremely important part to play in generating employment and wealth and in the regeneration of depressed areas, which often occur in historically developed parts of the flood plain.</p>
<p>Other organisations</p>	<p>Other organisations with shared interests in flood risk asset management include: , National Trust, Associated British Ports, Countryside Landowners Association, National Farmers Union</p>

Rationale

As noted in the first section of this document, a wide-ranging programme of action is being developed, to deliver the Government's and the Agency's aims within the 'Making Space for Water' programme, to implement a more holistic approach for FCERM in England and Wales. The approach will involve taking account of all sources of flooding, as well as a wide range of solutions. Implementing this new approach will require a further step changes in to many parts of the decision-making process and these change will be defined and provided by R&D in this Theme.

Defra/EA support for this research Theme is important because it will deliver the scientific tools and models that encourage the provision of sustainable, a more holistic and risk based approach to managing flood and coastal erosion risks in England and Wales. A primary aim of this research theme is to support government, agencies, authorities and all interested parties to reduce the threat to people and their property and deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles. The risk assessment and modelling approach will involve taking account of all sources of current and future flooding, range of current Government policies and operations of flood and coastal erosion risk management and other portfolio of approaches which reflect both international, national and local experiences and priorities.

This programme will be evaluated by asking the following questions:

1. Has MAR assisted Defra/Environment Agency in implementing the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management'?
2. Has MAR assisted Defra/EA to understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management within the context of the Water Framework Directive?
3. Has MAR increased the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change?
4. Has MAR supported better flood and coastal erosion risk management by developing whole-system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses, which are sufficiently reliable for everyday use.
5. Has MAR developed methods and tools for assessing integrated portfolios of structural and non-structural measures in an evidence-based, transparent and demonstrable way?
6. Has MAR promoted the development and use of generic risk and uncertainty modelling techniques and to support other Themes in their specific topic areas.
7. Has the quality of the research been high and of national and international standing?
7. Have the benefits been realised and has the programme achieved value for money?
8. How successful has uptake been, both within the Environment Agency and among the wider community of users?

The MAR Programme vision notes the importance of working with other themes and funders, particularly on cross-cutting research areas. In particular, the following areas will be developed in a co-ordinated way to avoid duplication and gaps:

- Urban flood management – the policy needs will be identified by the MSfW programme, and MAR will work with that programme to identify and meet the R&D needs. A key need is likely to be to develop improved models flood risk assessment in these complex areas driven by flooding from multiple sources.
- Communities – The IMC will do research into social processes and responses to flood and coastal risk. MAR will incorporate social interests into risk models to inform and support decision-makers.
- Climate Change – SPD will lead on CC policy and deciding on allowances. MAR will provide assessments and modelling to support, and will incorporate CC into flood and coastal risk management tools. A key area here will be the proper use of the UKCIP^{next} probabilistic scenarios
- Asset management – MAR will draw up the vision and conceptual approach for risk – based FRM, (including the RASP family of tools) - SAM will deliver tools and guidance to asset managers.
- Integrated catchment management – there will be close links with WFD, and Habitats work, and in particular close links with the Environment Agency's catchment science programmes
- Relationships will be maintained with FRMRC and Floodsite.
- MSfW implementation plan will produce R&D needs and MAR will engage and respond as appropriate
- Tyndall Centre is active inter alia in long term coastal management and futures, and we will work towards closer collaboration.
- TE2100 is providing a test bed for much emerging research and this will continue.

Potential stakeholders or partners who have overlapping interests in this programme include other Operating Authorities, professional bodies and industry. Consultations with these bodies have insured that this research programme does not overlap with on-going projects and fills gaps in knowledge/ business needs. In some cases the MAR Theme will seek to carry out collaborative research with these organisations.

Finally it is vital that the programme co-operates with the developers and vendors of relevant software, both in pre-competitive development and in ensuring proper whole-life dissemination and support. The concept of open software will be important in this and will need to be developed.

External drivers	<p>Contextual drivers</p> <ul style="list-style-type: none"> • Government risk improvement programme - encourages departments and Agencies to improve the way they assess and manage risk • Foresight Future Flooding project - foresees major increases in flood and erosion risk and proposes a new approach for managing risk, with action plan. • Making Space for Water programme - sets a new direction of travel for flood and coastal risk management and establishes a programme to change policy and guidance • Government Spending reviews - require periodic assessment of achievement and justification of future investment to manage risk • Propose European Floods Directive - may require new approaches for mapping flood hazard and risk
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Internal drivers	<ul style="list-style-type: none"> • Making it Happen theme – Reducing Flood Risk • River Basin Management Plans • Catchment Flood Management Plans (CFMPs) • Shoreline Management Plans (SMPs) • Strategies for major estuaries e.g., Thames Estuary 2100 • Environment Agency Strategy for Flood Risk Management - requires improved approach to assessing risk and taking account of risk in decision-making. • Water Framework Directive • Lessons Learnt Reports – 2000 and 2004 floods
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Influences

- **Influence** by emerging UK science agenda:
 - EPSRC Flood Risk Management Research Consortium (FRMRC)
 - NERC Flood Risk from Extreme Events (FREE) programme
 - ESRC/BBSRC/NERC Rural Economy and Land Use (RELU) programme
 - SNIFFER flood risk management research
 - Other Theme areas in joint Defra/ Environment Agency FCERM R&D Programme
- **Influences** by emerging EU Framework V and VI research programmes:
 - FLOODsite
 - Real-time flood decision support system integrating hydrological, meteorological and remote sensing (FLOODRELIEF)
 - European exchange circle on flood forecasting, early warning (EXCIFF)
 - Achieving Technological Innovation in Flood Forecasting (ACTIF)
 - Wide Information Network for Risk Management (WIN)
 - Co-ordination of Research in Europe (CRUE)
 - European Flood & Drought Integrated Project (EFDIP)
 - Interreg projects including COMRISK and Safecoast
- **Other organisational influences:**
 - Defra High level targets for flood and coastal defence
 - Defra Flood and coastal defence funding review 2002
 - EU Directives (Water Framework, Groundwater, Landfill)
 - Regional Spatial Strategies, Planning Policy Guidance review e.g., PPG25

Defra / Environment Agency Flood & Coastal Erosion Risk Management
R&D Programme



Modelling and Risk (MAR) - Theme Work Plan, 2005-2010

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1 Introduction

The Theme Work Plan provides an overview of the theme. It sets out the planned and completed activities that have been, or will be carried out to develop and undertake R&D within the Modelling and Risk (MAR) theme of the joint Defra / Environment Agency Flood and Coastal Erosion Risk Management (FCERM) R&D programme over the five-year period 2005-2010. Key supporting documents are located in the Appendices, and others are listed in the References.

It is a working document for use by those involved in managing, advising, reviewing and evaluating the programme. It would be unrealistic to expect the Theme Work Plan to set out a complete, detailed programme of projects for the next five years. The future budget is not known, and such a list of projects would not only be long but inflexible in responding to changing user needs and opportunities that arising from advances in scientific knowledge and technological capability. Rather it gives a vision via the theme objectives and a logical framework of sub-themes and projects areas with typical examples and user benefits, and describes a process by which project lists will be created annually. Theme work plans will be a higher level document and will be reviewed annually. Based on this 5-year Theme Work Plan a detail Annual Work plan for the following FY will be developed.

The proposals for new projects for each FY, together with an analysis of achievement against objectives for the past year, will be presented and recorded in detail in an Annual Work Plan. This will contain the budget and list of new starts for the next FY, with supporting Short Form As. It will progress from an early draft through consultation with the TAG, users and other Themes and the programme management team, to a final version following approval of projects by the programme management and in the case of Agency-funded projects, by the PAB.

2 Five-year plan for achieving the RO aims and objectives

2.1 The MAR RO statement

The rationale for MAR is set out in the RO statement, from which the policy and scientific objectives are given below for convenience. The RO can be found in Appendix A:

2.1.1 Policy Objective

“The overall objective of the MAR theme is to develop and deliver better risk assessment and management as needed by FCERM. The purpose is to enable improved decision-making and delivery to reduce flood and coastal risk. It will be achieved by improved knowledge, process understanding, new methods, models and integrated impact assessment, taking into account future uncertainties.

The R&D in this Theme will provide underlying knowledge and tools to FCERM users, to other Themes and relevant science programmes for further development or full implementation.”

2.1.2 Specific Objectives

“1. To assist Defra/Environment Agency to implement in a sustainable and cost-effective way the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management' by developing more integrated FCERM models and tools.

2. To do this by allowing Defra/EA to understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management including land use planning within the context of the Water Framework Directive, through the development of open-interface multi-purpose tools.
3. To increase the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change.
4. To enable improved flood and coastal erosion risk management by continuing to develop system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses.
5. In particular to facilitate the development of integrated portfolios of structural and non-structural measures in an evidence-based, transparent and demonstrable way by developing consistent modelling, appraisal and decision support, and risk communication tools.
6. To promote the development and use of generic risk and uncertainty modelling techniques and to support other Themes in their specific topic areas.”

2.1.3 Beneficiaries

The overall beneficiaries are defined in the RO as:

“Defra / Environment Agency policy and process developers; Environment Agency operational teams; Local Authorities and Emergency Services; The financial services industry; Other parts of the Joint R&D Programme as well as the people, communities and businesses in or adjacent to areas of flood risk.”

The RO should be referred to for details of beneficiary groups.

2.1.3 MAR management and Theme Advisory Group (TAG)

The MAR Theme Manager is accountable for development and delivery of MAR programme and projects, assisted by the MAR Theme Champion, Theme Advisor and MAR Theme Advisory Group. The membership of the MAR TAG includes representatives of the major stakeholders, Defra and EA, and leading experts covering the theme topics. They are shown in Appendix B with their affiliations and topic areas.

The theme is also supported by Project Area Steering Groups (PASGs). These are in the process of establishment at the time of writing this TWP.

2.2 Basis of development of the MAR theme

This document is intended to set out a five-year work plan for the MAR theme. With such a wide-ranging theme it would not be appropriate to choose annually a random set of new projects. Instead it must be a programme with a coherent long-term view, building on past projects and guided by scoping studies and research plans.

As noted above the plan will be of necessity, more of the nature of a vision than a list of specific projects for the next five years. It must keep in mind the theme objectives and must aim to satisfy them. It must cover the whole term of the plan, but must at the same time be responsive to changes in Defra/EA needs and to the opportunities provided by advances in science and technology.

In order to satisfy these requirements a rational and transparent process is proposed based on:

- A logical framework which translates the generic policy and operations-oriented theme objectives into concrete areas of R&D.
- A series of research plans or scoping studies which provide plans for the development of these research areas over the term of the plan, to provide medium term coherence to the theme.
- An annual process of consultation with the TAG and stakeholders to review and update the work plan, and generate new ideas for research topics, in order to ensure that the theme is responsive and flexible.
- An annual process of identification and prioritisation of new starts which is based on the above, checking always for a balanced and user-oriented satisfaction of the theme objectives.

All assessment tools and models of flood and erosion impacts and responses will be built on good scientific understanding of processes, systems, uncertainty and sustainability, within a risk framework.

2.2.1 The MAR Logical Framework

All assessment tools and models of flood and erosion impacts and responses must be built on good scientific understanding of data, processes and systems, within a risk framework. A logical framework based on three sub-themes is therefore proposed:

- Cross-cutting Risk based Knowledge and Methods
- Spatially-based Processes and Models
- Integrated System, Models and Applications

The cross-links showing which sub-themes respond to which theme objectives is shown in the matrix below:

	Sub-theme		
	1. Cross cutting Risk based Knowledge and Methods	2. Spatially-based Process and Models	3. Integrated System, Models and Applications
MAR objective			
1. To assist Defra/Environment Agency to implement in a sustainable and cost-effective way the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management' by developing more integrated FCERM models and tools.			✓
2. To do this by allowing Defra/EA to understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management including land use planning within the context of the Water Framework Directive, through the development of open-interface multi-purpose			✓

tools.			
3. To increase the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change.	✓	✓	
4. To enable improved flood and coastal erosion risk management by continuing to develop system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses.		✓	
5. In particular to facilitate the development of integrated portfolios of structural and non-structural measures in an evidence-based, transparent and demonstrable way by developing consistent modelling, appraisal and decision support, and risk communication tools.	✓	✓	✓
6. To promote the development and use of generic risk and uncertainty modelling techniques and to support other Themes in their specific topic areas.	✓		

The full logical framework, fleshed out with sub-theme research areas and objectives, is shown in the three tables below.

The tables show in the third column the scientific research areas framed in terms of user benefits, in order to convey something of the vision of the MAR theme in terms of impact on improvements in the ability of users to carry out their FCERM tasks.

The tables include the list of research topics given in Table 3.2 of the External Review of the FCERM R&D programme, rearranged and supplemented under the research sub-themes and topic areas.

Table 1: Sub-theme 1 – Cross-cutting Risk based Knowledge and Methods

Topic Areas	Sub-theme objectives	Research Area Examples and User Benefits
1.1 Data, Information, knowledge and software	<ul style="list-style-type: none"> * To carry out research to encourage and enable more effective collection, use, storage and exchange of data and information * To ensure the FCERM community is able to take full advantage of new technology, both hardware and IT, for data and information management * To do research and pilot work to develop encourage better knowledge management within FCERM 	<ul style="list-style-type: none"> • Better data monitoring, collection, quality and management • High resolution meteorological data for flood warnings • Access and sharing of data • Improved software access, support, IPR and open code
1.2 Climate change and extremes	<ul style="list-style-type: none"> * To develop and communicate to a range of users a consistent and up to date view of the likely nature, impacts and magnitude of climate change impacts. 	<ul style="list-style-type: none"> • Impacts on FCERM standards and practices • Information needs of large projects (e.g. Thames

(and Source related)	<ul style="list-style-type: none"> * To provide knowledge and methods to enable engineers, planners, decision makers to assess extreme environmental loads * To understand and asses source of flooding and erosion 	<p>Estuary)</p> <ul style="list-style-type: none"> • Refining climate change guidance • Making use of new probabilistic information on uncertainty in climate projections
1.3 Risk, reliability uncertainty and decision (and Pathways related)	<ul style="list-style-type: none"> * To develop generic approaches to allow the incorporation of risk, uncertainty/reliability and performance-based techniques in FCERM * To provide basic guidance to enable and encourage risk-based decision-making * To develop approaches to analysis of the robustness of risk management solutions under a uncertain future conditions * To understand and asses pathways of flooding and erosion * To understand how risks change through time and develop approaches to strategic management of dynamical systems 	<ul style="list-style-type: none"> • Embedding uncertainty analysis into analysis and design • Assessment of risk and uncertainty all sources of flooding • Communication with those involved particularly on understanding tolerable risk • Aggregation of the impact of local responses in regional assessments of risk • Flood defence failure and integrity in extreme events • Better decision-making under uncertainty • Improved approaches to reliability analysis
1.4 Social, economic, environmental and sustainability (and Receptors related)	<ul style="list-style-type: none"> * To develop methodologies to assess social environmental and economic aspects of risk * To understand changing perceptions of risk and expectations for risk reduction * To develop methodologies to facilitate and encourage sustainable FCERM * To understand and asses consequences to the receptors by flooding and erosion 	<ul style="list-style-type: none"> • Publicly available tools (web-enabled) for communication of risk and participative evaluation of risk management options (with IMC) • Economic methods (with SPD) • Understanding of tolerable risk • Implications on risk of managed realignment (urban, fluvial, estuarial and coastal) • Tools to support decision-making through CBA, MCA and SEA

Table 2: Sub-theme 2 - Spatially - based Process and Models

Topic Areas	Sub-theme objectives	Research Area Examples and User Benefits
2.1 Catchment Management	<ul style="list-style-type: none"> * To develop models and methods to enable sustainable risk management by altering catchment characteristics and features * To identify the gaps in knowledge of key physical process and to do research to fill the gaps to enable 	<ul style="list-style-type: none"> • Better integration of FCERM and spatial planning • Models to predict broad-scale long-term change, including improved answers on the impact of land management and use on flood risk • WFD impacts on FCERM policies and practices

	better catchment modelling and flood risk management * To understand and assess how social and economic factors affect sustainability of catchment management	
2.2 Urban flood risk Management	To define requirements for risk assessment and modelling tools to meet the needs of MSfW. * To develop frameworks and tools for integrated urban flood modelling * To support policy and strategy development by modelling the impacts of urban management on the wider catchment	<ul style="list-style-type: none"> • Integrated urban flood risk management planning • Understanding groundwater flood risk • Damage to the historic environment • Urban flood risk resilience - strategic approaches • Impact of urban drainage planning on the wider scale
2.3 Estuary management	* To do process research to fill in main gaps in knowledge * To produce and implement tools for estuary management and planning * To integrate physical, social, economic and environmental aspects of estuarial management	<ul style="list-style-type: none"> • Better estuary management through the development of Estuary Management System (ERP Phase 3)
2.4 Coastal management	* To do process research to fill in main gaps in knowledge * To produce and implement tools for coastal risk assessment and management * To integrate physical, social, economic and environmental aspects of coastal management	<ul style="list-style-type: none"> • Better modelling of coastal flooding and erosion processes, risks and responses • Better assessment and management of coastal erosion • Assessment of the potential impacts of climate change on the coast and approaches to adaptation. Assessment of the limits to adaptation.

Table 3: Sub-theme 3 - Integrated System Models and Applications

Topic Areas	Sub-theme objectives	Research Area Examples and Benefits
3.1 System Tools for flood and coastal erosion risk management	Integration of above methodologies into.... * National risk assessment (investment appraisal, national policy appraisal horizon scanning) * Interactive tools for strategic planning through to scheme appraisal * Interactive tools for asset management and flood incident management * Tools for mapping flood probability, hazard and risk * Linking to tools for other policy areas e.g. WFD, integrated water management * To make tools more widely available within government and to broader stakeholder groups.	<ul style="list-style-type: none"> • Better data and model resolution • More effective use of models • Assessment of risk and uncertainty from all sources of flooding • Aggregation of the impact of local responses in regional assessments of risk • Embedment of uncertainty analysis into analysis and design • All integrated in better flood risk assessment decision support tools to support CFMPs, SMPs, Strategies and FRAs

2.2.2 A five-year vision for MAR

We have given above a process and a logical framework for MAR R&D. This does not however entirely convey the vision of the theme. While it would not be possible or practical to set out at the beginning of the 5-year period a complete list of fully-defined projects, the diagram below is intended show a snap shot / a broad vision of the direction in which MAR intends to go. In the diagram, projects already in the pipeline are highlighted and some of the projects that will be developed in the future are indicated (in broad terms only). They will be developed under the process described earlier in this section.

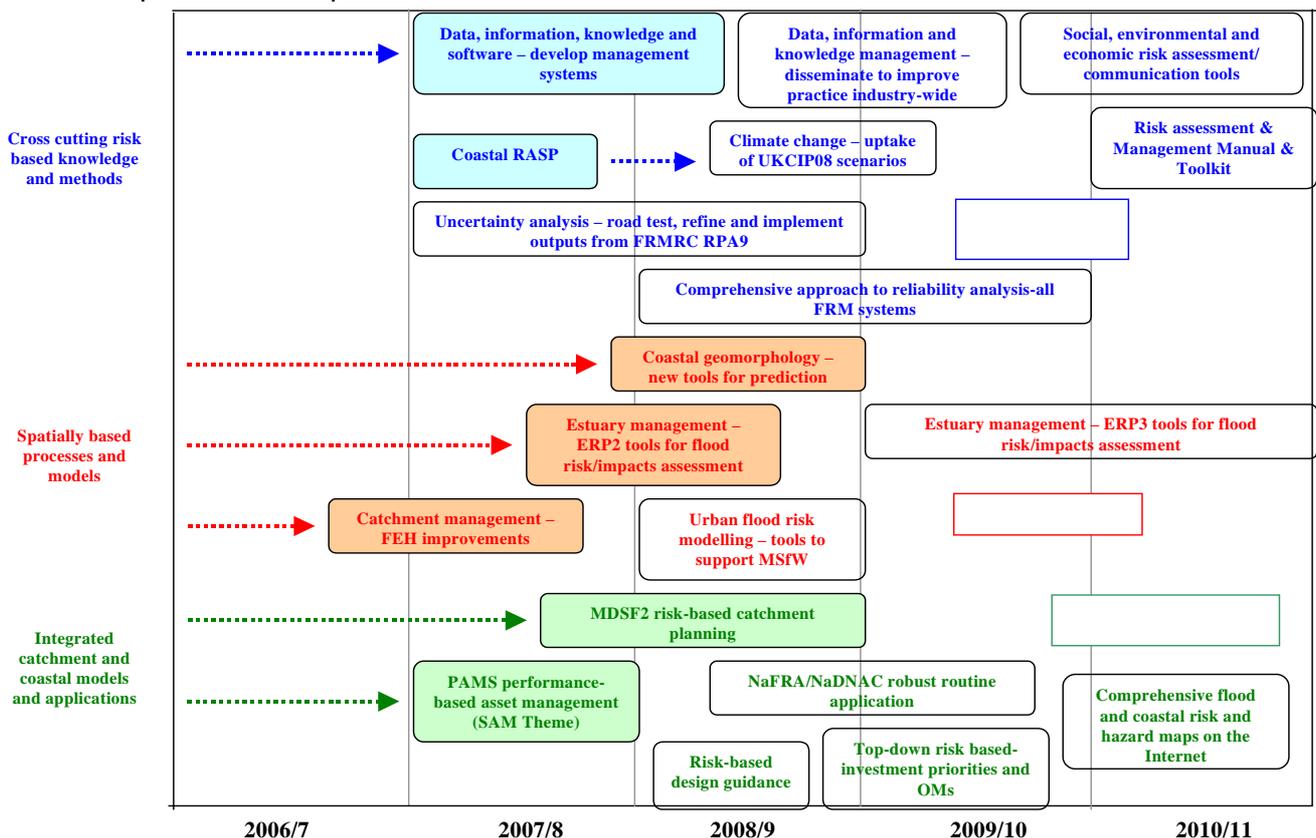


Figure 1. A snap shot of strategic destination of MAR theme

2.2.3 MAR research plans and scoping studies

Having defined the logical framework with sub-themes and examples of research areas and user benefits, we now have to have a means of translating these into coherent, user-focused programmes of research. This will be done, as noted, by combining the use of research plans and scoping studies with the annual process of TAG and user consultation. Existing and ongoing research plans and scoping studies are listed below by sub-theme. They include studies and recommendations from relevant past projects from the REUU, BSM and FCP Themes in the previous thematic R&D programme. The lists will be updated each year in the Annual Work Plans:

Sub-theme 1

- Research recommendations arising from studies that define, provide best practice principles, key statements of potential need for improvements in data, information and knowledge management and identification of research and development needs including for implement the concepts and best practice (e.g. FD2314 and FD2323)

- Research recommendations arising from monitoring and assessment studies including fluvial and coastal extremes, joint probability of extreme loads, vertical land movements at tide gauges in order to detect long term absolute and relative sea level change, and to examine hydrological, geological, land use and climatic influences (e.g. FD2304, FD2311, FD2308, FD2301, FD2319).
- FD2121-Software requirements for Joint FRM R&D Programme modelling outputs and architecture specification for RASP family outputs (2006)
- FD2311, W5B-029, W5B-032, FD2319 - studies that identify the R&D needs to develop indicators of climate change (CC) and environmental change, to understand CC impacts in river flows in wide range of catchments and absolute and relative sea level rise, to adapt CC scenarios for FCERM and to trial application
- Recommendations during developing and delivering approaches and tools for risk and uncertainty:
 - Develop framework for risk assessment and management, and guidance on use of risk and uncertainty and performance evaluation tools and techniques (FD2302)
 - Provide method and guidance for assessing risks to people (FD2321)
 - Provide method and guidance for flood risk assessment for new developments (FD2320)
 - Provide method and guidance for flood event / incident management (SC)
 - Method for flood risk assessment and for mapping flood probability and flood risk and provide advice on how the Agency should use new flood risk maps to target flood warning services (W5B-030, RASP, (W3(03)01)
 - Define approach and collect data on failure rates / reliability of flood defence components such gates and pumps, Define approach to assessing performance and reliability of 'linear' flood defences such as embankments and sea walls, and provide practical guidance on developing and using 'fragility curves'. (W5-031, FD2318)
 - Scoping and definition of performance evaluation, and development of PAG6 - Performance Evaluation in project appraisal, development of the framework and scope R&D activities required to move to a risk and performance-based system (PAMS) for inspecting, maintaining and repairing flood defences. (FD2302, FD2315, W5-070)

Sub-theme 2

- Scoping the broad scale modelling hydrology programme (FD2104, 2002)
- Review of Impacts of Rural Land Use and Management on Flood Generation, Report B: Research Plan (FD2114, 2004).
- Estuary Research Programme. Phase 2 Research Plan (FD2115, 2002)
- A Coastal Vision for Broad Scale Modelling (BSM TAG paper, 2005).
- A socio-economic "vision" for Broad Scale (Modelling BSM TAG paper, 2005, and the forthcoming Environment Agency social science strategy)
- ERP2 - Estuary Management System scoping and dissemination (FD2119)

Sub-theme 3

- Recommendations during the development of method, models and software for flood risk assessment and decision support for strategic planning (NaFRA, CFMPs, SMPs) and for mapping flood probability and flood risk (W5B-030, RASP, MDSF1, MDSF2)
- Scoping the development and implementation of Flood and Coastal Risk Models. (SC050065, 2006).
- Broad scale modelling – a scoping study for MAR vision FD2118, 2007)

2.2.4 The annual cycle of programme formulation

The annual planning cycle for the Joint Programme outlined in the Programme Definition Document has been shown above. The planning cycle shows two important periods for programme development and implementation activity, April-July and September-January, to which users and the MAR TAG will provide input.

The outline scope of work for the theme management and the TAG are indicated below. It is expected that in addition to formal TAG meetings there will be follow-up activity by specific TAG members on particular research areas or projects.

April - July (under the Programme Definition Document, themes are to present their outline proposals that they received from the FRM business and FR scientific community in July, usually following the December TAG meeting). This period will focus on the derivation of the programme for the following FY and will include:

- Review of completed projects from previous FY
- Review of progress on fulfilment of research area plans and scoping study recommendations generally, and against theme objectives.
- Review of need for update of research plans or new research plans
- Identify gaps in the programme and new ideas for next FY
- Production of Short Forms outlining proposed projects.
- Prioritise projects and submit to Programme Management

September – January (under the Programme Definition Document, themes are to develop projects). This period will focus mainly on the implementation of projects in the current FY and prepare detail business case for the priority projects for next FY, but may also look forward to the formulation of the programme for the following FY. It will include:

- Review status of new starts for current FY
- Identify procurement / planning issues for individual projects and programmes and remedy any problems
- Outcome of any reviews of research plans, ready for the formulation of the programme for the FY following
- Preliminary consideration of the shape of theme programme for the FY following

In addition MAR will take into account the following in developing its annual programmes:

- Foresight recommendations and the Defra/Agency Action Plan
- Requirement from the Making Space for Water implementation programme
- Opportunity arising from research programmes such as FRMRC, FREE, FLOODsite and CRUE, other Agency science programmes (e.g. Climate Change) and major projects such as TE2100.
- The Agency's Data Strategy
- The Agency's Climate Change Policy and Science Strategy, which includes developing a strategy and research plan for FCERM
- The Agency's Social Policy and Science are developing a strategy and research plan for FCERM
- The Agency's Modelling Strategy
- The Agency's Mapping Strategy

As noted earlier the annual process of identification of new starts will check always for a balanced and user-oriented satisfaction of the theme objectives.

2.3 Relationship to other themes

Close liaison is maintained with other themes through regular meeting of the Theme Managers and less frequent meetings of the whole Joint Programme Management Team (JPMT).

It has been agreed that a theme interaction matrix should be drawn up similar to that derived for the previous thematic programme. This will be included in the Theme Work Plan when available.

3 Annual Work Plan

As noted in Section 2.4.3 the Annual Work plan will be developed and produced in the period April-September each year. It will be finalised upon approval of projects for the following FY by the programme management, Programme Board and, in the case of Agency-funded projects, by the PAB.

As also noted, the 5-year Theme Work Plan will be reviewed each year but is unlikely to be amended except in respect of any changing matters at a higher level.

Appendix A RO (Rationale, Objectives) Statement

Programme title: Modelling and Risk (MAR) Theme – Joint Defra / Environment Agency R&D Programme

Programme vision

Defra and the Environment Agency are adopting a risk-based approach to flood and coastal erosion risk management (FCERM). Proposed policies in 'Making Space for Water' (MSfW) and the Environment Agency's 'Strategy for Flood Risk Management' define a new approach to decision-making and delivery of FCERM. This approach is in part a response to the Foresight Future Flooding project, which found that flood and coastal risk could rise markedly unless new approaches were adopted, while the proposed new European Directive to tackle flooding is likely to call for improved flood risk mapping.

Flood and coastal risk management will need to be economically, environmentally and socially sound, taking into account both the probability and the consequences of flooding. Solutions will be developed from integrated portfolios of both structural (e.g. asset management) and non-structural (development control and flood incident management) responses. This integrated approach promises to deliver more efficient and sustainable solutions that are better adapted to the needs of particular localities.

To implement these changes, decision-makers will need better data, information, and models. A risk-based approach must predict, and plan for, events that have not necessarily occurred before. This relies heavily on data analysis, prediction and modelling over a range of physical, social, environmental and economic domains. Decision-makers also need to be able to communicate and engage with stakeholders in these important decisions.

Good science, new tools and improved data will be needed to assess current and future risks, detect changes and trends, and to decide on the best way to manage risks. This must support the development of national policies and processes, and their delivery through operational practice.

So the MAR Theme will support Defra and the Environment Agency in their aims of managing and reducing risk effectively efficiently. The Theme will develop tools and models to improve our understanding of the sources, pathways and receptors of flood and coastal erosion risk. This will include the physical processes, environmental extremes, system responses, vulnerabilities, and uncertainties. The science will be practical and based on the best available data, and information, and give the most appropriate mathematical and numerical representations of the problem or solution. The Theme will develop and promote a 'risk based' framework. The Theme will have clear view of who the appropriate business sponsors and beneficiaries are, For all projects and programmes, the benefits will be identified and there will be a clear plan to ensure that the benefits are realised.

To achieve this vision the MAR Theme is divided into 3 Sub-themes, representing the outstanding issues and challenges:

- **Cross cutting risk based knowledge and methods** to produce information and knowledge to develop tools, techniques, frameworks and models and to support decision making and delivery of all aspects of flood and coastal erosion risk management.
Example topics to be researched in the Sub-theme are: data, information, knowledge and software; climate change and extremes; risk, reliability and uncertainty methods; methods for sustainability
- **Spatially-based processes and models**, to Improve our understanding and model the physical, social and economic processes of flooding and coastal erosion to help us to manage the risk in a more sustainable way
Example topics in the Sub-theme are: catchment urban flood risk; coastal and estuary processes; resilience and other non-structural approaches.
- **Integrated catchment and coastal models and applications**, to manage flood and coastal erosion risk at national, regional / catchment and area / local levels.
Example topics are: tools for national risk assessment; catchment level strategic planning, scheme appraisal; asset management and flood incident management; tools for risk and hazard mapping.

In planning the programme the MAR theme will build on the work of the first five years of the Joint Programme. It will also continue to work in partnership with the research councils and the EU on such projects as the FRMRC, FREE and FLOODsite where these provide clear and identified added value for users. MAR will work closely with other themes in the Joint Programme.

Overall objective	Beneficiary groups	Baseline
<p>The overall objective of this theme is to develop and enable better risk assessment and management in FCERM. The Theme will improve decision-making and management of flood and coastal risk. This will be achieved by improved process understanding, new methods and models and integrated impact assessment, taking into account future uncertainties.</p> <p>The R&D in this Theme will provide underlying knowledge and tools to FCERM users, to other Themes and relevant science programmes for further development or full implementation.</p>	<p>The people, communities and businesses in or adjacent to areas of flood risk Defra / Environment Agency policy and process developers; EA operational teams; Local Authorities and Emergency Services; The financial services industry; Other parts of the Joint R&D Programme</p>	<p>Without this programme, Defra / Agency will fail to deliver flood risk management to the appropriate standards, as the UK climate and land use changes. This will lead to unacceptable increased human and financial impacts as a result of floods and coastal erosion, and misallocation of investment.</p>

Specific objectives	Named Beneficiaries	Baseline
<p>All assessment tools and models of flood and erosion impacts and responses will be built on good scientific understanding of processes, systems, uncertainty and sustainability, within a risk framework.</p> <ol style="list-style-type: none"> To assist Defra/Environment Agency to implement in a sustainable and cost-effective way the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management' by developing more integrated FCERM models and tools. To do this by allowing Defra/EA to better understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management including land use planning within the context of the Water Framework Directive, through the development of open-interface multi-purpose tools. To increase the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change. To enable improved flood and coastal erosion risk management by continuing to develop system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses. To developing methods for modelling, appraisal decision support, and risk communication aimed at encouraging integrated risk management using both structural and non-structural measures To promote the development and use of consistent risk and uncertainty modelling techniques and to support other Themes in specific topic areas. 	<p>The above beneficiary groups</p>	<p>Defra / Agency will fail to deliver flood risk management to the appropriate standards as the UK climate and land use changes. This will lead to unacceptable increased human and financial impacts as a result of floods and coastal erosion.</p>

Key (Agency) Beneficiaries	Key Agency Users	Comment
Agency FRM Policy	Flood Risk Policy Manager - Strategy, Planning & Risk Head of Flood Risk Management Policy Policy Advisor - Flood Data, Mapping and Modelling Policy Advisor - Flood Risk Planning Policy Adviser - Urban Flooding	
Agency FRM Processes	Technical Manager – Flood Risk Mapping & Data Management Technical Manager – Strategic Planning & Development Control Head of Flood Risk Management Process Technical Advisor - Risk Mapping & Data Management Process Technical Advisor – Strategic Planning Process Technical Advisor – Development Control Process	
Science and Projects	Theme Manager – Sustainable Asset Management Theme Manager – Incident Management and Community Science Manager - Climate Change Science Manager - Integrated Catchment Science Science Manager – Sustainable Resource Use Science Manager – Tools and Technology Science Manager – Ecosystem Science Manager – Environment & Human Health Science Science Manager – Risk and Forecasting Project Managers - Making Space for Water Project Managers - Flood Risk Mapping Project Managers - TE 2100 and other Internal Projects	
CIS and Legal	Strategic Programme and Strategic Development Managers Enterprise Architects and Legal Advisors	
Investment and Capital Works	Head of Investment and Funding Head of NCPMS / NCPMS Appraisal – Strategy Team	
Agency's Region/Area	Regional / Area Flood Risk Managers	

Key Beneficiaries	Key Users – Government Departments/Agencies and Operating Authorities	Comment
Defra	Policy - Flood and Coastal Erosion Risk Management Science - Theme Manager – Strategy and Policy Development	The department responsible for FCERM
Other Operating authorities	Local Authorities / Coastal Authority (Coastal Groups) Internal Drainage Boards Water Companies Maritime Local Authorities	Operating authorities for ordinary watercourses, urban and coastal flooding Operating authority for coastal erosion

<p>Other Government Departments/ Agencies</p>	<p>ODPM, Welsh Assembly Regional planning and development agency's / bodies Highway's Agency</p> <p>English Nature(Natural England) English Heritage</p> <p>OST / Dti</p>	<p>A role in shaping key infrastructure and planning decisions on development in flood-prone areas</p> <p>Partner organisation in determining the best solutions for environment , for archaeology and ancient monuments; responsible for management of national and international designated sites</p> <p>FCERM science, Technology / foresight</p>
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Other Beneficiaries (Researchers and Consultants)	Comment
<p>Research Councils NERC, EPSRC, SSRC</p> <p>SNIFFER (Scottish and Northern Ireland Forum for Environmental Research)</p> <p>UKWIR (UK Water Industry Research)</p> <p>European Research (<i>FLOODsite, CRUE, etc</i>)</p> <p>Framework Consultants / Framework Contractors</p>	<p>Agency has been a key stakeholder alongside Government, EU, business/industry, NGOs and research sectors in developing research programmes to address problems in flood risk management.</p> <p>Responsible for the development of FRM strategies, appraisal and design of schemes</p>

Other Beneficiaries (General Public and other)	Comment
<p>The people, communities and businesses in or adjacent to areas of flood risk</p> <p>National Flood Forum</p> <p>Developers and other commercial organisations with a stake in flood-plain development</p> <p>Other organisations</p>	<p>Will benefit from improved risk management</p> <p>NFF was set up with Agency R&D funding and provides a focus for community initiatives in flood response</p> <p>The private sector has an extremely important part to play in generating employment and wealth and in the regeneration of depressed areas, which often occur in historically developed parts of the flood plain.</p> <p>Other organisations with shared interests in flood risk asset management include: , National Trust, Associated British Ports, Countryside Landowners Association, National Farmers Union</p>

Rationale

As noted in the first section of this document, a wide-ranging programme of action is being developed, to deliver the Government's and the Agency's aims within the 'Making Space for Water' programme, to implement a more holistic approach for FCERM in England and Wales. The approach will involve taking account of all sources of flooding, as well as a wide range of solutions. Implementing this new approach will require further step changes in to many parts of the decision-making process and these changes will be defined and provided by R&D in this Theme.

Defra/EA support for this research Theme is important because it will deliver the scientific tools and models that encourage the provision of sustainable, a more holistic and risk based approach to managing flood and coastal erosion risks in England and Wales. A primary aim of this research theme is to support government, agencies, authorities and all interested parties to reduce the threat to people and their property and deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles. The risk assessment and modelling approach will involve taking account of all sources of current and future flooding, range of current Government policies and operations of flood and coastal erosion risk management and other portfolio of approaches which reflect both international, national and local experiences and priorities.

This programme will be evaluated by asking the following questions:

1. Has MAR assisted Defra/Environment Agency in implementing the policies set out in MSfW and the Agency's 'Strategy for Flood Risk Management'?
2. Has MAR assisted Defra/EA to understand the interaction between policies, strategies and delivery of flood and coastal erosion risk management within the context of the Water Framework Directive?
3. Has MAR increased the understanding of physical, economic and social flood and coastal erosion processes, risks and uncertainties and the impact on them of climatic, socio-economic and environmental change?
4. Has MAR supported better flood and coastal erosion risk management by developing whole-system based tools and predictive models of catchment, urban, estuarial and coastal areas for assessment of risk and responses, which are sufficiently reliable for everyday use.
5. Has MAR developed methods and tools for assessing integrated portfolios of structural and non-structural measures in an evidence-based, transparent and demonstrable way?
6. Has MAR promoted the development and use of generic risk and uncertainty modelling techniques and to support other Themes in their specific topic areas.
7. Has the quality of the research been high and of national and international standing?
7. Have the benefits been realised and has the programme achieved value for money?
8. How successful has uptake been, both within the Environment Agency and among the wider community of users?

The MAR Programme vision notes the importance of working with other themes and funders, particularly on cross-cutting research areas. In particular, the following areas will be developed in a co-ordinated way to avoid duplication and gaps:

- Urban flood management – the policy needs will be identified by the MSfW programme, and MAR will work with that programme to identify and meet the R&D needs. A key need is likely to be to develop improved models flood risk assessment in these complex areas driven by flooding from multiple sources.
- Communities – The IMC will do research into social processes and responses to flood and coastal risk. MAR will incorporate social interests into risk models to inform and support decision-makers.
- Climate Change – SPD will lead on CC policy and deciding on allowances. MAR will provide assessments and modelling to support, and will incorporate CC into flood and coastal risk management tools. A key area here will be the proper use of the UKCIP $next$ probabilistic scenarios
- Asset management – MAR will draw up the vision and conceptual approach for risk – based FRM, (including the RASP family of tools) - SAM will deliver tools and guidance to asset managers.
- Integrated catchment management – there will be close links with WFD, and Habitats work, and in particular close links with the Environment Agency's catchment science programmes
- Relationships will be maintained with FRMRC and FLOODsite.
- MSfW implementation plan will produce R&D needs and MAR will engage and respond as appropriate
- Tyndall Centre is active inter alia in long term coastal management and futures, and we will work towards closer collaboration.
- TE2100 is providing a test bed for much emerging research and this will continue.

Potential stakeholders or partners who have overlapping interests in this programme include other Operating Authorities, professional bodies and industry. Consultations with these bodies have insured that this research programme does not overlap with on-going projects and fills gaps in knowledge/ business needs. In some cases the MAR Theme will seek to carry out collaborative research with these organisations.

Finally it is vital that the programme co-operates with the developers and vendors of relevant software, both in pre-competitive development and in ensuring proper whole-life dissemination and support. The concept of open software will be important in this and will need to be developed.

External drivers	Contextual drivers <ul style="list-style-type: none"> • Government risk improvement programme - encourages departments and Agencies to improve the way they assess and manage risk • Foresight Future Flooding project - foresees major increases in flood and erosion risk and proposes a new approach for managing risk, with action plan. • Making Space for Water programme - sets a new direction of travel for flood and coastal risk management and establishes a programme to change policy and guidance • Government Spending reviews - require periodic assessment of achievement and justification of future investment to manage risk • Propose European Floods Directive - may require new approaches for mapping flood hazard and risk
Internal drivers	<ul style="list-style-type: none"> • Making it Happen theme – Reducing Flood Risk • River Basin Management Plans • Catchment Flood Management Plans (CFMPs) • Shoreline Management Plans (SMPs) • Strategies for major estuaries e.g., Thames Estuary 2100 • Environment Agency Strategy for Flood Risk Management - requires improved approach to assessing risk and taking account of risk in decision-making. • Water Framework Directive • Lessons Learnt Reports – 2000 and 2004 floods

Influences

- **Influence** by emerging UK science agenda:
 - EPSRC Flood Risk Management Research Consortium (FRMRC)
 - NERC Flood Risk from Extreme Events (FREE) programme
 - ESRC/BBSRC/NERC Rural Economy and Land Use (RELU) programme
 - SNIFFER flood risk management research
 - Other Theme areas in joint Defra/ Environment Agency FCERM R&D Programme
- **Influences** by emerging EU Framework V and VI research programmes:
 - FLOODsite
 - Real-time flood decision support system integrating hydrological, meteorological and remote sensing (FLOODRELIEF)
 - European exchange circle on flood forecasting, early warning (EXCIFF)
 - Achieving Technological Innovation in Flood Forecasting (ACTIF)
 - Wide Information Network for Risk Management (WIN)
 - Co-ordination of Research in Europe (CRUE)
 - European Flood & Drought Integrated Project (EFDIP)
 - Interreg projects including COMRISK and Safecoast
- **Other organisational influences:**
 - Defra High level targets for flood and coastal defence
 - Defra Flood and coastal defence funding review 2002
 - EU Directives (Water Framework, Groundwater, Landfill)
 - Regional Spatial Strategies, Planning Policy Guidance review e.g., PPG25

Appendix B TAG membership and representation

Table C1 MAR TAG membership

Name	Affiliation	Topic area
Dr. Suresh Surendran	Environment Agency	Theme Manager / Principal Scientist
Dr. Kate Scott	Environment Agency	Theme Champion / Modelling Advisor
Prof. Edward Evans	Independent	Theme Advisor / planning and modelling
John Goudie	Defra	Defra representative / Risk Mapping & Data
Trevor Linford	Environment Agency	EA Process / Risk Mapping & Data
Stuart Pomeroy	Environment Agency	EA CIS
Dr. Rob Wilby / Bill Donovan	Environment Agency	Climate change/ hydrology
Dr. Kevin Horsburgh	CEH POL	Oceanography
Dr. Ann Calver	CEH Wallingford	Hydrology
Prof. Christopher Collier	University of Salford	Meteorology/ hydrology
Prof. Jim Hall	University of Newcastle	Risk / coastal engineering
Jeremy Benn	JBA	Hydrology/ catchment planning

Defra / Environment Agency Flood & Coastal Erosion Risk Management
R&D Programme



Incident Management and Community Engagement (IMC) - Theme Work Plan, 2005-2010

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1. Introduction

This Work Plan sets out the planned and completed activities that have been, or will be, carried out to develop and undertake R&D within the Incident Management & Community Engagement (IMC) Theme of the DEFRA / Environment Agency Coastal & Flood Defence R&D Programme. Key supporting documents are located in the Appendices, and others are listed in the References.

The Incident Management and Community Engagement Theme was one of the four new themes formed following the recommendations of the independent review of the thematic research programme. These replaced six former themes covering the same areas of work. The IMC Theme inherited the work programme previously undertaken by the Flood Forecasting and Warning Theme, with some projects from other predecessor Themes.

The Theme Work Plan provides an overview of the IMC Theme. It is a working document for use by those involved in managing, advising, reviewing and evaluating the Programme. It is not intended for general circulation but is available, along with details of IMC projects, on the Defra website under FCERM and the Environment Agency website under Science.

Theme work plans will be updated and issued annually.

2. Theme Structure and Relationships

2.1 Coverage of Incident Management & Community Engagement (IMC) Theme

Incident Management & Community Engagement is taken to include:

- Monitoring and detection of weather conditions by field instrumentation, including the measurement and forecasting of rainfall by the Met Office/EA national weather radar network and tide levels by the POL/Met Office Storm Tide Forecasting Service;
- Forecasting future river levels and flows and onshore wave and tide levels by modelling;
- Formulating and issuing flood warnings to vulnerable locations using databases of at-risk property and assets;
- Response to flooding by individuals and agencies to minimise the impact of events;
- Post-event recording and analysis.

The IMC Theme Work Plan aims to address both operational issues (i.e. those having an immediate bearing on improving efficiency and effectiveness) and strategic issues (i.e. those aimed at developing new techniques and improved systems and methods). The Theme will not deal with long term, basic research. Where this is not covered by other theme areas, the IMC Theme will aim to influence the programmes promoted by research agencies such as EPSRC and NERC.

The policy objectives and their relevance to Defra and Environment Agency business needs are set out in the RO Statement

2.2 Programme Management

The overall structure and organisation of the joint programme is set out in the Programme Definition document. Each theme has a Theme Manager, who has day-to-day responsibility for the theme programme, a Theme Champion who provides overall direction to the theme and a Theme Advisory Group who provide input and review for the programme.

The TAG members are listed at Appendix C

2.3 Project Area Steering Groups

These groups provide and review project proposals for TAG. They are flexible groups which can be dissolved and reformed as the emphasis of the programme changes. Initially, there will be 3 PASGs covering:

1. Forecasting/real-time modelling issues.

This has representation from FIM Process and Regional forecasting technical specialists. It covers NFFS development issues, Met Office and STFS forecasting/modelling issues with links to Joint EA/Met Office Steering Group and Tidal Flood Group.

Externally, there are links to FRMRC RPA3 and RPA9, FLOODsite Tasks 1, 15, 16 and 20 and the FREE Programme.

2. Warning and infrastructure issues

This has representation from FIM Process and Area warning technical specialists. It covers systems such as FWD and other dissemination media (web etc.) and Public Awareness.

Internally, there are links to MSfW workstreams covering increasing awareness and resilience to all forms of flooding (RF5-7)

Externally, there are links to FRMRC WP 7.1 and 7.3, FLOODsite Tasks 6, 17 and 19 and the Emergency Planning Society Flood Issues Group

3. Social and community engagement issues

This group covers response and self-help issues. It has representation from FRM Policy, Social Policy, Public Awareness and Area Operations/EWF.

Internally, there are links to MSfW workstreams SD6, RF1 – 4 and RF8

Externally, there are links to FRMRC WP7.5, FLOODsite Task 11 and National Flood Forum. It is intended to develop links with appropriate ESRC programmes

2.4 Interrelationships with other Themes

The linkages between the four Themes have been considered by Theme Leaders in developing their Theme programmes. Regular meetings of the Joint Programme Management Team (JPMT) allow Theme Managers to monitor the programmes of other themes and identify overlaps, duplication and possibilities of joint promotion and co-operation.

The IMC Theme is strongly linked to other Themes as indicated:

- Modelling & Risk (Climate Change, Risk Mapping, Modelling applications to real-time situations)
- Strategic Asset Management (Performance of defences under overtopping/hydraulic loading)
- Policy Development (Social policy issues)

2.5 Links established with External Scientific and Technical Organisations

Four consultants have been appointed to review the programmes covered by the EPSRC Flood Risk Management Research Consortium, the EU FLOODsite programme and the NERC FREE (Flood Risk From Extreme Events) programmes. This aims to provide input and influence the direction and scope of research strands in these programmes which support Environment Agency business needs.

The following areas of FLOODsite have been identified for detailed involvement:

Task 11 Risk perception, community behaviour and social resilience

Task 19 Development of a framework for flood event management planning

Task 20 Development of a framework for the influence and impact of uncertainty

The Theme is represented by the Theme Manager and operational staff on the Flood Risk Management Research Consortium RPA3 Real-time Modelling and also has informal links to RPA 9 Uncertainty

The Theme has expressed interest in several proposals in the FREE programme and involvement awaits final programme selection.

2.6 Making Space for Water

Making Space for Water is a cross Government programme of work which is responsible for taking forward the new strategy on flood and coastal erosion risk management in England. The aim of this new strategy, taken from the Response document, is outlined below:

“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.”

There are 25 projects, which will be undertaken under the umbrella heading of Making Space for Water. These projects have been divided into 4 themes – taking a holistic approach to managing flood and coastal erosion risk, achieving sustainable development, increasing resilience to flooding, and funding.

The following projects are of relevance to IMC Theme and will influence the future R&D programme:

HA5: Groundwater Flooding
SD6: Stakeholder and Community Engagement
RF1: Resilience Pilots
RF2: Encouraging Uptake of Resilience Measures
RF3: Sustainable Buildings Code
RF4: Building Regulations
RF5: Expanding Flood Warnings
RF7: Rapid Response Catchments
RF8: Emergency Planning Response and Resilience

3. Five-year plan for achieving the RO aims and objectives

3.1 General Principles

The aim of the theme programme is to reflect the business needs of the Environment Agency over the next ten years and to develop tools and guidance to support those needs. The Theme RO Statement contains the vision and objectives of the programme. This takes account of the business plans and other drivers of flood incident management.

Programme development is carried out by occasional workshops involving practitioners and academics to identify key issues and areas for action. The programme is regularly reviewed by the Theme Advisory Group and Environment Agency business groups.

The research issues identified below will form the major new initiatives in the programme over the next 5 years. Work will continue on existing research strands dealing with improving existing systems and methods.

3.2 Risk based Flood Incident Management

Currently, forecasts and warning are produced on a deterministic basis. Warnings are issued by reach and do not differentiate between recipients or the catchments characteristics.

Development of a risk based FIM system will allow warnings to be issued on the basis of the consequences of flooding, tailoring the service to the requirements of end users. Forecasts will be produced giving a range of probabilities. This will permit more targeted warnings to be given, for different groups, types of flooding, catchment characteristics and other parameters, but guidance is needed on how groups and catchments should be differentiated, what use recipients would make of more differentiated information and what form this should take.

3.3 Community Planning and Response

Recent developments in Defra and Environment Agency policies on flood risk management, from *Directing the Flow*, through the Environment Agency's *Flood Risk Management Strategy*, to *Making Space for Water*, place increasing emphasis on social dimensions. These reflect broader developments in Defra and Environment Agency policy. For example, health and the environment, environmental inequalities, regeneration, liveability and environmental citizenship are all key elements of the

quality of life theme within the Environment Agency new corporate strategy, Creating a Better Place.

Recent research has highlighted, on the one hand, the diverse social and health impacts of flooding and on the other hand, the range of institutional and social responses required to manage these and other impacts effectively. It has become clear that:

- Different communities respond to flood warnings, and to flooding, in different ways. Some communities are more vulnerable than others – both before, during and after flooding;
- Effective responses - both before, during and after flooding - require effective co-ordination between a range of institutions (both the Agency and its partners) and the communities themselves.

3.4 Other Flooding Types

This will take up the research identified in MS4W in Groundwater and Urban situations.

A significant amount of flooding of properties occurs within and outside flood plains which is not currently covered by specific flood warnings. These floods are often referred to as pluvial floods and are the result of short, intense periods of heavy rainfall – typically summer thunderstorms, and mainly effect urban areas, though other rapidly responding steep, localised catchments are also affected. Some estimates suggest that around 40% of flood damage, and associated economic losses, are attributable to pluvial flooding.

Groundwater flooding poses particular problems since flood occurrence is infrequent compared to surface flooding but once floods have occurred, they are very long lasting and can cause considerable long-term disruption of people lives. A good knowledge of their causes and their properties will enable the Environment Agency to predict their occurrence, to assist in devising ameliorating measures and to give the people affected good information with which to plan their response.

3.5 Information Requirements

Developments in the flood forecasting and warning service have produced an increase in the amount and complexity of information presented to both forecasting and warning Duty Officers. Major systems such as the National Flood Forecasting System (NFFS) and Floodline Warnings Direct (FWD) are currently being introduced to regions and areas. There are also greater demands on the service to provide reliable and timely warnings by the introduction of Levels of Service (LOS).

3.6 Performance Measures

Research has been carried out to develop performance measures for flood forecasting models. Recent research as part of the MAR Theme project *Risk Assessment for Flood Incident Management* has identified and scoped the requirements for more comprehensive performance measures covering the whole of the flood incident management process. This will allow resources to be directed towards the areas which will provide the most benefit from improvement.

4. A statement of achievements for year ending March 2006

4.1 Warning for Extreme Events

Recent flood events have identified the need for advance warning of periods of potentially severe weather and extreme weather events. The flood event at Boscastle in 2004 focussed attention on the need to improve forecasts and warnings in rapid response catchments.

Successful mitigation of flood impacts depends on reliable warnings, which require accurate and timely forecasts. The earlier the forecast reliably indicates a flood situation, the more time is available for management of the situation and for promulgation of warnings to people who may be at work or asleep when the flood actually arrives. with potentially tragic consequences.

The IMC Theme programme has been looking at techniques offering potential improvements in this area. While forecasts produced before rain has entered the rivers are inevitably uncertain, critical opportunities for mitigation are lost if warnings are delayed until too close to an event. Whether in urban areas or in steep terrain, as at Boscastle, fast rising catchments provide little lead time between the rain hitting the ground and settlements being inundated.

The recently completed project on Storm Scale Modelling (FD2207) showed that a storm-resolving model does have the capability to produce useful forecasts of convective storms on scales applicable for flood prediction. Further work to determine whether a 1 km model is able to give useful predictions of the convective events that produce extreme rainfall totals, and the critical factors associated with forecasting such events is now under way in project FD2210 Modelling Extreme Rainfall Events. Both projects are jointly funded with the Met Office.

Another completed project covers Extreme Event Recognition (FD2208). This looks towards the possibility of earlier warnings, up to a day ahead, of events likely to cause major disruption and requiring substantial mobilisation of resources. Phase 1 of this project, completed in 2002, identified several factors common to extreme rainfall events of the 20th century. Work in Phase 2 is focussed on deriving these factors from weather forecast models, determining whether they can be used to predict extreme events with any skill, and on how such predictions might be used in the flood warning process. Findings from the Extreme Event Project have been used to inform the development of an indicator of the vulnerability of catchments to extreme rainfall events which was one of the actions from the review of the Boscastle event.

4.2 Improving Flood Warning Awareness in Low Probability and Medium-High Consequence Flood Zones (SC020079)

Since the review of the flood events in 1998 and 2000, the need to increase public awareness of the risk of flooding has been a priority for the Environment Agency. Generally the areas targeted to increase awareness have been those communities calculated to be at the higher end of the "at risk" spectrum. Under its terms of operation, the Environment Agency is duty bound to provide a flood warning service. Low probability flood zones, where flooding consequences may be medium to high,

potentially present large risks to the public and the Agency owing to a number of factors, including a false sense of security if areas are defended to any degree.

This 2 phase project identified a series of recommendations for the Agency in developing strategies to raise awareness of flood risk in low probability medium-high consequence flood zones. A broad review of various approaches to risk communication in terms of flooding and other hazards both in the UK and elsewhere was undertaken to identify key lessons learnt. This review was taken from both literature as well as from practice, with input obtained from an array of stakeholders engaged in flood risk management and communication both within the UK, as well as from three other countries, namely The Netherlands, Australia and the United States. All of this background work is captured in more detail within the four appendices accompanying the report. The project has provided information which has fed into the public awareness programme.

4.3 Public Response to Flood Warnings (SC020116)

In 2004 researchers in the Department of Sociology and Centre for Environmental Strategy at the University of Surrey were commissioned by the Environment Agency to develop a detailed knowledge of how the 'at flood risk' public understand and respond to flood warnings and to arrive at a full understanding of their priorities on receipt of warning.

The methodology for the project was divided into three distinct stages. Stage One involved the preparation of an accessible review of relevant literature, and a secondary analysis of existing survey data collected by BMRB. Stage Two comprised qualitative work with different groups in several flood risk areas in order to reach a detailed understanding of participants' priorities on receipt of the Agency flood warning codes. Stage Three took the form of a survey to provide quantitative data on how residents of at risk areas intend to act in response to the three levels of flood warning and to explore what factors inform differences in warning response.

The results from this project have informed the Public Awareness campaign. The project has also been instrumental in defining what is meant by "appropriate action" and how it is measured and reported. "Appropriate action" is a performance measure in the Flood Warning Investment Strategy and an Environment Agency corporate scorecard measure.

4.4 Managing the Social Aspects of Floods (SC040033)

This project was carried out by Collingwood Environmental Planning. There were four objectives for the work, organised in six discrete parts:

To review work on the social impacts of floods and the most effective ways of addressing these (parts 1, 2);

To review work on the most effective ways of working with stakeholders, including local government and local communities, in flood risk management, and the most effective ways of improving these (parts 3, 4);

To review the role of social science within flood defence research, and how this role might best be strengthened (part 5);

Summarise main findings and recommendations from parts 1-5 into a short, targeted synthesis report (part 6).

The work was completed in June 2005. A presentation on the results of this project were made to TAG and the recommendations were used to develop the current research proposal *Improving Institutional and Social Responses to Floods*.

5. Evaluation of Theme progress

The Theme development process is currently in the initial stages and is on programme. The first Theme Advisory Group meeting was held on 15 March 2006. A second TAG meeting on 20 July 2006 discussed the long term programme and identified proposals for 2007/08.

6. Theme development: a plan and programme for the next financial year

The following table sets out the projects that have been identified as new starts for 2007/08.

Project Nr	Title	Objective	Cost/time	RO Objective Addressed
FDK(07)01	Probabalistic Fluvial Forecast Modelling	To evaluate the impact of adopting probabilistic flood forecasting operationally for hydrological and hydraulic fluvial flood forecasting models, and to recommend practical ways of reducing model runtime and an operational statistical framework for processing multiple model runs with probabilistic inputs and interpretation of the hydrological model components.	£175k over 18 months	1.2, 2.1
FDK(07)02	Performance Indicators for Flood Incident Management	To develop Performance Indicators which will allow the evaluation of elements of the FIM process to identify and target improvements to the service	£200k over 2 years	1.1
FDK(07)03	Improved methods for groundwater dominated flooding	To develop improved procedures for forecasting groundwater dominated flood events and guidelines for use by flood forecasting practitioners.	£60k over 1 year	1.3
FDK(07)04	Public understanding of and response to flash flooding	To provide a better understanding of customers' needs in relation to flash flooding and to develop evidence to support policy decisions on the feasibility of providing a warning service and what form it should take.	£100k over 1 year	2.3
FDK(07)05	Long term social data collection	To provide recommendations for long term data needs. Currently EA does not hold all data collected into public response and understanding of Flood Risk. The work is delivered in report form and adapted into Policy, Process or Operations as appropriate by the business and the ability to recall data for further analysis is lost.	£50k over 1 year	1.1, 3.1-3.4
FDK(07)06	Blending	To develop an optimal combination of convective scale NWP and	£70k over	2.4

	convective scale NWP with ensemble nowcasting	ensemble nowcasting products in order to improve the reliability and accuracy of rainfall information in flood prediction.	2 years (joint funding with Met Office)	
FDK(07)07	Meteorological indicators of summer storms	To provide a long lead time indication that a high risk of extreme convective storms will exist during the following summer producing a higher state of preparedness for severe events.	£50k over 1 year	2.3
FDK(07)08	Development of Pluvial Flood Warning System	To provide customised flood warnings for Local Authorities, thus allowing them to respond more effectively to heavy rainfall likely to lead to pluvial flooding. Local authority response and mitigation plans will benefit from more targeted forecasts.	£332k over 2 years	1.3, 2.2, 3.3
FDK(07)09	Institutional & Social Response Phase 2	To build on previous work to develop ways of managing effective responses by communities - both before, during and after flooding - by effective co-ordination between a range of institutions (both the Agency and its partners) and the communities themselves.	£200k over 2 years	3.2-3.4
FDK(07)10	MOSES	Contribution to EU Interreg project to develop fully operational tool for information management during flood incidents for use by area and regional FIM staff to improve performance during flood events	£100k over 2 years	2.1, 2.2, 3.3
FDK(07)11	Communication & dissemination of probabilistic flood warnings	To review best practice in communication of probabilistic information in flood warnings and related areas (e.g. weather forecasting), and to make recommendations on the improvements to systems, operational procedures, staff training and public awareness needed before probabilistic flood forecasts are used operationally. This project will build upon the initial recommendations provided by project FD2910 "Probabilistic Flood Forecasting Scoping Study"	£80k over 1 year	1.2, 3.1

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

Incident Management and Community Engagement Theme – RO Statement

Programme vision

Even with increasing investment in flood risk management, it will never be technically, economically or environmentally acceptable to prevent flooding entirely. Society has to reassess the way it lives and copes with the threat of flooding. Government and the Environment Agency have changed their thinking from *defending* to *managing* floods.

Flood incident management is a very complex system. It is comprised of flood forecasting and warning, raising public awareness, communication before during and after an incident, effective emergency planning and exercising, co-operation between emergency services and effective aftercare. There are a range of key organisations involved which adds complexity.

But successful flood incident management can play a vital role in minimising the consequences of flooding incidents, and in helping people to live with flood risk. The two principal purposes of flood forecasting and warning are to save lives by allowing people, support and emergency services to prepare for flooding and to reduce the damaging effects of flooding by giving people time to take appropriate action, like protecting their property. In addition an effective flood forecasting and warning system informs operating authorities of the need to operate structures, temporary defences or other control structures, and initiate other elements of the flood incident management system.

So the importance of flood forecasting in defended areas is considerable, as the consequences of established defences breaching or being overtopped are considerable, particularly in areas where people are not accustomed to or aware of these risks. Other elements of the flood incident management system rely on informed professional partners and an informed public who are ready to act on receipt of a warning.

The success of the flood incident management system in achieving these goals depends on a number of factors. These include geographical coverage of the service; its reliability; the ability of people to act on a warning; the effectiveness of action taken.

The increasing trend of flooding resulting from climate change and sea level rise and the changing nature of society, with increased expectations of the duties of public bodies, will continue to alter the perceptions of what constitutes a reasonable service and drive the need for continuous improvements. In order to meet the demand for reliable performance from flood warning systems by the public, the Environment Agency has drawn up targets for improving the service to 2013.

This programme seeks to ensure that future performance targets both for incident management of flood events by the Environment Agency and for community response to flood events are met. As the sponsoring ministry, Defra will wish to ensure that improvements to systems and techniques are carried out to meet public expectations and to cover the full range of flood situations likely to be experienced by people at risk. This will involve this programme in investigation of solutions to non-river flooding situations.

Overall objective	Beneficiary groups	Baseline
To help reduce the consequences of flooding through the application of sound science in developing effective flood incident management systems.	The people, communities and businesses in or adjacent to areas of flood risk; EA FRM Policy, Process and Operational teams; Local Authorities and Emergency Services; vulnerable groups and individuals.	The Environment Agency fails to meet targets for improvements to the coverage and effectiveness of the flood warning service. Local communities lack knowledge and guidance to mitigate the effects of flooding and the time taken to recover from flooding does not improve.

Specific objectives	Named beneficiaries	Evaluation Criteria
<p>1. Organisation</p> <p>To review the operation of the overall system in order to identify areas where improvements will give greatest benefit and to maximize the resilience and reliability of the service</p> <p>To develop the processing of input data and forecasting to provide warnings which reflect the uncertainty inherent in specific techniques in order to allow the provision of a range of warning products for different risk categories with guidance on the best approach for each situation.</p> <p>To develop the coverage of the system in areas of non fluvial flooding in order to provide a comprehensive service for all users</p> <p>To develop best practice in all aspects of service delivery training and support in order to improve the effectiveness of the service</p>	<p>FRM Policy Manager</p> <p>Technical Manager, Flood Incident Management</p> <p>Regional Flood Forecasting Teams</p> <p>Area Flood Incident Management Team</p> <p>Area Operations Delivery Teams</p>	<p>1.1 The programme will develop and implement best practice in forecasting and warning methods</p> <p>1.2 The programme will develop the tools and techniques to allow risk based forecasting and warning to be carried out to all significant flooding locations.</p> <p>1.3 The programme will develop a national system for training and facilities to provide assistance to Duty Officers in performing their roles efficiently and effectively.</p>
<p>2. Technical</p> <p>To develop and trial best practice models and systems for national use and to provide guidance for regions and areas in use of technology in order to improve the accuracy, reliability and timeliness of flood warnings</p> <p>To develop appropriate new techniques to operational use in order to improve the accuracy and timeliness of warnings</p> <p>To develop methods for identification of conditions which give rise to extreme events in order to focus resources on those conditions likely to produce emergencies</p> <p>To co-operate with Met Office and others in the improvement of weather forecasting, radar rainfall prediction and measurement and tidal surge forecasting</p>	<p>Marketing and Communications team</p> <p>Public Awareness Campaign team</p>	<p>2.1 Rainfall information from weather radar is currently subject to a number of inconsistencies which are hampering its use in real-time modelling. On completion of the programme, weather radar data will be routinely used in operational forecasting models</p> <p>2.2 There is considerable difference in the use of models and systems for forecasting in regions and areas. This programme will draw on both existing practice and review new developments to identify best practice and provide guidance for operational effectiveness.</p> <p>2.3 The programme will develop methods for identification of weather conditions which give rise to extreme events</p>
<p>3. External interfaces</p> <p>To identify the situations where risk is greatest and to develop the means to focus awareness of vulnerability in order to</p>	<p>Area Operations</p> <p>Local Authorities</p> <p>Emergency Services</p> <p>Public</p>	<p>3.1 The programme will produce guidance and improved methods so that people in flood risk areas will receive clear information aimed at their particular needs and will know</p>

<p>improve response in vulnerable situations. To develop sustainable community flood mitigation measures which can be applied by local people in order to reduce the effect of flooding and build more resilient communities, to identify appropriate actions when flood events occur in order to provide guidance to improve the extent and effectiveness of the response of the public To develop best practice advice and information for all agencies involved of the planning and actions which can be taken before, during and after a flood event in order to increase the effectiveness of flood response, with particular reference to the Civil Contingencies Act 2004. To identify best practice by reviewing the current methods of dissemination of flood warnings and to identify and develop new techniques in order to improve targeting of and response to warnings.</p>		<p>how to act when faced with flood information. Targets for improvement in public awareness will be met.</p> <p>3.2 The programme will provide guidance and technical solutions and will develop methods to actively promote community engagement so that more recipients of warning messages will have the knowledge and support to take appropriate action to mitigate losses and damage and risk of loss of life in flood situations will be reduced. Targets for flood response will be met.</p> <p>3.3 The programme will provide guidance for inter-agency flood response.</p>
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Internal Stakeholders	Comment
Flood Risk Management Policy Manager	Responsible for development of FIM policy
Process Manager – Flood Incident Management	Responsible for delivery of FRM Strategy for Flood Incident Management
National Operational Systems Manager	Responsible for effectiveness of Environment Agency systems including FLOODline and NFFS
Chair of Warning & Informing the Public Media Group	Responsible for policy on warning messages content and dissemination
Social Policy Manager	Responsible for overall coordination of social science policy and linking to other social science work
Flooding Capabilities Programme	Assesses the country's ability to deal with flooding and its resilience
Marketing & Communications Development Manager	Environment Agency Public Awareness Campaigns
MSfW Project Managers	Responsible for identifying FIM R&D issues through MSfW programme
Regional Flood Forecasting Officers	Responsible for delivering a flood forecasting service to Area staff
Area Flood Warning Officers	Responsible for issuing and disseminating flood warning information to other agencies and the general public
Area Operations Officers	Responsible for directing the Environment Agency's response to flood events

Other stakeholders	Comment
Regional planning and development bodies	The Environment Agency has a role in shaping key infra-structure and planning decisions that affect flooding
Partner agencies	Partner organisations with shared interests in incident management and community response include: Meteorological Office, Emergency Planning Society, Local Authorities Association (LAA) and Scottish and

<p>Research Councils NERC, EPSRC, SSRC</p>	<p>NI Forum for Environmental Research (SNIFFER). Co-operation includes jointly funded research.</p> <p>The Environment Agency has been a key stake-holder alongside Government, business, NGOs and research sectors in developing research programmes to address problems in flood risk management. This Theme has established links to EPSRC Flood Risk Management Research Consortium and the FLOODSite programme and is anticipating strong links to the FREE programme. Efforts will be made to develop links with ESRC.</p>
<p>Meteorological Office</p>	<p>The Environment Agency has a MoU with Met Office to develop weather forecasting and precipitation measurement systems for use in flood forecasting. A Joint Steering Group and two sub groups have been formed to overview service delivery and development of the full range of Met Office products..</p>
<p>Proudman Oceanographic Laboratory</p>	<p>POL has carried out the development of the coastal shelf model which is used for surge tide prediction within the Storm Tide Forecasting Service. The service is delivered to the Environment Agency from the Met Office. The Environment Agency has recently taken ownership of the management of the service and has specific interest in ensuring the service is developed to meet its business needs.</p>
<p>National Flood Forum</p>	<p>NFF was set up with Environment Agency R&D funding and provides a focus for community initiatives in flood response</p>
<p>Universities Weather Radar Group</p>	<p>Funded by NERC to act as a focus for research proposals in this area.</p>
<p>Emergency Planning Society</p>	<p>Drawn from County and District Emergency Planning Officers. Has two relevant Professional Interest Groups, Flood & Severe Weather Group and Social Issues Group. Potential for co-operation and jointly funded research.</p>
<p>Flood risk communities</p>	<p>Advice on mitigating the effects of flooding</p>

Rationale

The specific DEFRA and Environment Agency policy objectives that will be addressed by this programme are:

“ To reduce the risks to people and the developed and natural environment from flooding and erosion:

- by encouraging the provision of adequate and cost-effective flood warning systems;
- by encouraging the provision of adequate, technically, environmentally and economically sound and sustainable flood and coastal defence measures.”

This programme also supports the “Reducing Flood Risk” theme of the Environment Agency’s long-term corporate strategy:

- Flood warnings and sustainable defences will continue to prevent deaths from flooding;
- Property damage and distress will be minimised.

The overall objective of research and development in the Incident Management and Community Engagement Theme is to improve the timeliness, accuracy and reliability of flood forecasts, the ability and availability of those at risk to respond to flood warnings, and the effectiveness of that response in saving lives, preventing harm and minimising property damage and disruption. The Environment Agency’s Flood Warning Service Strategy for England and Wales (September 1999) set out the key elements of the flood warning “process” - from monitoring and detection of precursor events, through forecasting and warning dissemination, to response by relevant organisations and agencies (“professional partners”) and the at-risk public. It also identified, in outline, linkages and responsibilities of the various professional partners in delivering an effective flood warning service.

A revised *Flood Warning Investment Strategy (2003/04 to 2012/13)* was developed by the Environment Agency and endorsed by Defra. This identifies, in broad terms, the key elements of development (and therefore investment) needed over the ten years period to enable the Environment Agency to meet its performance targets.

The Environment Agency’s *Strategy for Flood Risk Management (2003/4-2007/08)* recommends the adopting of a strategic approach to flood risk management where the Environment Agency proactively delivers flood risk reduction, targeting and prioritising investment and resources at those areas where flood risk can most effectively be reduced. Doing so will balance risk management options to reduce the probability of flooding or the adverse impacts, or both. The strategic approach will require greater collaboration with government, local planning authorities, landowners, local communities and other stakeholder groups. Catchment Flood Management Plans and Shoreline Management Plans will need to be developed to establish flood risk on a larger scale and examine the pressure on flooding, whether from development or climate change. The change in approach requires a change in culture and mindset from flood “defence” to flood “risk reduction”.

The recent Foresight report, *Future Flooding*, confirmed that because of climate change, flood and coastal erosion risk should command greater attention. We need to plan for more frequent occurrence of the extreme flood events we already experience, and for more extreme events in the future. Recent work from the joint Defra/Environment Agency Flood and Coastal Defence Programme (R&D Report W5B-01-050 “Impact of climate change on flood flows in river catchments”) indicates that Foresight may have under-estimated future flooding, because it used the relatively dry UKCIP02 climate scenarios. In addition, there is still considerable uncertainty over the level of climate change that may take place and how this will affect the United Kingdom. Recent information suggests that the sensitivity of the climate system to increasing concentrations of greenhouse gases in the atmosphere is greater than previously estimated. In light of these pressures, the Government’s Flood and Coastal Erosion Risk Management strategy needs to be adaptable and pragmatic, and actively support research into these areas. This programme will focus on the tools and techniques needed to adapt flood detection, forecasting, warning and response to the changes in weather patterns.

The programme has strong links to *Making Space for Water (MSfW)* Building stakeholder and community engagement (SD6), Encouraging and incentivising increased resilience to flooding (RF1&2), Resilience standards for new buildings (RF3&4), Increasing awareness and resilience to all forms of flooding including through improved flood warning (RF5-7) and Emergency planning, response and resilience (RF8).

The Environment Agency recently undertook a review of the social aspects of flood risk management, including the contribution of social science to FCERM science. A significant finding and recommendation from this review was that while there is already quite a range of social science projects being carried out within the DEFRA/ Environment Agency joint research programme, there is **no overall strategy** for why these projects have been commissioned. Linked to this, whilst there is a sense that social science is useful for FRM especially where technological solutions are seen to be failing, most staff (in both Defra and the Environment Agency) have little or no knowledge of social science research, methods and practice. As a

result, social science appears to mean many different things to different people. This led to a recommendation to develop a clear vision of the role of social science research within the Defra/ Environment Agency joint research programme. As the key user of social science information, this programme will play a major part in delivering this recommendation.

The Civil Contingencies Act 2004, together with accompanying guidance and regulations, sets out clear expectations and responsibilities for front line responders at the local level to ensure that they are prepared to deal effectively with the full range of emergencies from localized incidents through to catastrophic emergencies. This programme will support improvements to integration and co-ordination of action during emergency situations.

This programme has been developed to support the Environment Agency's ability to sustainably implement the improvements to service identified in the Flood Risk Management Strategy and to tie in with and be capable of supporting the investment strategy. The programme will develop to meet the changing needs identified by future strategies.

<p>External drivers</p>	<p>Contextual drivers:</p> <ul style="list-style-type: none"> • Emerging UK science agenda: <ul style="list-style-type: none"> ▪ EPSRC Flood Risk Management Research Consortium (FRMRC) ▪ NERC Flood Risk from Extreme Events (FREE) programme ▪ ESRC/BBSRC/NERC Rural Economy and Land Use (RELU) programme ▪ Office of Science and Technology Foresight Future Flooding programme ▪ SNIFFER flood risk management research ▪ Other Theme areas in joint EA/DEFRA FRM R&D Programme • Emerging EU Framework V and VI research programmes: <ul style="list-style-type: none"> ▪ FLOODsite ▪ Real-time flood decision support system integrating hydrological, meteorological and remote sensing (FLOODRELIEF) ▪ European exchange circle on flood forecasting, early warning (EXCIFF) ▪ Achieving Technological Innovation in Flood Forecasting (ACTIF) ▪ Wide Information Network for Risk Management (WIN) ▪ Co-ordination of Research in Europe (CRUE) ▪ European Flood & Drought Integrated Project (EFDIP) <p>Organisational influences:</p> <ul style="list-style-type: none"> • Defra High level targets for flood and coastal defence • Defra Flood and coastal defence funding review 2002 • EU Directives (Water Framework, Groundwater, Landfill) • Regional Spatial Strategies, Planning Policy Guidance review e.g., PPG25 • Civil Contingencies Act 2004
<p>Internal drivers</p>	<ul style="list-style-type: none"> • Making it Happen theme – Reducing Flood Risk • Making Space for Water • River Basin Management Plans • Catchment Flood Management Plans (CFMPs) • Shoreline Management Plans (SMPs) • Strategies for major estuaries e.g., Thames Estuary Strategy 2100 • Strategy for Flood Risk Management • Water Framework Directive • Lessons Learnt Reports – 2000 and 2004 floods • Exercise TRITON • Combined Floods Action Plan • Tidal Warning Action Plan

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

Sustainable Asset Management Theme – RO Statement

Programme vision

The drivers of flood and coastal erosion risk will increase as society develops, and particularly as climate changes, with wetter winters, sea level rise and increased storminess. Even with increasing investment in flood risk management, it will never be technically, economically or environmentally acceptable to prevent flooding entirely. Consequently the Government and the Environment Agency have changed their thinking from *defending* to *managing* floods.

The aim of the new cross-Government strategy, Making Space for Water, is 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.

The Sustainable Asset Management theme addresses an integrated portfolio of activity covering the planning, design, construction, operation, maintenance, renewal, upgrading, removal and /or replacement of flood and coastal erosion assets, and the systems that they comprise. Flooding covers fluvial, coastal, pluviial and groundwater sources, and coincident effects. Assets include conventional "defences" - such as embankments, barriers and pumping stations, natural features – such as river channels, saltmarshes and beaches – that contribute to the flooding and erosion process, and temporary flood barriers. Assets will generally be managed by Operating Authorities, but we will consider the needs of private owners.

We are moving from the construction and maintenance of individual structures, watercourses and beaches to whole life asset management with the assessment of risk and performance in Flood and Coastal Erosion Risk Management Systems. We shall aim to reduce whole life costs and improve performance whilst delivering overall sustainability.

Our vision is therefore that sustainable asset management will:

- ensure that flood and coastal erosion risk management infrastructure remains appropriate to the changing conditions in which it must contribute to the management of flood or coastal erosion risk
- over its service life minimise the loss of life due to flooding and provide best value
- enable assets to perform in an optimal manner – both under normal service conditions, and resiliently and predictably under extreme storm or flood events
- achieve the best outcome for people and both the natural and built environment.

We aim to reduce the uncertainty surrounding flood and coastal erosion performance, particularly through the introduction of risk based techniques and decision support frameworks to assist in the decision making process and optimise the funding of asset management.

The emphasis of working with natural processes underpins the new Government Strategy through making more space for water through the appropriate use of realignment to widen fluvial and tidal river corridors and to provide wider benefits for recreation and wildlife. We shall develop better understanding of new techniques and build on best practice to increase public confidence in our approach to flood risk management.

The introduction of the Water Framework Directive will require better integration of asset management and ecology to meet the drivers of better ecological status of our rivers and estuaries. Consequently, achieving the balance of reducing flood risk and achieving the best ecological standards will become a major priority. Developing effective links with other hydro-morphology programmes will improve better understanding of each others needs.

Making our outputs fit for purpose is a major goal. The programme has an important role to play in improving the skills and competences of existing engineers and forming the building blocks for the training of future engineers.

Overall objectives	Beneficiary Groups	Baseline & Evaluation Criteria
To help reduce the risk of flooding and coastal erosion through the application of sound science in developing sustainable asset management systems.	The people, communities and businesses in or adjacent to areas of flood risk; EA FRM Policy, Process and Operational teams; Local Authorities and Internal Drainage Boards; particularly vulnerable groups and individual private owners	<p><u>Baseline</u> The Agency fails to meet targets for reduction in flood risk. Asset systems for flood risk management do not perform to standard under all flood conditions.</p> <p><u>Evaluation Criteria</u> How has the application of science in sustainable asset management systems been developed so as to reduce the risk of flooding and coastal erosion.</p>

Specific objectives	Named beneficiaries	Evaluation Criteria
<p>Specific objectives of the Programme are to:</p> <ol style="list-style-type: none"> 1. Improve understanding of the concepts of sustainability as related to asset management. Investigate and develop approaches that are more adaptable to long term changes in site conditions- climate change (extreme events), morphological change, hydraulic loading etc. 2. Improve our understanding of asset condition (both components and systems) so that our assets in order that they can be appropriately designed, constructed and maintained. Develop knowledge surrounding sustainability issues such as deterioration, resilience and flexibility. 3. Improve our design and management techniques (including risk-based methods) in order to ensure that the condition and performance of assets is in line with their intended standard of service and loading conditions 4. Identification of means of reducing the whole life costs of assets in order to improve their value and cost-effectiveness for given standard of service. Improve the whole systems approach to sustainable asset management using decision support framework tools to help underpin decision making processes. 5. Improve our understanding of the construction process for assets in order to improve the quality and efficiency of delivery of the construction product and to minimise adverse environmental impact during construction and maintenance. 6. Contribute to the concepts of building sustainable communities and achieving wider benefits alongside flood risk 	<p>Flood Risk Management Asset Management, Operations Delivery and Capital Management Service Programme.</p>	<ol style="list-style-type: none"> 1. How has the understanding of sustainability been developed so as to achieve more effective techniques of asset management 2. How has the understanding of asset condition been improved in order to optimise approaches used in design, construction and maintenance. 3. How have design and management techniques been improved in order to achieve greater asset performance and condition. 4. How have improvements been made in reducing whole life sustainable asset costs so that higher levels of service can be obtained. 5. Have approaches used during the construction and maintenance process of sustainable assets been improved so as to advance quality and efficiency in delivery and reduce environmental impact. 6. How has the interaction between asset systems and the local environment improved so as to

management. Improve the interaction between asset systems and the local environment (e.g. operational staff / public H&S, landscape and amenity value)		increase benefits of providing a sustainable community.
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Named Beneficiaries	Comment
Brian Empson	Flood Risk Management Policy Manager
Jackie Banks	Process Manager – Asset Management Responsible for delivery of FRM System Asset Management Plans
Dave Allsop	Process Manager- Operations Delivery Responsible for inspecting assets, delivery of FRM maintenance programme
Miles Jordan	Head of National Capital Management Service Responsible for delivery of the FRM capital programme
Ross Marshall	Head of National Environmental Assessment Service Responsible for environmental assessment of FRM activities
Paul Raven	Head of Conservation and Ecology
Jonathan Chapman	Responsible for delivering Integrated Urban Drainage element of MSW
Area Asset Management teams	Responsible for preparation of system asset management plans
Area Operations Delivery teams	Responsible for visual inspections and delivery of the maintenance programme

Other stakeholders	Comment
Defra, WAG, ODPM	Principal Government policy leads
Local Authorities and Internal Drainage Boards	Operating authorities for ordinary watercourses
Maritime Local Authorities	Operating authority for coastal erosion
Natural England (English Nature)	Partner organisation in determining the best environmental solutions; responsible for management of national and international designated sites
English Heritage	Partner organisation in determining the best solutions for archaeology and ancient monuments
Non Government Body	Royal Society for the Protection of Birds and Wildlife Trusts
Regional planning and development bodies	Agency has a role in shaping key infra-structure and planning decisions that affect flooding
Other organisations	Other organisations with shared interests in flood risk asset management include: , National Trust, Associated British Ports, Countryside Landowners Association, National Farmers Union
Partner organisations for research	Scottish and NI Forum for Environmental Research (SNIFFER).
Research Councils NERC, EPSRC, ESRC	Agency has been a key stake-holder alongside Government, business, NGOs

National Flood Forum	<p>and research sectors in developing research programmes to address problems in flood risk management.</p> <p>NFF was set up with Agency R&D funding and provides a focus for community initiatives in flood response</p>
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Rationale

The Agency's *Strategy for Flood Risk Management (2003/4-2007/08)* recommends the adopting of a strategic approach to flood risk management where the Agency proactively delivers flood risk reduction, targeting and prioritising investment and resources at those areas where flood risk can most effectively be reduced. Doing so will balance risk management options to reduce the probability of flooding or the adverse impacts, or both. The strategic approach will require greater collaboration with government, local planning authorities, landowners, local communities and other stakeholder groups. Catchment Flood Management Plans and Shoreline Management Plans will need to be developed to establish flood risk on a larger scale and examine the pressure on flooding, whether from development or climate change. The change in approach requires support from this research programme in order to underpin the recent change in mindset from flood "defence" to flood "risk reduction".

The recent Foresight report, *Future Flooding*, confirmed that because of climate change, flood and coastal erosion risk should command greater attention. We need to plan for more frequent occurrence of the extreme flood events we already experience, and for more extreme events in the future. Recent work from the joint Defra/Environment Agency Flood and Coastal Defence Programme (R&D Report W5B-01-050 "Impact of climate change on flood flows in river catchments") indicates that Foresight may have under-estimated future flooding, because it used the relatively dry UKCIP02 climate scenarios. In addition, there is still considerable uncertainty over the level of climate change that may take place and how this will affect the United Kingdom. Recent information suggests that the sensitivity of the climate system to increasing concentrations of greenhouse gases in the atmosphere is greater than previously estimated. In light of these pressures, the Government's Flood Risk and Coastal Management strategy needs to be adaptable and pragmatic, and actively support research into these areas. This programme will focus on the tools and techniques needed to adapt flood risk asset management to the changes in weather patterns.

Sustainable Asset Management will cover a suite of measures to manage current and future flood risk. Asset performance must now be combined with condition standards using a systems based approach in order to determine the likelihood of flooding to people, property or infrastructure.

Flood Risk Management has adopted the Source-Pathway-Receptor model for our risk based approach. The pathway is the major component; receiving new and improved modelling tools and techniques from the Modelling and Risk programme, making them meet our needs and ensuring effective implementation to reduce the consequences of flooding to assist achievement of the aims of flood incident management.

Our current flood and coastal defence infrastructure has served the nation well in dealing with current risks, there is still room for improvement. Improvements need to take account of new approaches to design and management; developments in the construction process; techniques for monitoring of field performance and physical and mathematical modelling techniques.

The programme will be based on four sub-themes.

(Note – this list is to be developed and finalised with new TAG)

1. Asset Condition

- Improved inspection/assessment tools and techniques
- Optimisation of operational risk
- Practical application of risk and uncertainty
- Knowledge management

2. Asset and Materials Performance

- Whole life costs – national dataset
- Site studies of specific structures / materials / environments
- Flood defence failure/performance ratings and integrity in extreme floods
- Design life – testing and visual assessment
- Breach repairs
- Demonstration and pilot studies
- Defence vulnerability assessments and sensitivity to changing conditions
- System analysis for asset management

3. Planning and Design

- Sustainable design
- Environmental management
- Novel forms of coastal protection
- Temporary flood barriers
- Maximising design life
- Water Framework Directive and Habitats Directive implications

- Impact of extreme floods on environment/ecology
- Social behaviour to asset design implications?
- Adaptability in design
- Procurement of design and construction

4. Management and Construction

- Floodplain restoration and managed realignment
- Abandonment and removal of defences
- Sustainable techniques
- Risk based maintenance
- Good practice in maintenance and repair
- Good practice in construction

Synthesis of results of new scientific research and of developing practice in order to provide Good Practice guidance is an essential component of each of these themes and will continue to be provided alongside other resulting research products. It is also intended that where appropriate research will be linked with pilot and demonstration studies planned in conjunction with users in order to provide confidence and reality testing for the end users.

<p>External drivers</p>	<p>Contextual drivers:</p> <ul style="list-style-type: none"> • Emerging UK science agenda: <ul style="list-style-type: none"> ▪ EPSRC Flood Risk Management Research Consortium (FRMRC) ▪ NERC Flood Risk from Extreme Events (FREE) programme ▪ ESRC/BBSRC/NERC Rural Economy and Land Use (RELU) programme ▪ Office of Science and Technology Foresight Future Flooding programme ▪ SNIFFER flood risk management research ▪ Other Theme areas in joint EA / Defra FRM R&D Programme • Emerging EU Framework V and VI research programmes: <ul style="list-style-type: none"> ▪ FLOODsite ▪ Real-time flood decision support system integrating hydrological, meteorological and remote sensing (FLOODRELIEF) ▪ European exchange circle on flood forecasting, early warning (EXCIFF) ▪ Achieving Technological Innovation in Flood Forecasting (ACTIF) ▪ Wide Information Network for Risk Management (WIN) ▪ Co-ordination of Research in Europe (CRUE) ▪ European Flood & Drought Integrated Project (EFDIP) <p>Organisational influences:</p> <ul style="list-style-type: none"> • Defra High level targets for flood and coastal defence • Defra Flood and coastal defence funding review 2002 • EU Directives (Water Framework, Groundwater, Landfill) • Regional Spatial Strategies, Planning Policy Guidance review e.g., PPG25
<p>Internal drivers</p>	<ul style="list-style-type: none"> • Making it Happen theme – Reducing Flood Risk • Making Space for Water • River Basin Management Plans • Catchment Flood Management Plans (CFMPs) • Shoreline Management Plans (SMPs) • Strategies for major estuaries e.g., Thames Estuary Strategy 2100 • Strategy for Flood Risk Management • Incident and Flood Risk Management (IFRM) structure • Water Framework Directive • Lessons Learnt Reports – 2000 and 2004 floods • Structures and methods of other Operating Authorities • Strategy for Sustainable Asset Management (To be released April 06)

Defra / Environment Agency Flood & Coastal Erosion Risk Management
R&D Programme



Sustainable Asset Management (SAM) - Theme Work Plan, 2005-2010

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1 Introduction

This Work Plan sets out the activities that have been or will be carried out to develop and undertake science projects within the Sustainable Asset Management (SAM) Theme of the joint Defra / Environment Agency Flood and Coastal Erosion Risk Management (FCERM) R&D programme over the five-year period 2005-2010. Key supporting documents associated with this work plan are the SAM Rationale & Objectives (RO) Statement and the FCERM Programme Definition Document (www.defra.gov.uk/environ/fcd/research/default.htm).

The Theme Work Plan provides an overview of the science (research and related development) programme needed to respond to the drivers, vision and objectives in the RO Statement. It sets out priority work areas and a schedule for delivery. It is a working document for use by those involved in managing, advising, reviewing and evaluating the programme. Theme work plans will be reviewed annually.

It would be unrealistic to expect the Theme Work Plan to set out a complete, detailed programme of projects for the next five years. Such a list of projects would be aspirational and perhaps inflexible in responding to changing user needs and opportunities arising from advances in scientific knowledge and technological capability, as well as fluctuations in funding streams. The Work Plan provides a vision, particularly of the outcomes via the theme objectives, and a logical framework of sub-themes and project areas with typical examples and user benefits. It provides a basis for determining the annual programme of projects.

The proposals for new projects for each financial year, together with an analysis of achievement against objectives for the past year, will be presented and recorded in detail in an Annual Work Plan. This will contain the budget and list of new starts, with supporting Short Form As/project proposals. Theme Advisory Groups will be consulted in the drafting of these lists, as well as other Themes and the programme management team. Projects to be procured through the Environment Agency will be subjected to further Project Appraisal Board (PAB) approval.

2 Setting the context of SAM R&D

The context of the SAM Theme within the overall FCERM R&D Programme is set out in the Programme Definition Document. This establishes the policy and operational context of the R&D Programme in relation to the Government's 'Making Space for Water' Strategy for Flood Risk Management with its strategic and holistic approach. However, given the strong engineering and environmental aspects of asset management, the SAM Theme Programme necessarily supports the continuous improvement of best practice in (a) efficient and cost effective design, construction and management of flood management assets, and (b) their environmental performance. This applies to all Operating Authorities.

Critical success factors established in the Programme Definition Document that apply to the SAM Theme Programme are as follow:

- Timely provision of innovation in delivery of flood and coastal erosion risk management
- Evidence and innovation needs of flood and erosion risk management aligned with the pressures and opportunities created by the principal drivers for changes in flood and coastal erosion risk levels, namely climate change and socio-economic pressures
- Excellence in practical application of science and technology
- Successful partnerships with other policy areas and projects funded in collaboration with internal and external partners.

The Programme Definition Document states that the SAM Theme should cover all aspects of improved delivery of the FCERM asset management function where assets will include all physical measures that contribute to flood and coastal erosion risk management and are owned and operated by the Environment Agency or other operating authorities.

Thus the Theme Programme must encompass the overall process of planning and identification of flood or coastal erosion management interventions (i.e. physical measures to interact with flood or coastal erosion processes) as a appropriate means of risk management, together with the consequent design and construction of new works and the operation, maintenance, renewal, upgrading, removal and/or replacement of existing assets. Assets include **conventional “defences”** - such as embankments, revetment, walls, barriers and pumping stations; **natural features** – such as river channels, saltmarshes and beaches – that contribute to the flooding and erosion process; and **temporary flood barriers**.

While the SAM Theme Programme will naturally focus on the development of tools and techniques for good practice, the Programme Definition Document emphasises the need, where necessary, for Theme Programme to develop the evidence and information base to support innovation and improved methods.

The Environment Agency Asset Management Strategy was produced in Summer 2006 and now provides further context within the Environment Agency for the development of future SAM Theme Programme. The Theme Programme is already (2006/07) broadly aligned with the direction of the new strategy, since both have been informed by the systems, risk and performance-based approach to the assessment and design of assets and to their management and replacement. The Environment Agency has now designated approximately 3300 asset systems in England and Wales, all of which demand appropriate technical and environmental management in achieving the optimum balance of resource allocation, and management of risk and performance.

The SAM Theme inherited a programme of on-going projects in September 2005. This comprised of the former Engineering Theme Programme, the PAMS (performance based asset management system) project formerly under the Risk Evaluation & Understanding of Uncertainty (REUoU) Theme and several projects from the disbanded Fluvial, Estuaries & Coastal Processes (FECPC) Theme. Also, in establishing the new SAM Theme Programme, efforts have been made to consider the future research issues identified under the former themes, as well as the issues identified in the Independent Review (Defra, 2005).

Objectives and Outcomes

The rationale for the SAM Theme is set out in the Rationale and Objective (RO) statement through the Theme Vision and a suite of Key Objectives for completion over the five-year period.

The Theme Vision is that sustainable asset management will:

- ensure that flood and coastal erosion risk management infrastructure remains appropriate to the changing conditions in which it must contribute to the management of flood or coastal erosion risk;
- over its service life minimise the loss of life due to flooding and provide best value;
- enable assets to perform in an optimal manner – both under normal service conditions, and resiliently and predictably under extreme storm or flood events; and
- achieve the best outcome for people and both the natural and built environment.

The Theme Programme should reduce the uncertainty surrounding flood and coastal erosion performance, particularly through the introduction of risk based techniques and decision support frameworks to assist in the decision making process and optimise the funding of asset management.

The Overall Objective of the SAM Theme is:

to help reduce the risk of flooding and coastal erosion through the application of sound science in developing sustainable asset management systems.

The Key Objectives in the RO Statement (see table overleaf), which establish the broad focus of the SAM Theme, have been developed through discussion with the Programme Board and Managers, the Theme Advisory Group and representative users of the Theme outputs. Broad evaluation criteria are also given in the RO Statement in order to evaluate our progress against the objectives.

The Independent Review and the Programme Definition Document emphasise the need to focus on delivery of the science to end users in order to secure the expected benefits. Making our outputs fit for purpose is therefore a major goal of the theme. Key beneficiary groups within Operating Authorities and the wider F&CERM industry are identified in the RO Statement. The process of implementation of the output following the successful completion of the science project (which of course needs to be considered in principle at the outset of the project) is a matter for joint planning between the SAM theme management and the end user (or representative). Not every science project will deliver directly to the policy or operational end-user; some projects will feed into further science projects (such as PAMS – see Section 5), into updates of good practice guidance (such as the Beach Manual), or into client development initiatives (such as Environment Agency Work Instructions).

The Outcomes (see table overleaf) indicate what the end user will do or have that is different as a result of the Theme Programme. In general this will be an improved tool or technique. The product will be in a form appropriate for specific

implementation and use by the end user within a recognised sector of business change. Implementation is an active planned process, as distinct from the more passive dissemination of science results through publication in journals or scientific reports.

RO Key Objective	End-user Outcome
<p>1. Improve understanding of the concepts of sustainability as related to asset management. Develop approaches that are more adaptable to long term changes in site conditions, climate change, morphological change, hydraulic loading etc.</p>	<p>1.1 Sustainability concepts will be interpreted and techniques described from the viewpoint of FCERM asset management. These will cover basic engineering function, environmental and societal context, and life-cycle economics. Basic material utilised in education and professional training.</p> <p>1.2 Concepts and techniques will be bedded into (a) planning and decision-support guidance for asset management interventions, and (b) recommended tools, good practice guidance and work instructions for FCERM asset management (detailed design and operations).</p>
<p>2. Improve our understanding of asset condition (both components and systems) in order that our assets can be appropriately designed, constructed and maintained. Develop knowledge surrounding sustainability issues such as deterioration, resilience and flexibility.</p>	<p>2.1 Factors contributing to deterioration of component materials and overall asset condition, as well as how this affects the engineering, environmental and other functions, will be described from the viewpoint of the different tasks of asset management – asset monitoring; inspection; in-depth assessment; maintenance and upgrading; optimal design of new works. The descriptions will be bedded into relevant education and training material, work instructions, decision-support tools and good practice guidance.</p> <p>2.2 The sensitivity of engineering performance (incl. resilience and risk of failure) to asset condition will be explicit in guidance on asset management.</p>
<p>3. Improve our design and management techniques (including risk-based methods) in order to ensure that the condition and performance of assets is in line with their intended standard of service and loading conditions.</p>	<p>3.1 Risk-based methods (involving progressive shift from deterministic to probabilistic approaches) including fragility assessment of different asset types will be described and bedded into relevant training material and tools.</p> <p>3.2 Design and assessment tools and techniques for establishing or adapting the performance and standard of service of asset, including overall methods for asset systems, will be progressively developed, piloted and implemented.</p> <p>3.3 Effect of management intervention or “do nothing” will be quantifiable.</p>
<p>4. Identify means of reducing the whole life costs of assets in order to improve their value and cost-effectiveness for given standard of service. Improve the whole systems approach to sustainable asset management using decision support tools to help underpin decision making processes.</p>	<p>4.1 Rational procedures for monitoring and archiving life-cycle costs of asset ownership (to include operation, maintenance, renewal, upgrading, removal and/or replacement) will be developed and implemented.</p> <p>4.2 Cost models for different asset types and approaches to investment and / or asset management intervention will be available to support decision-making processes in asset management planning and detailed design.</p> <p>4.3 Historic and life-cycle costs will be better linked into (a) whole system tools in 3.2 & 3 above, and (b) good practice guidance for individual assets.</p>

<p>5. Improve our understanding of the construction process for assets in order to improve the quality and efficiency of delivery of the construction product and to minimise adverse environmental impact during construction and maintenance.</p>	<p>5.1 FCERM construction process will be screened against best practice in other comparable or relevant sectors of the construction industry for quality (engineering; environmental; costs; societal) of construction product. 5.2 Areas considered to benefit from improvements or new practice will be identified with involvement of FCERM stakeholders. Continuous improvement process initiated or modified accordingly (links to 1.2 above). 5.3 Guidance on the environmental (particularly WFD) and societal potential of selected FCERM assets will be improved (links to 6 below).</p>
<p>6. Contribute to the concepts of building sustainable communities and achieving wider benefits alongside flood risk management. Improve the interaction between asset systems and the local environment (e.g. operational staff / public H&S, landscape and amenity value)</p>	<p>6.1 Concepts of multi-functional performance and multiple benefits from the viewpoint of FCERM assets will be included in the planning and design process. Then utilised in education, training and good practice guidance. 6.2 Collaborative working on multiple benefits developed under science (including pilot) projects with other internal and external partners, including good practice on achieving “good ecological potential” for FCERM assets under WFD.</p>

3 Programme Planning

This section of the Work Plan sets out the main considerations leading to the structure of the Theme Programme, the main subject areas that are planned to be covered, and the selection of the projects in the Annual Work Plan.

4.1 Principal considerations

Independent Programme Review – 2005

The broad coverage of “all physical measures” envisaged for the SAM Theme by the Programme Review has been described in Section 3. The Programme Review expects the SAM Theme Programme to address both short and longer-term needs (sometimes referred to as tactical and strategic research). The short term focus should be on developing more efficient ways to deliver FCERM in today’s environment. At the same time, the SAM Theme must respond to the longer-term “new or increasing demands”. At the time of writing (January 2007) these drivers are already well recognised:

- Climate change and socio-economic development pressures
- Asset condition and management
- Urban flood risk
- Water Framework Directive (WFD) and the Habitats Directive
- Shortage of skills

The Programme Review identified the potential research issues listed in Appendix B. These arise from (a) the Foresight Future Flooding project, and (b) the User Workshop during the Programme Review

The Programme Review also requires the Theme Programme to focus on needs of practitioners and ensure the logical delivery of results in a useable form to those responsible for delivering FCERM. The Theme Programme is expected to include updating of existing tools and good practice guidance with new knowledge and know-how.

Inherited and on-going research

As explained in Section 2, the SAM Theme inherited a programme of on-going projects in September 2005 and builds its programme principally on the former Engineering and Processes Themes. The important PAMS (Performance-based Asset Management Systems) project was part-sponsored by the Engineering Theme.

The background, projects (past, on-going and potential) and outputs from the Engineering Theme are recorded in its Work Plan (updated in November 2004). The proposals or suggestions for research that had previously been identified in the Engineering Theme Work Plan have either been rolled forward into the planning of the SAM Annual Work Plans for 2005/06 and 2006/07, or are now reflected in the list of potential SAM research proposals.

The inherited on-going projects have been reviewed against the current Programme Definition Document, the Independent Programme Review, and the SAM RO Statement. In general these have been accepted into the SAM Theme Programme. Some projects have been varied to provide secure improved outputs from the viewpoint of delivery to current FCERM structures and business programmes.

These include (a) Conveyance and afflux estimation systems (CES / AES – for use in channel performance management); (b) Flood embankments – Good practice review (to link consistently with EA Asset Management); (c) PAMS (to include logical Measured Steps Forward and improved links to EA Asset Management); (d) Impact of maintenance of river sediments and habitats (to include channel classification and link to current good practice).

- Understanding of current gaps in knowledge

From the viewpoint SAM Programme planning, perhaps the key intellectual knowledge that has been inherited is the broad understanding of where the gaps in knowledge or in guidance and tools exist. This impacts on the type of research, development, demonstration or simply training that is, or isn't, needed. Several of the issues for potential support from an Asset Management programme listed in Appendix B do not need research or development per se, but rather the better synthesis and presentation of existing knowledge and good practice.

- Existing important collaborations

The future SAM Programme should build on the following collaborations. These bring in significant funding and research resources as well as important interfaces with practitioners.

- **Flood Risk Management Research Consortium (FRMRC)** Lead funder EPSRC, with support funding from Defra / EA, Scottish Executive, Rivers Agency (NI) and UKWIR. Two Priority Areas relevant to SAM Programme – (a) Infrastructure Management (embankments, coastal) and (b) Urban Flood Management (integrated modelling).
- **FLOODsite** Lead funder EC Research, with support from national organisations including Defra / EA. Three key Tasks relevant to SAM Programme – (a) Understanding and predicting failure modes, (b) Reliability analysis of flood defence structures and (c) Pilot projects (including TE2100 asset risk attribution model). FLOODsite is quoted in the new Floods Directive as a contributor to collective EU understanding of flood risk management practice.
- **Thames Estuary (TE) 2100** The EA project team has worked with the Defra / EA Joint Programme to make appropriate use of improved flood risk management methods. Key areas relevant to SAM Programme as (a) asset deterioration and condition assessment, and (b) modelling for system risk attribution and management intervention
- **EA Asset Management** Following the implementation of the EA's Asset Management Strategy, SAM Theme management has worked closely with the EA Asset Management team to link outputs into their Implementation Programme (see 4.2 below)
- **Pilot and Demonstration projects** These have provided successful opportunities to test and develop tools and techniques with practitioners at specific locations, particularly with coastal authorities.
- **Partnerships with science contractors** The Environment Agency has a framework agreement with HR Wallingford and has a mutually beneficial arrangement for working through CIRIA on projects involving the wider FCERM industry.

4.2 Structure of SAM Programme

Obviously the on-going SAM Programme has been influenced in its first two year by the inherited research. Irrespective of the projects within the programme, it is important to establish a structure to the programme that reflects the SAM RO Statement, and the main direction of the Objectives and Outcomes in Section 3.

Four sub-themes have been identified under the SAM Programme to reflect the principles, framework and hierarchy within which Sustainable Asset Management can logically be considered. Key areas of science which can be associated with each of the sub-themes are listed in the following table. Notably, particular science projects can span between sub-themes.

Sub-theme	Area of science
Risk and strategic planning (related to assets)	Sustainability concepts Types of risk, including business risk Whole life / life cycle concepts Strategic planning (links to SAM – e.g. MDSF2) Multi-functional schemes and multiple benefits
Environmental state and asset condition	Asset inspection and condition assessment Asset deterioration Morphological and ecological quality (incl Habitats /

	WFD) Environmental assessment Geotechnical characteristics and material properties
Asset systems (planning and design of intervention)	Asset performance and failure modes Structure loading and analysis (risk-based methods) System analysis (including decision support on intervention) Asset life and cost models Risk attribution
Asset improvement and operational delivery	Demonstration and pilot studies Construction process Good practice in maintenance and repair Asset disposal Operational Health & Safety

The sub themes relationship with the objectives set out in the R&O Statement can be seen below.

Objective*	Risk	Environmental State and Asset	Asset	Delivery Techniques
1. Asset management Sustainability concepts.	■	■	■	■
2. Asset condition	■	■	■	■
3. Design and management techniques (including risk-based methods)	■	■	■	■
4. Whole life costs of a systems approach to sustainable asset management.	■	■	■	■
5. Construction Process and Maintenance	■	■	■	■
6. Asset systems and the local environment	■	■	■	■

* Refer to R&O Statement for full objective descriptions

The time scales of projects will be influenced by delivery targets for the initiatives and strategies that the SAM Programme supports. The projects may also be influenced by other themes within the FCERM Programme, where a project over arches a number of programme areas.

5 Summary of activities

Whilst expanding on the summary of activities there is a need to remind ourselves that the Defra / EA Joint Programme has to address the interests of all Operating Authorities.

Continuing demand arises for the need of strong engineering and environmental aspects of asset management, providing best practice and appropriate tools for efficient and cost effective design, construction and management of flood management assets, and their environmental performance. The environmental drivers should be reflected in catchment-based, multi-functional and appropriately “soft” considerations within FCERM. An urban demand arises from both the increased EA interest (new Strategic Role) and Local Authorities, which see this as

an increasing concern to the public but an area in which generally their resources (and COWs role) have been cut back. Whilst a lot of research has been carried out on fluvial management the development of Shoreline Management Plans and future changes in coastal accountabilities have highlighted the need for increased research in the coastal area. There is no doubting that climate change has increased the hazard of pluvial flooding in relation to fluvial, and that further good practice is required in this area of considerable uncertainty. This in turn has a knock on effect for socio-economic scenarios.

The division of Programme areas has been influenced by the conclusions of the Review Team (Appendix 3), as well as a number of strategies and scientific thinking. A detailed summary of proposed, ongoing and completed projects can be found within the SAM Annual Work Plan. This annual plan importantly documents what the expected benefits of the research will be, as well as what benefits have been realised by completed research.

5.1 Urban Flood Management

This is an area of increasing concern driven by climate change and the policy need for a more strategic and integrated approach to flood risk management. Integration involves both different operating agencies and sources of flooding. Key needs are for integrated planning tools, particularly to clarify risk attribution between sewer and surface water systems and to assist in improving / optimising physical infrastructure. The research and evidence base to support this change now needs a substantial effort.

In relation to fluvial flood risk, urban flood risk is seen to be increasing both in incidence of flood generating events and in their consequence. Urban flood “infrastructure” (i.e. the complex “flooding system” of sewers, drains, storage, soakaways etc) is the responsibility of several different authorities.

The need to address complex urban flooding issues was highlighted in the ICE’s Learning to Live with Rivers (2002) and Foresight Future Flooding (2004). The Government is taking action under Making Space for Water via the Integrated Urban Drainage (IUD) Pilots initiative. This action will initially focus on a review of good practice and issues, and then proceed to pilot a range of different approaches to effective integrated urban drainage management. The IUD scoping study (done by MWH) will also help to establish the baseline for future research.

As a step towards clarifying the R&D issues, the former Engineering and Risk Themes actively supported an Urban Flood Risk Assessment Working Group. This comprised the main researchers and practitioners who are involved in current urban research initiatives and helped to draw together a consensus position on current science and new tools for the IUD initiative.

Ongoing urban flood management / drainage projects include a Dti led project on “SAM - System-based analysis and management of urban flood risks” (HR-W); Urban drainage interface with Operating Authorities (AUDACIOUS urban drainage management tool box; CIRIA 'Designing for exceedance in urban drainage - good practice'); Flood Risk Management Research Consortium, Priority Area 6 – Urban Flood Management.

5.2 Asset condition and management

This topic area is driven by Government policy and the implementation of the Environment Agency strategy and operational changes (IFRM). The continuing move towards asset management, away from a compartmentalized “construct – operate – maintain” approach, was strongly reflected in the questionnaire responses received by the review team. Practitioners want more guidance on the assessment of performance and deterioration of FCERM assets, the management of risks/ cost/ performance, decision support tools particularly to examine risk attribution across asset systems and the effects of management interventions (including “do nothing”) on that. The EA Sustainable Asset Management Strategy and the scale of the existing asset base (£15 billion plus) highlights the value of such research.

The PAMS (Performance-based Asset Management System) framework below was developed under the previous Defra / EA R&D Joint Programme. The related principles of (a) asset condition assessment and (b) the prioritisation of management intervention (whether ‘maintenance’, ‘refurbishment’ or ‘replacement’ works) of asset systems is now embedded in the EA’s IFRM (Incident and Flood Risk Management) structure. Catchments and coastal cells have been subdivided into c.3000 “Asset Management Systems” for operational management.

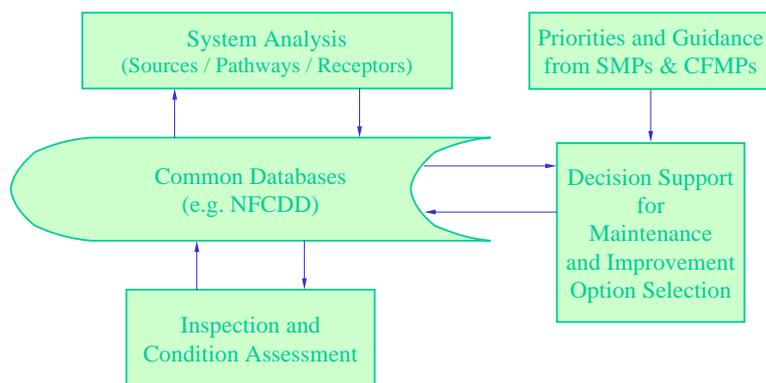


Figure: The PAMS framework for decision support in asset management intervention

Phase 2 of PAMS (currently underway) identifies the desirable elements to a future asset management system. Since taking overall charge of this project in September 2006 (from the Modeling & Risk Theme (MAR)), the SAM Theme Management have worked with EA Process teams in Asset System Management and Operations Delivery and the contractor to restructure the research project to deliver so-called ‘Measured steps forward’ to operational staff in 2006. These ease implementation by ensuring that the user takes on new procedures in a measured step-by-step manner, focusing on the most appropriate issues first and recognising the major cultural and ownership issues involved in moving to a new approach. (This contrasts from seeking to implement a major step change later.)

SAM has also opened up a dialogue with the Association of Drainage Authorities via its Technical Group specifically on drain and watercourse management (involving IDBs and lead LA Operating Authorities).

Ongoing asset management projects include: Performance-based Asset Management Systems – Phase 2; Embankment vegetation management trials; Aquatic Plant Management Group (formerly CAPM) programme at CEH; Flood Risk Management Research Consortium, Priority Area 4 - Infrastructure Management ; FLOODsite (EU project); Integration of geotechnical process into flood embankment management; Implementation – CES Standalone for channel management; Embankments – Good practice.

5.3 Environmental Asset Management

The Water Framework Directive (WFD) and the Habitats Directive act as constraints on the implementation of a range of potential solutions, as well as drivers for taking a catchment-based approach to planning and operational management. The WFD requires the integration of flood risk management into catchment management generally, with a focus on water protection, improvement and use. FCERM managers will need tools and techniques that enable them to use, or demonstrate that they are using, best practice for achieving good ecological potential for water bodies that are heavily modified by FCERM works. Ongoing projects in this area include the Environmental River Engineering Design Manual, The Fluvial Design Manual, The Aquatic Plant Management Group (APMG).

5.4 Coastal Processes

The SAM Programme to date has had a relatively good coverage of fluvial processes, however Coastal aspects still require particular consideration. This is highlighted through the development of Shoreline Management Plans. There is a concern that there is still inadequate linkage between coastal erosion and flood risk management (often largely technically, environmentally and economically driven) and the planning process when it comes to coastal processes. This is fundamental to sustainable management of the coast, particularly with regard to development control, but also in terms of the broad consideration of planning issues in managing the coast. Climate change impacts such as sea level rise and increased tidal surges have become of particular concern. Projects that are ongoing in this area include: Wave Overtopping, Beach Management Manual - an amalgamation of best practice, including the Lowering of Beaches, Beach permeability, Coastal protection methods (Dunwich), realignment of shoreline (Tollesbury, Freiston), Shingle Management – Coastal Demonstrations.

5.5 Climate Change & Socio-economic Scenarios

The *Foresight Future Flooding report* (OST, 2004) highlighted a number of key areas where we must consider adaptation to Climate Change uncertainties. These effectively drive the future scenarios covered in the Catchment and Shoreline Management Planning process, which in turn establish the future policies and strategies to which FCERM asset management must respond. The report highlighted that changes in tidal surges, waves, coastal sediment supply and morphology, and relative sea level rise are capable of increasing risk (average annual damages). River flow processes, such as vegetation and flood conveyance could also increase risks up to 6 times present levels under the community-oriented scenarios owing to the

effects. Restrictions on channel maintenance and the wish to re-naturalise rivers should be considered within this context. Changes in land use, such as urbanisation could see an increase in risk by up to 4 times than present levels. The uncertainty drives us to consider flexibility in our design, adapting sustainability to ensure appropriate resilience. We should define consequences using a probabilistic scenario, rather than a definitive, as we build on our understanding. Ongoing projects in this area include: Coastal Wave Overtopping, Conveyance Estimation System, Beach Management Manual and the Performance Based Asset Management System.

Good Practice Guidance

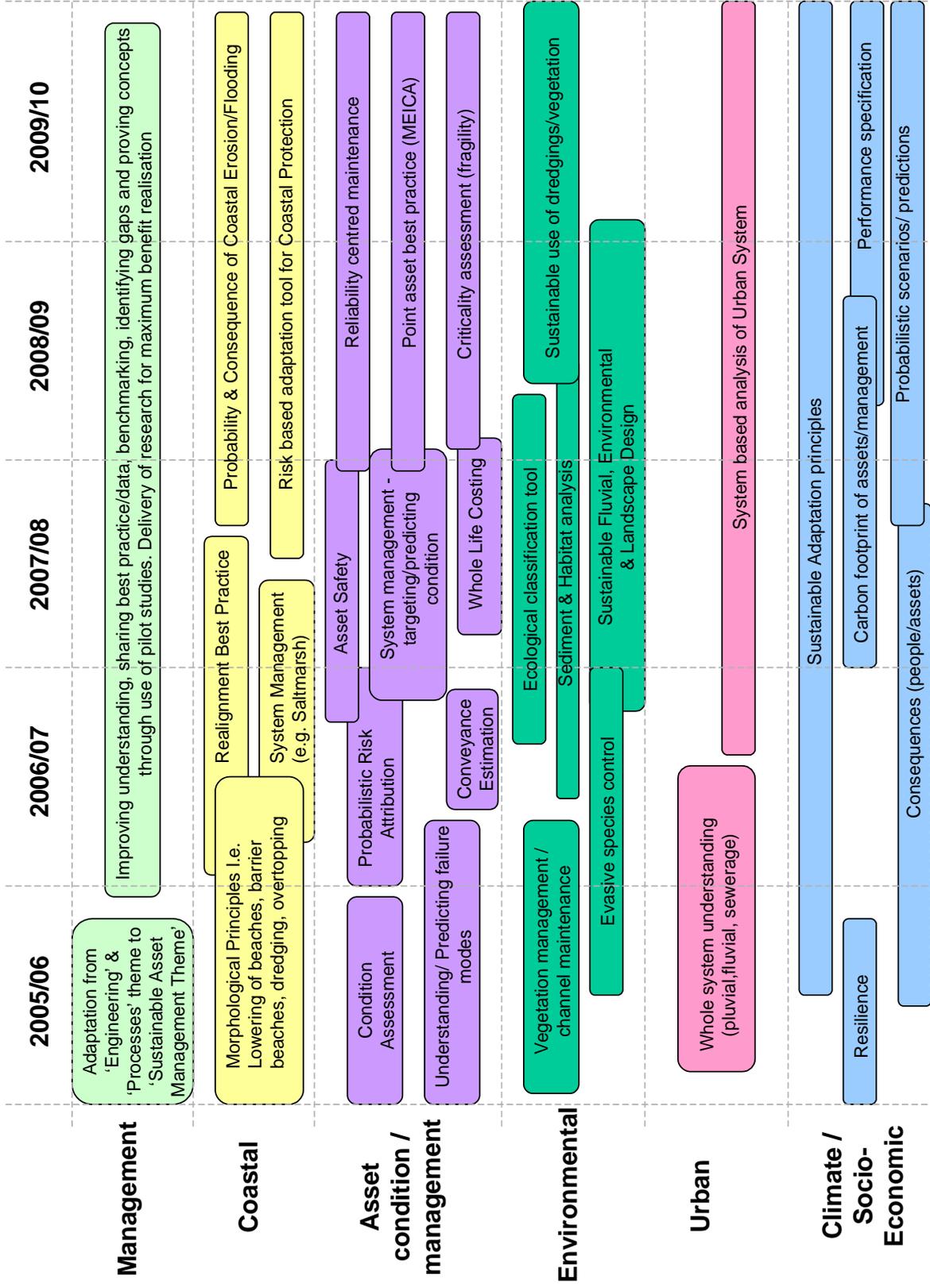
In response to the needs of practitioners, the maintenance of strong user focus was a recurring theme in both the questionnaire responses and the workshops held by this programme in 2005. There were consistent calls for practical guidance that would pull together existing good practice and new knowledge / know-how and make it available in a useable form to those responsible for delivering FCERM.

A range of 'good research practice' has emerged over the past four years relating to the best way to demonstrate the research product (called 'proof of concept' by EA Science) and then move on to implementation in practice. Also, some difficulties in implementation were highlighted in the Programme Review.

We hope that the use of pilot and demonstration projects will feature strongly in the SAM Theme Programme. We believe that complex issues like the development and implementation of performance-based asset management can only be effectively addressed via pilot work involving real sites and real users. We are pleased to see similar support for the pilot approach from the Government in the Making Space for Water consultation response on Integrated Urban Drainage Management (Project HA2 – see Section 4 below).

Information Systems

A separate delivery issue that must be addressed carefully in the future programme is the EA's overall IS/IT framework into which the large potential number of new software and computer-based tools are not only developed, but subsequently used, supported and eventually upgraded or replaced. Unless a clearer generic approach is provided, individual projects will (a) be slow to approve and to implement, (b) be less consistent and potentially non-compliant, and (c) be potentially less effective and beneficial to users. We understand that such a framework will be highlighted in the EA's FRM Modeling Strategy which is now at the consultation stage.

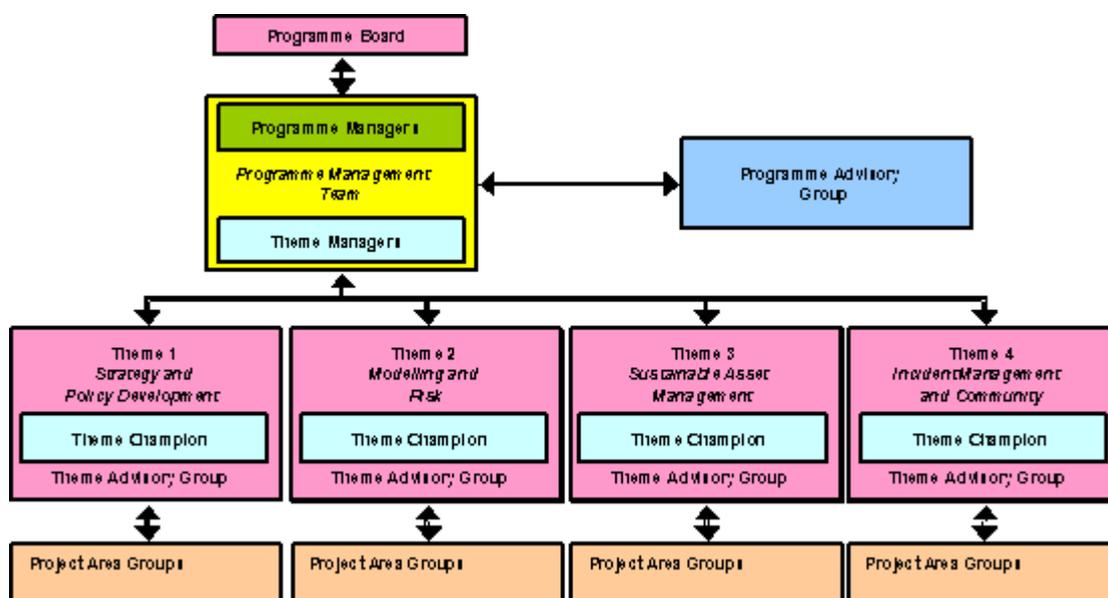


6 Resource management

6.1 Human resource

The SAM Theme Champion is Brian Empson (Environment Agency) and the Theme Manager is Chrissy Mitchell (Environment Agency), assisted by a Theme Advisor, Mervyn Bramley (Independent).

The SAM Theme is one of four themes under the FCERM R&D Programme, working in close association with the Modelling & Risk theme (MAR), Strategy and Policy Development (SPD) and Incident Management and Community Engagement (IMCE). It reports directly to the Joint Programme Management Team (JPMT), who are steered by the Programme Board and advised by the Programme Advisory Group. Further details on the roles of each of these groups can be found in the Programme Definition Document.



Structure of the Joint Defra/EA FCERM Programme

The membership of the SAM TAG includes representatives of the major stakeholders, Defra and Environment Agency, and leading experts covering the theme topics. They are shown in Appendix A alongside their affiliations and associated topic areas.

The programme planning cycle can be found within the Programme Definition Document, but essentially comprises of

Time	Planning cycle	Expectations
Pre June	Proposals for future R&D collated	<ol style="list-style-type: none"> 1. Review of completed projects from previous FY 2. Review of progress on fulfilment of research area plans and scoping study recommendations generally, and against theme objectives. 3. Review of need for update of research plans 4. Identify gaps in the programme and new ideas for next FY 5. Production of Short Forms outlining proposed projects. 6. Prioritise projects and submit to Programme Management
June	Themes present proposed annual plan, usually following a TAG meeting	
July	Programme Management Team discuss proposals and clarify issues	
August	Programme Advisory Group challenge programme proposed. Programme Management Team finalise plan	
End Sep	Defra and Environment Agency seek authorisation for expenditure	<ol style="list-style-type: none"> 1. Review of current programme 2. Identify procurement / planning issues for individual projects and programmes 3. Debate and discuss practical methodologies to carry out R&D proposed 4. Preliminary consideration of the shape of theme programme for the following FY
Oct-Jan	Procurement & Planning	
April	Plan implemented	

An essential component to the efficient running of the SAM programme, is appropriate resource at a project management level. It should be recognised that the level of Project Manger (PM) competency required varies from project to project. At a higher level, both a technically competent external project manager and internal (Defra/Environment Agency) PM may be required. At the lower end of the scale there is an expectation of a competent internal PM, or an competent external PM with a support internal PM to manage the internal systems (e.g. Science Management Information System (MIS), Joint Defra/EA FCERM R&D Web site etc.)

Appropriate resource is becoming a challenge due to a growing shortage of skills. This is influencing the ability of operating authorities (and their consultants) to deliver FCERM, which in turn highlights the need for the science programme to link into the provision of training, tools and guidance. (Identified by Reports within the EA and ICE examining engineering skills for FRM, 2005/6). This programme should continue to support the breach of this gap in experience. For example, through provision of updates to training courses/University material.

The SAM Theme has the ability to appoint Project Area Groups. These are flexible groups that can be formed, refocused and, where appropriate, disbanded as the emphasis of the programme changes. They essentially form a sub advisory group to

the Theme on a detailed area of research, informing SAM Theme where appropriate (e.g. coastal, urban).

An Annual Work plan will be developed and produced in the period April-September each year. It will be finalised upon approval of projects for the following FY by the programme management, Programme Board and, in the case of Agency-funded projects, by the PAB. The annual Work Plan will also hold information on completed projects, detailing the benefits that have been realised by the research, financial information (refer to next section) and proposals for future research.

This document (the 5-year Theme Work Plan) will be reviewed each year but is unlikely to be amended except in respect of any changing matters at a higher level.

6.2 Financial Resource

The proportion of budget for the SAM Programme is set on an annual basis by the Joint Programme Chairs. Details of budget forecasts and actual spend can be found in the Annual work plan.

The review of the joint programme carried out by an independent panel and focusing on the period between 2001-05 identified the percentage budget set for the Engineering Theme at 16% of the total Defra/EA Joint Programme. In 2006/07 this increased to 24% of the budget. This remains inconsistent with expenditure by Operating Authorities on FRM infrastructure. For example Operating Authorities expenditure on fluvial and coastal flood management in England and Wales accounted for over 60% of the budget in 2004. Further to this there are particularly strong reasons within the SAM Theme Programme to increase the amount of developmental science on fundamental issues for the effective risk management of infrastructure – e.g. embankment fragility, and material deterioration.

The SAM Theme continues to bid for a higher percentage cut of the budget for SAM R&D, in the hope that expenditure may reflect operating demand.

Appendix A TAG membership and representation

Name	Affiliation	Topic area
Brian Empson	Environment Agency	Theme Champion
Chrissy Mitchell	Environment Agency	Theme Manager
Mervyn Bramley	Independent	Theme Advisor
John Horne	Defra	Governance of Delivery Programme
Jackie Banks	Environment Agency	Asset System Management & Enforcement
Tim Kersley	Environment Agency	Head of Asset Management
Fola Ogunyoye	Royal Haskoning	Coastals & Rivers Division
Paul Sayers	HR Wallingford	Group Manager
Dick Thomas	HR Wallingford	Coastal Consultant
Steve McFarland	Canterbury City Council	Coastal Authorities
John Gosden	Jacobs Babties	Senior Consultant
Jo Murphy	Environment Agency	National Environmental Assessment Staff (NEAS)
Stuart Hemmings	Black Sluice IDB	Representing ADA Technical Committee

Corresponding Member

Brian Francis	Environment Agency	National Capital Programme Management Services (NCPMS)
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Appendix B Extracts from Report on Independent Review of Joint Programme - May 2005

Table IR1 – Requirements for future research in asset management specifically raised in Foresight Future Flooding

Topic area	Summary of research requirements
River vegetation and conveyance	Vegetation processes in rivers, and improvement of the way that hydraulic models represent resistance and estimate conveyance
Contribution of river and coastal maintenance activities to reducing risk	Asset management tools to monitor expenditure on maintenance activities, the condition of defences, their performance under extreme loadings and the resulting impact on flood risk
Enhanced database of flood-defence assets	Improve the accuracy and coverage of existing databases of flood and coastal defence infrastructure
Performance of defences during flood events	Monitoring and post-project appraisal studies on the type and severity of damage occurring to flood and coastal defences subjected to extreme events and increased environmental loadings
Vulnerability of coastal defences	Response of beach and shoreline profiles in front of existing defences will respond to climate change Establish how serious and widespread failures of coastal defence infrastructure are likely to be under each scenario in the 2050s and 2080s due to foreshore steepening and scour in front of coastal defences
Energy reduction and renewable energy extraction	Potential for energy to be extracted in multi-purpose schemes designed to manage coastal erosion and generate renewable energy.
Managed realignment of coastal defences	Methodological basis for assessment of the true costs and benefits of infrastructure relocation and managed realignment as a policy response to intensified coastal erosion
Sustainable beach recharge and recycling	Further research into sediment sourcing and recycling

Table IR2 – Issues for potential support by future Asset Management Programme identified at User Workshop during the Independent Review – January 2005

Topic	Summary of issue potentially for Asset Management Programme
1. Best practice and guidance	<ul style="list-style-type: none"> - Best practice in construction - Best practice for communicating I.T. between project parties - Design guide for operational and public safety - Design guide for resilience of structures during exceedance events - Practical advice on flood defence design for sustainability - Health and safety guidance - Compendium of design guidance - Climate change and standard design - Impacts on structures/materials - Ensuring adaptability

	<ul style="list-style-type: none"> - Scheduling investment / upgrades - Guidance on the provision of ecological habitats in channel systems - Generation of trash and modelling its movement /impacts - Guidance on sea-level rise / surge and wave loadings - British standards for design of M&E - Identification of best practice/continued
Topic	Summary of issue potentially for Asset Management Programme
2. Development of design techniques	<ul style="list-style-type: none"> - Sustainable design principles in river/coastal systems - Maximising the whole life of coastal structures / river defences - Design in flexibility/adaptability/reversibility - Maintainability of assets - Buildability of FCERM structures - Innovative methods - Breach repairs
3. Asset inspection, assessment and management tools and techniques	<ul style="list-style-type: none"> - Asset inspection techniques, assessment and management - Asset performance and integrity - Non destructive testing - Visual inspection of structural integrity - Culvert conveyance, condition - MEICA asset management plans and testing - <u>Appropriate</u> condition monitoring (risk-based approach) - Asset performance and management (including failure recovery) - Residual life assessment of assets and risk-based maintenance - Rapid non-destructive structural condition tools
4. Procurement and cost management issues	<ul style="list-style-type: none"> - Procurement process best practice - Appraisal of the merits of different approaches to procurement and risk in design and construction - Behavioural aspects of client – consultant – contractor (partnering) - Capital vs. revenue inconsistency - HEs (House Equivalents): estimating property damage from flooding - Allocation and prioritisation of Flood Defence GiA - Seeking other sources of funding + developing partnerships (guidance for staff) - How can FRM learn from other industries and sectors e.g. charities - Cost estimation of flood risk management. Operational and capital - national set of unit rates
5. Urban design and rehabilitation	<ul style="list-style-type: none"> - Urban flood / drainage management (design and social implications etc) – accommodation of storage and flow – cross-cutting theme. - Culvert rehabilitation - Rehabilitation of old structures - Flow through defences – process and design and rehabilitation guidance
6. Miscellaneous	<ul style="list-style-type: none"> - Demonstration and pilot studies in implementation - Software – how does the programme or client promote and support development / implement maintenance - Innovative engineering technology - FRM implementation efficiency – reduce time - “Future proofing” for climate in face of (extreme) uncertainty - Knowledge management - Capturing practical experience of design and construction - Typical details / specifications (science scoping done; delivery is non-science issue)

Appendix C : Extract from Chapter 3 of Independent Review – Responding to the drivers of FCERM

3.4 Recommendations – the future directions

The proposed new thematic structure for the R&D Programme is designed to allow change in relation to new directions for FCERM and new user priorities, and indeed we feel strongly that if there is no change then opportunities are being wasted and the structure is not being used to its full potential.

An indication of the emphases for the new R&D Programme is contained in **Table 3.2** (Table 1 in this TAG paper), which builds on the existing R&D agenda already in play. In drawing up this table we have not sought to identify particular projects, as that is not in the spirit of the thematic approach that has successfully developed over the last five years. Furthermore, no attempt has been made at prioritising the topics listed in **Table 3.2**. The more detailed information contained in the Appendices can be used by the Programme Board and its support staff to suggest priorities and thereby to steer the overall Programme in new directions in the initial stages of the new structure.

However, the following 10-point action plan list summarises what we believe to be the key areas for future emphasis in the R&D Programme, based on the wide range of sources consulted as part of our review. The list draws also on statements from Making Space for Water, and other key documents, where these are clearly reflecting or reinforcing the messages that we have received from all other sources. It should be noted that the list is not presented in order of priority:

One of the strongest messages to come out of the two workshops that we held was the need to get developing and established science into **good practice tools and guidance for practitioners**. The need for such tools and guidance is also reinforced by the knowledge that we are currently facing a growing skills shortage in FCERM. The availability of sound and approved guidance, and practical tools, in readily useable formats will help to overcome some of the problems created by the shortage of appropriately skilled personnel. **This work has been part of the current Programme, but there is a clearly-voiced demand for more such outputs.**

Another major theme in Making Space for Water is that of **risk management**, encompassing a range of subject areas from the appraisal of potential schemes to the delivery of effective solutions for groundwater and sewer flooding. This theme is, of course, also strongly represented in the Foresight Future Flooding report, in terms of assessing the range of risks and developing strategies to deal with them. **Much of this is new work**, and provides strong support for the continuation of the work of the Risk and Uncertainty Theme in the R&D Programme and its inclusion of greater attention to social issues.

The as yet unanswered question of the impact of **rural land use management** on flood risk also comes within the ambit of risk management. Until the current Programme of research is completed, there will continue to be heated debate about the connection between farming practices and floods and what steps should and

could be taken to reduce flood risk. Some initial work has been done, but **the fundamental questions remain unanswered**

The important role of **flood warning systems** in managing risk is also emphasised in Making Space for Water, and it must be recognised that warning systems cannot operate without effective **flood forecasting**. **There remains much to be done in the R&D Programme** to improve our ability to generate accurate forecasts and deliver timely warnings.

The need to **integrate drainage planning and management in urban areas** has been identified in the existing R&D Programme and a number of initiatives have been pursued (e.g. AUDACIOUS). This same message is reinforced in both Making Space for Water and Future Flooding. This is clearly a rapidly evolving area which should be emphasised in the R&D Programme for the next five years, with appropriate levels of coordination with ongoing and proposed pilots and related initiatives (e.g. FRMRC), and cooperation with other research bodies with overlapping interests (e.g. UKWIR). **This is critical and urgent work.**

Making Space for Water also quite rightly raises the issue of **public awareness**, which is linked to the better understanding of risk, as well as to more informed decision-making. There is strong support for **greater community engagement** from many quarters, not least of all the ICE's Learning to Live with Rivers (2001) and the Agency's Strategy for Flood Risk Management (2003). **This area of research is virtually untouched**, and is clearly an area where the Defra/Agency R&D Programme would benefit from better coordination with ESRC (with the assistance of ODPM).

The impact of the **Water Framework Directive** (WFD) has yet to be felt in the delivery of FCERM, but there can be no doubt that this far-reaching piece of legislation presents both constraints and opportunities at all levels from policy to operations. There is a clear need for R&D over the next five years to explore the consequences and develop solutions, taking account of other more established legislation such as the Habitats Directive. Furthermore, there are particular questions to be answered in respect of coastal flooding and erosion management, not least of all in terms of the implementation of a policy of managed realignment and its social dimensions. **This area of research is in its infancy.**

Of course, one of the most fundamental drivers of change in the delivery of FCERM is **climate change** and all the implications thereof, as explored in the Foresight report. There can be no doubting that there is further work to do in the science of climate change. In the previous review, the focus on research related to climate change was low key, awaiting outputs from the international research at the necessary level of resolution. This level of information is now becoming available and there is a need to examine impacts but the focus of the Defra/Agency R&D Programme should be **the development of appropriate responses and adaptations** to the predicted changes. **This is an R&D field that demands innovation, and recent scientific evidence suggests that it should be given a high priority.**

In parallel with climate change are the ongoing **social and demographic changes**, which have to be reflected in the delivery of FCERM, but these changes to date have been the subject of very little systematic analysis. If solutions are to be developed that build on the three pillars of sustainability (social, economic and environmental), then evidence on such changes needs to be integral to policy-making and strategic planning, as identified in the Foresight report. The research required needs to link closely with similar work ongoing elsewhere within Defra and with the Agency unit for Social Policy. **This is a new area of research for the Programme.**

Although the focus in the delivery of protection to people and property has changed over the past decade, from the provision of flood defences to the wider concept of flood risk management, it is recognised that much of the management of risks comes from the continued functioning of **flood defence assets**. Therefore the calls for better approaches to asset management are well founded, and **there is much more that the R&D Programme can deliver in this regard.**

In summary, the Defra / EA R&D Joint Programme must make a substantial contribution to reducing flood risk for the people of England and Wales. The outcomes from the investment should be:

Better evidence-based policies;
Better allocation of resources;
Improved risk assessment and risk management, and
More timely solutions based on sound engineering, environmental and social sciences.

The Programme may also encourage academic excellence, accelerate research productivity, and add to the sum of human knowledge.

We do not have to draft another “vision” in order to provide direction for the R&D Programme. The Foresight and Making Space for Water initiatives have clearly defined the strategic framework, essential policy elements, and higher level targets for the next five years and beyond. However, in order to ensure that the next phase of the R&D Programme is set on the right course, we suggest that the Programme Board prepares a “route map” for consultation. This would involve considering the above ten point plan, and setting out achievable objectives that are required to support delivery of more effective and appropriate FCERM in the future.

Finally, the FCERM R&D Programme must include a much enhanced means of measuring its own performance (successes and failures), so that the benefits of this R&D effort can be evaluated much more systematically and the case for continued investment more clearly demonstrated in the future.

Independent Review team:

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