

## **ESTABLISHING A PERFORMANCE-BASED ASSET MANAGEMENT SYSTEM FOR FLOOD DEFENCES (PAMS)**

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### **INTRODUCTION**

An important element of *flood risk management* is managing flood defence assets such as channels, walls, embankments, gates and pump systems. This activity requires information, tools and techniques to assist decision-makers to ensure that assets perform as required under a range of conditions. Current approaches are relatively crude and not fully consistent with a risk-based approach. Improved decision-making will require important technical issues to be addressed, related to assessing risk and managing performance in a manner linked to the assessed risk.

A programme of research leading to a Performance-based Asset Management System (PAMS) will take measured steps to develop a risk-based approach for identifying and prioritising works to manage existing defences. This will support improved inspection, operation, maintenance and renewal of flood defence systems, helping the Agency and other operating authorities to reduce flood risk.

PAMS sits within and supports the Agency's Water Management Asset Strategy. Key issues emerging for water management asset management include:

- Need for risk-based system asset management plans
- Measurement of asset performance - move from asset condition to asset performance
- Whole-life management of assets and asset systems
- Prioritisation across capital and maintenance / operational expenditure
- Design assets to meet multiple criteria
- Respond to climate change

PAMS forms part of the overall data, modelling and decision framework being developed for flood risk management in England and Wales. The risk-based approach will follow the framework set out in the Review of Risk, Uncertainty and Performance (Defra / Environment Agency, 2002), available on the Agency web site. It will use risk information including that derived from country-wide assessments based on the RASP High Level Methodologies (Risk Assessment for Strategic Planning – see <http://www.rasp-project.net/>) and utilise more the detailed risk assessment methodologies being developed through RASP. PAMS will also draw on many other R&D projects for knowledge on behaviour, performance and reliability of a wide range of asset types.

This short paper outlines progress towards the development of PAMS, the next steps, and the longer term plan.

### **THE PAMS PROJECT**

PAMS aims to support flood and coastal defence managers in assessing the performance of, and management requirements for, existing flood defence assets. These may involve maintenance, adaptation, replacement or removal as part of a risk-based management strategy.

The development of PAMS is organised into three phases:

- **Phase 1** is a scoping study and aims to review possible approaches and highlight a number of options. This has recently been completed and is the subject of this paper.
- **Phase 2** will take forward the most promising options and develop a detailed methodological approach, tested through pilot study. It will also outline a plan for implementation including training, documentation, software interfaces etc.
- **Phase 3** will see the implementation of the new approach along with supporting manuals and software.

The PAMS R&D project will consider the whole life cycle of systems as well as maintenance, renewal, and replacement options with the goal of optimising the performance of assets to reduce flood risk to people and the developed and natural environment.

## RESULTS OF THE SCOPING PHASE (PHASE 1)

The scoping study has been completed and the findings are summarised below.

### 1. User Needs and Requirements.

Practitioners, policy managers and process managers were consulted, through workshops and individually. The results highlight the need for an asset management system that enables detailed insight into risk at a local scale. It will need to support the identification of a preferred programme of management interventions to achieve a particular outcome – some desirable reduction in flood risk – through maintenance or improvement interventions.

Within this overall aim, a number of specific needs and requirements were identified (Defra / Environment Agency 2004b), including:

- Clearer asset performance objectives to be established within the CFMPs / SMPs and subsequent Strategy Planning processes.
- Recognition that “defence system” includes linear defences, ‘point’ assets such as pumping stations and sluices, and all relevant watercourses, all of which must be managed in an integrated manner.
- PAMS must include a range of strategic and tactical decisions including inspection frequency and type, and prioritisation / optimisation of operations, maintenance and improvements using a ‘whole life’ approach.
- PAMS must recognise that risk is managed by defence systems but these may only be as good as the weakest component.
- PAMS must be risk-based. Risk depends on the probability and consequences of flooding or erosion, and that risk depends on the combined effects of the ‘Source - Pathway - Receptor’ system.
- PAMS should be flexible enough to respond easily to changes such as economic context (e.g. discount rate), climate change, and changes in technology. It should have an ‘open’ modular architecture and be future-proof.
- PAMS must be able to include non-flood defence issues that may pose important constraints or opportunities. Examples include public access and safety, ecological and morphological attributes, and navigation, recreation and amenity issues.
- PAMS should be auditable and reasonably transparent, and should allow the user to investigate issues through sensitivity testing.

### 2. Review of existing methods

Two main areas have been examined:

- **Lessons learnt from the introduction of FDMM / FDMS** – This part of the R&D highlighted the key lessons that can be learnt from the introduction of FDMM/FDMS and gained important insights into how new procedures and processes through PAMS should be developed and implemented.
- **Lessons to be learnt from other industries** – This part reviewed approaches to asset management in other industries and abroad.

These elements of the R&D have provided essential knowledge and information to steer the future direction of PAMS. A key requirement to emerge was for a short-term improvement in the way assets are inspected and monitored. This would lead into a full PAMS approach, supported by software, in the longer term. (see Defra / Environment Agency, 2004b for further details).

### 3. PAMS CONCEPTUAL BASIS

The conceptual basis for the performance based management of assets was completed through the Concerted Action on Operation and Maintenance (Posford Haskoning, 2002) - see Figure 1. Within PAMS this framework has been developed as shown in Figure 2 (see Defra / Environment Agency, 2002a for a more comprehensive version). The key modules shown in Figure 2 are outlined below:

1. **Inspection and condition assessment** - covering inspection methods, and condition and hazard assessment
2. **System analysis (including sources / pathways and receptors)** – the general concepts of the system are currently being addressed outside of PAMS. However, PAMS will need to develop a methodology tailored to asset management.
3. **Decision approaches and option selection** – as with the system analysis a number of generic issues are currently being addressed outside of PAMS. Specific decision approaches will be needed to reflect the interface with higher level plans and the broad spectrum of criteria to be considered in selecting the preferred intervention.
4. **Common databases** – specification of the asset data to be recorded in the National Flood and Coastal Defence Database (NFCDD) will need to be addressed; including format, mandatory and optional parameters, and asset histories.

### 4. WHAT HAPPENS NEXT?

Through the next phases of PAMS the following threads will be developed:

1. **A measured step forward in current approaches** – This will include:
  - *Changes to the present inspection and condition assessment methodologies* - There are several aspects to this but the most important involves introducing a 'condition index'. The condition index will build on the visual condition grade which is the current basis for visual inspections. It will also include the function of the component or asset being assessed, and the effect of condition on the ability to carry out that function.
  - *Use of simplified hazard indexing approaches* - A closely related aspect to improved condition assessment is to extend the condition index to a 'hazard index' - this will capture the potential consequences of failure as well as the performance and failure probability (based on the condition index). The hazard index therefore provides an additional basis of risk-based prioritisation.
2. **The development of a full PAMS** – This is likely to include the develop of science, software, best practice procedures and training, including:
  - *Inspection and condition assessment* (e.g. better understanding of asset location and geometry, understanding asset condition and linking condition assessment to performance, understanding and characterising the change in asset condition and performance through time, linking surface and sub-surface infrastructure, better training of staff)
  - *System analysis* (e.g. *sources* – understanding system loads and their variation in time, *pathways* - defence performance, morphological behaviour, flood inundation, *receptors* – detailing with tangible and intangible impacts/issues)
  - *System interventions* (e.g. guidance on the performance of interventions and their design)
  - *Decision Approaches and Option Selection Techniques* (e.g. sensitivity analysis, multi-criteria techniques, uncertainty propagation and prioritisation techniques)
  - *IT and data management* (e.g. software interface and the use of common databases)

### References

1. Defra / Environment Agency, 2002. Risk, performance and uncertainty in flood and coastal defence: A review. Defra / Environment Agency Report FD2301/TR1.
2. Defra / Environment Agency 2004a. Performance based Asset Management System (PAMS) Scoping study report. W5-070/TR.

- 3. Defra / Environment Agency 2004b. Performance based Asset Management System (PAMS) Scoping stage - Needs and requirements and best practice review. W5-070/PR
- 4. Posford Haskoning (2002b) Operations and maintenance concerted action. EA R&D Technical Report W5A-059/TR/3.

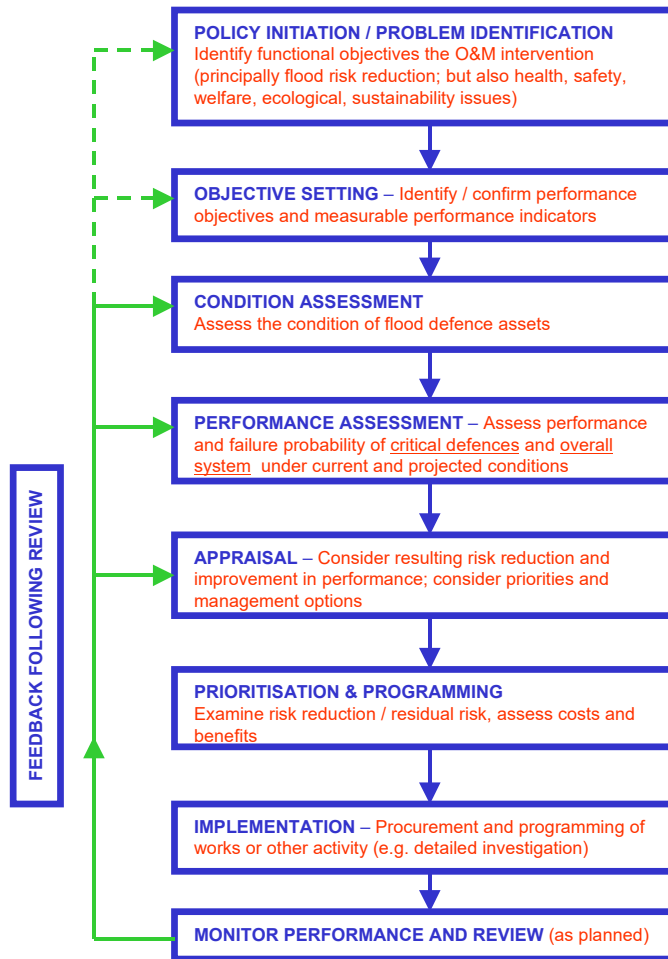


Figure 1 The Environment Agency's Logical Framework for O&M Activities (Posford Haskoning 2002b)

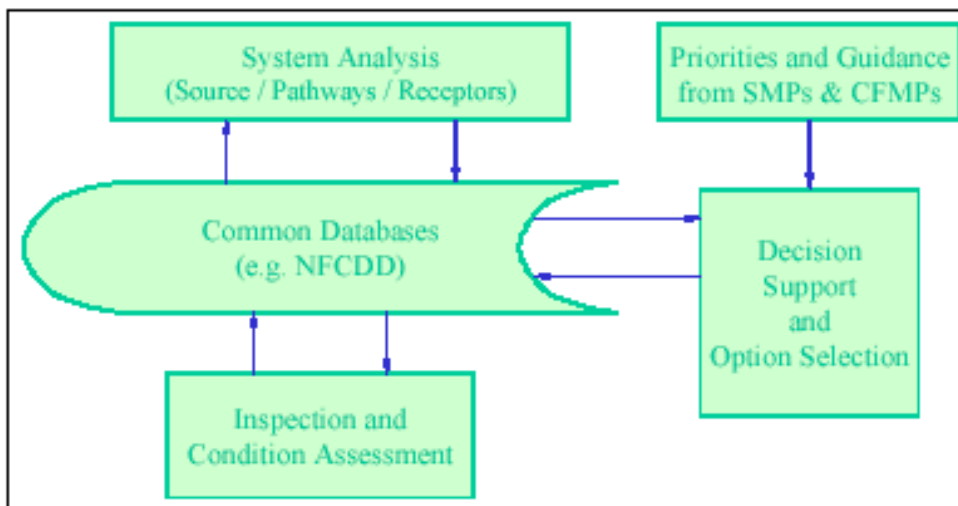


Figure 2 Key components of the PAMS proposed modular framework