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

Improving Data and Knowledge Management for Effective Integrated FCERM

Appraisal of value of information and data management

R&D Technical Report FD2323/TR4

Environment Agency

defra
Department for Environment Food and Rural Affairs

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

Improving Data and Knowledge Management for Effective Integrated Flood and Coastal Erosion Risk Management

Work Package 4 - Appraisal of value of information and data management
Final Report

R&D Technical Report FD2323/TR4

Produced: September 2007

Author(s):
Dr John B Chatterton
Greg Guthrie
Fola Ogunyoye
Andrew D C Robinson

Statement of use
This is the final report of work package 4 from FD2323 'improving data and knowledge management for effective integrated FCERM.' It explains and illustrates the development of a methodology for appraising the value of data to support business decisions. Its intended users are managers, suppliers, producers and users of FCERM information both within and outside the FCERM industry.

Dissemination status
Internal: Released Internally
External: Released externally

Keywords:
Data appraisal; data justification; data optimisation; data quality

Research contractor:
Fola Ogunyoye, Royal Haskoning, Rightwell House, Bretton, Peterborough, PE3 8DW, email f.ogunyoye@royalhaskoning.com

Project Partners: ABPmer, J B Chatterton and Associates, Cranfield University, Pennine Water Group (Sheffield University), Charlie Rickard.

This work package was led by J B Chatterton and Associates

Defra project officer:
Dr Suresh Surendran, Environment Agency, Kings Meadow House, Reading, RG1 8DQ, email suresh.surendran@environment-agency.gov.uk

Publishing organisation
Department for Environment, Food and Rural Affairs
Flood Management Division,
Ergon House,
Horseferry Road
London SW1P 2AL

Tel: 020 7238 3000 Fax: 020 7238 6187

www.defra.gov.uk/environ/fcd

Published by the Department for Environment, Food and Rural Affairs (Sept 2007). Printed on material that contains a minimum of 100% recycled fibre for uncoated paper and 75% recycled fibre for coated paper.

PB No. 12527/18

Executive summary

Flood and coastal erosion risk management (FCERM) usually involves managing dynamic systems onto which loadings are continually acting, leading to responses which change the state of the system. Relevant, accurate and up-to-date information about the drivers of this change and their effects is necessary for effective FCERM. A review of approaches within the FCERM industry to planning data collection and the management of the data once obtained shows that there is a tendency to focus on data, as opposed to the business objectives for which the data is required to support. This data-led culture has resulted in an ineffective approach to data management, where the cart is effectively driving the horse. This current approach has given rise to:

- Inability to determine the optimum amount and quality of data required and hence justify the procurement of additional data when needed
- Data in the wrong form, requiring a lot of additional work to convert to useful information
- The duplication of data and its management, due to lack of awareness of data that already exists
- Data redundancies due to lack of objective-led planning
- The inability to re-use or maximise the use of data due to lack of knowledge about other parts of the business requiring the same data
- The inability to share data due to lack of knowledge about others requiring the data and inconsistent standards

Following earlier reviews of data issues within the joint Defra/Environment Agency R&D programme, Defra commissioned the FD2323 project to develop a strategic approach to FCERM data management, to ensure it effectively feeds into knowledge about the business and the delivery of FCERM objectives.

The FD2323 project involved the development of a framework for improving data and knowledge management through a move into a more objective-led approach to data management. A number of techniques and tools were developed within the project to support the culture change required to deliver the objective-led approach. The FD2323 project was carried out within five work packages. The key outcomes of work packages 1–4 (FD2323\TR1–4) feed into the principal output of the project, FD2323\TR5, which provides a guide to support a more effective management of data and knowledge within FCERM. This document (FD2323\TR4) presents the outputs of work package 4, which develops a methodology for appraising the value of data to support business decisions on optimum data acquisition.

In the FCERM business, the awareness of data value is growing. However, there are concerns that inconsistencies and confusion in appraising and justifying the capture of data are affecting the value and benefits of data, and thus causing inefficiencies in the business. These inefficiencies include the duplication of data leading to the unnecessary expenditure of capital. Together with the ceaseless competition for resources, there is a need to develop a formal framework to standardise data appraisal.

Before the framework could be developed, current practices for appraising and justifying the need for and value of data and information were reviewed, both within the FCERM industry and beyond it. Initiatives from the Environment Agency as well as coastal and marine authorities have been considered to elicit good practices. To gauge the present attitude towards data justification and appraisal, a custom built questionnaire was targeted at bodies of the FCERM and non-FCERM industry. The current practices and attitudes have highlighted important principles, which have consequently shaped the developed data appraisal methodology.

Data quality plays an integral part in the appraisal methodology. It allows data to be divided into two categories for any particular FCERM role, which then assists data justification. It is apparent that there is a minimum level of data quality required for every FCERM task that enables informed and intelligent decisions to be undertaken. This concept is termed “house-keeping data” and its need is justified by the requirement to competently carry out a FCERM business role. Data beyond this quality is called “opportunity data” and requires justification for its collection.

Within the appraisal methodology, data quality attributes assist in providing provenance for data and in assessing the decision whether existing data is suitable for an objective. Data quality flags have been developed to quickly identify if data is fit for purpose through the use of data quality scores. Data quality flags are also a useful tool in data optimisation.

In combining different types of data to provide information or datasets, an understanding of the critical datasets composing an overall information quality for a particular use enables better targeting of improvements. The concept describing the combination of the various aspects of data types is termed Coherence. An awareness of the data requirements of others (see work package 1, FD2323/TR1) can lead to partnerships, where synergies exist, and increase the potential for data optimisation.

The resultant data appraisal framework incorporates the principles of data quality, coherence, justification, optimisation and data requirements awareness within an objective-led approach. The developed data appraisal framework has been demonstrated in fluvial and coastal scenarios to illustrate its practicability. Although the knowledge management tool (FD2323/TR3) was employed in the demonstration, the framework has been designed to be a stand-alone tool. It is recommended that the data appraisal framework is progressed into a computer-based tool.

The data appraisal framework gives a formal structure to data appraisal within an objective-led setting. It provides the concepts and process to enable decisions on whether new data investment is required and, if so, how best to make that investment. It aims to maximise the use of existing data and also promote partnerships, thus reducing redundancies and duplication respectively.

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1. Introduction

1.1 Background

Flood and Coastal Erosion Risk Management practitioners over recent years have moved towards a risk based approach to directing funding, in order to provide best value for money. Investment decisions need to be supported by appropriate information based on good quality data.

Data is of little value unless it provides information to expedite and support decision making within the component functions of Flood and Coastal erosion Risk Management (FCERM). Inappropriate and incomplete data of poor or uncertain quality can obfuscate the process and inform poor or wrong decision-making. Data collection must be directed towards the understanding and evaluation of risk both currently and into the future. The benefits of data collection must therefore be guided by its efficacy in informing both current and future investment programmes. Effective data monitoring forms part of this process.

This project (FD2323 Improving Data and Knowledge Management for Effective Integrated FCERM) was carried out within the Joint Defra/Environment Agency R&D programme. Its purpose, following on from previous research and studies, is to produce tools and best practice guidance for effective data, information and knowledge management related to FCERM. The commission is split into four different components (Work Packages). This report describes the work carried out within Work Package 4 of this study to develop a framework for appraising data needs to justify and prioritise spend on data and its management within an overall objective-led approach. This work package forms an integral part of the overall project looking to improving data and knowledge management for effective integrated FCERM.

The need for this project was identified within a preceding project, also commissioned under within the joint R&D programme 'A Position Review of Data and Information Issues within Flood and Coastal Defence' (FD2314). In order to facilitate a more effective and integrated flood and coastal erosion risk management at all levels, the FD2314 project identified an urgent need to understand and communicate the:

- Need, availability, quality of data and information and audit processes.
- Current roles and responsibilities related to data and knowledge management.
- Need and availability of policies, processes, research and development.
- Need and availability of enabling tools and techniques.

These recommendations, and building on other initiatives such as the Environment Agency's Data and Data Management Strategy, form the basis for this R&D project FD2323 to improve data and knowledge management for effective integrated FCERM within England & Wales.

1.2 Project objective and approach

The project has been developed with the following overall objective:

> To document a structured process which will assist FCERM managers to assess their data needs and maximise the knowledge available on associated information in improving efficiencies in sourcing and management of information they require to carry out their business.

The package of work undertaken to fulfil the objective is summarised below and the relationships between them are illustrated in Figure 1.2.1:

- Work Package 1 (FD2323\TR1) – The development of an 'ontology' to provide a systematic representation of the links from FCERM objectives through to data required to underpin their delivery and the associated information exchange network;
- Work Package 2 (FD2323\TR2) – The development of an ISO 19115 compatible metadata standard for FCERM data and its management through an ISO 19135 compatible format;
- Work Package 3 (FD2323\TR3) – The development of a knowledge management tool to support the ontology by providing an interactive link between management objectives, tasks within these and available information;
- Work Package 4 (FD2323\TR4) – Development of a methodology for appraising the value of data to support business decisions; and
- Work Package 5 (FD2323\TR5) – The development of a best practice guidance for improving data and knowledge management from the outputs of the above research and development work.

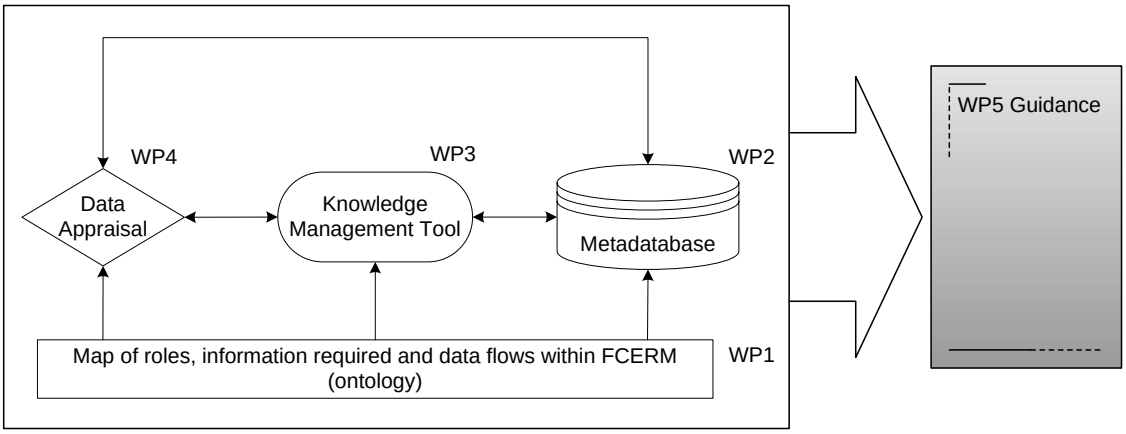

Figure 1.2.1 Overview of FD2323 Work Packages and links

The overall approach of the project team to the delivery of the improvement of data and knowledge management within FCERM is a culture change to embrace "objective-led data management". The whole of the project plan has been designed around the achievement of this culture change and the provision of tools and guidance to support this change.

1.3 Objectives of Work Package 4

Due to the need to target limited funds to maximise value for money, the objectives of Work Package 4 are to:

- Review available best practice methodologies that could be used for appraising the value, and for justifying and prioritising the need for FCERM data and information

- Develop a methodology (framework) for appraising the value of data and information that

    - is based on the link of data to business objectives as developed within Work Package 1;
    - can be progressed onto a computer based tool; and
    - is tested with some practical scenarios.

1.4 Approach

In order to develop the framework, it is necessary to contemplate the current practices, both within and outside the FCERM industry, for valuing and appraising information and associated data management. Important aspects (Section 2) are drawn from initiatives and reviews on the Environment Agency's data strategies as well as from the coastal and marine environments (sources found in Appendices). A stakeholder questionnaire was issued to data managers within and outside the FCERM industry to gain an insight into the present situation and elicit good practice, as well as barriers, in valuing and justifying data collection.

Analysis of the existing approaches has identified core facets. These fundamental principles are explored and examined in Section 3, which subsequently form the basis for the data appraisal framework. Comments from the Project Board provided further steer. Additional elaborations of the principles are referred to in the Appendices.

The data appraisal framework is described in Section 4. It retains the "objective-led" focus that underpins the overall project and has been developed for application as a stand alone or to be supported by the tools developed within the other work packages of the overall project. Fluvial and coastal scenarios were followed through to demonstrate the framework and its practicability.

Section 5 concludes by summarising good practice for data valuation and effective data management. Recommendations are made to progress the framework to facilitate its application.

2. Current practices

2.1 Approach

Current practice in data collection and data management initiatives has been elicited from the following sources:

- The Environment Agency strategic framework for flood risk management data and the development of the key asset data repository or warehouse - National Flood and Coastal Defence Database (NFCDD).
- Data Monitoring in the Coastal environment to inform and enable investment decisions both now and into the future when temporal trends in coastal dynamics are uncertain
- A bespoke Questionnaire on data valuation procedures within and outside the FCERM industry

The references for the first source are from mainly internal documents within the Environment Agency, except for the Flood Defence Data Review report (2005) - an audit carried out for the Environment Agency by Halcrow Group Ltd. Extracts of these documents can be found in Appendix A. The second source focuses on initiatives related to measuring and monitoring in the coastal environment where conventional cost benefit methodologies have been honed successfully, or otherwise, to value the benefits of data collection. These extracts are found in Appendix B.

The derivation of good practice to derive benefits (cost savings, value added and willingness to pay) of existing and improving data has also been deduced through targeting stakeholders (those who collect, analyse and gain benefit from data). The questionnaire was developed following the review of the first two sources and particular issues are drawn upon to highlight good practice and to aid the development of the data appraisal framework. The questionnaire and the results are detailed in Appendix C.

2.2 Literature review

2.2.1 Review findings

Key findings from the literature review are presented under the following sub-sections:

- Success stories or ***strengths*** – Examples where the ideas and recommendations have been applied and worked;
- Barriers to success – Examples where the concepts have not worked in practice or not attempted to put into practice and are ***weaknesses*** or even ***threats*** to good practice
- Perceived ***opportunities*** – The aims and objectives of data appraisal and justification within the specific studies and FCERM i.e. reoccurring ideas/ themes/ recommendations; these present opportunities for developing good practice

2.2.2 Success stories: strengths

The following points illustrate examples of successful data appraisal, justification and management, as well as ensuing benefits identified.

- Benefits attributable to NFCDD were based on cash savings (through reducing temporary staff, reducing maintenance and operational costs and more efficient access to data leading to improved investment decisions).

- Defra-style FCDPAG3 appraisal techniques can and have been applied though the robustness of estimated values of cost savings are often uncertain and require to be reviewed by peers or post project audits.

- The key benefits of concerted regional monitoring programmes relate to:

    - Savings and efficiencies in field data collection required for further detailed studies, coastal strategies and SMPs
    - Benefits in design and construction of capital schemes through improved data confidence leading to better modelling and efficiencies in design with less factoring for uncertainty
    - Benefits from reduced maintenance to coastal defence structures as a result for example of early detection of faults

- Regional monitoring will provide a consistent approach to data management to facilitate investment decisions both now and into an uncertain future

2.2.3 Barriers to success/ limitations/ shortfalls: weaknesses and threats

Good practice can be uncovered by acknowledging, not only successful application, but also areas where data objectives have not been realised.

- SATIS 2000 concluded that there was a lack of good data management and custodianship in the Environment Agency, with no real accountability for data quality. Local initiatives made co-ordination and ownership difficult with few consistent mechanisms for developing and disseminating Good Practice across the Environment Agency. Since 2000 however, further work culminating in the National Data Strategy (2004) has been carried out to put in place mechanisms and plans for addressing these issues. These plans if delivered should aid improvement in this area.

- It was recognised that uncontrolled replication of data (through local, uncontrolled and uncoordinated initiatives) may lead to inconsistency of information, as well as inefficiencies; inaccuracies were abundant. NFCDD phases 1 and 2 have had limited success at addressing these

issues due to functional and operational issues. The development and roll out of Phase 3 is expected to address some of these issues.

- Review of the application of data and management strategies and initiatives over the past 5 years identified concerns about the completeness, consistency and quality of data.

- The recently completed Flood Defence Data Review Report (Environment Agency, 2005) concluded that NFCDD is populated inconsistently. This results in a large, but unquantifiable, uncertainty in the results of flood risk modelling.

- The recommendation made in the Environment Agency's Data Strategy, 2004, made a number of good recommendations, including to develop a benefit cost model considering benefits of data in tandem with costs. A lot of these ideas are yet to be pursued.

- Unless there is inter-Regional and across organisational consistency to the data improvement, National level studies will continue to result in areas where the study is effective (due to the data being complete) and areas where assumptions will be required (due to lack of data).

- Willingness to pay method, though 'the ultimate measure,' is often volatile.

- Cost savings methods are often difficult to quantify objectively and either 'best guesstimates' are deduced or savings related to fixed percentages of operating costs without post project audit.

- Value added methods though difficult to quantify are useful to endorse the wider factual justification for improved data collection, e.g. advancing science for shared usage.

2.2.4 Perceived opportunities

The following points reveal the perceived opportunities and themes in data appraisal, justification and prioritisation.

- Data quality/accuracy, consistency and standards, nomenclature, metadata, version control, structure and efficiency, missing data ownership and custody are regarded as high priority.

- In the Environment Agency's 2004 data strategy document there was an overarching recognition that benefits of data should be evaluated in tandem with whole-life costs with a recommendation for the development of a benefit cost model

- Accuracy of information on risk (e.g. defence loading, defence level and condition, flood spreading and receptor characteristics) at local and strategic levels is vital to drive appropriate investment decisions at

strategic and policy levels. The recent uses of NFCDD data, such as in National Assessments of Flood Risk are starting to reveal the consequences of poor population and inadequate scoping of NFCDD, resulting in a renewed focus on improvement.

- It is recognised that knowing the quality (provenance) of the data is at least as important as having data of good quality. There is an opportunity for data quality to become a mandatory field in NFCDD and other relevant data sources.

- Incorporation of Data Quality Flags into NFCDD and other relevant data sources similar to DQS (Data Quality Scores) of the perceived quality of socio-economic data (Flood Hazard Research Centre, 2005) is a priority to capture both the confidence the user has when collecting data (e.g. condition grade) and evaluating specific accuracy of data (e.g. property threshold)

- The benefits of Data Monitoring can theoretically be measured using conventional economic modelling (Cost savings, value added, willingness to pay approaches) as well as scientific and environmental benefits (Appendix B1.3).

- Finally, it is recognised that there is a minimum baseline of data and information that without which FCERM will falter or even fail.

2.3 Practitioner questionnaires

The responses from the questionnaires (full details in Appendix C) revealed that while data value is being recognised (such as the implications for not having it or not having it at the appropriate level), data appraisal and justification are not being applied in a structured and widespread manner, Table 2.3.1.

The responses do confirm the notion that different techniques are required for different roles and that justification for collection of data can be simply to fulfil a statutory responsibility. Moreover the questionnaires emphasise the underlying theme of data quality and the questionable robustness of calculating cost savings or added value.

Table 2.3.1 Summary of questionnaire responses

Questions	Responses (EA = Environment Agency; SRM = Sefton Regional Monitoring; EN = English Nature; MO = Met Office)
How do you make a business case for the collection and management of data?	1) EA - BCA based on cost savings but largely based on guesses with no formal application of PAG3 2) SRM - most comprehensive, applying full PAG3 techniques 3) EN based on urgency and statutory requirement 4) MO prioritised based on exposed population
How are the benefits of data collection assessed/ quantified?	1) Highly prescriptive cost savings (SRM) or guesstimates (EA) 2) Historic or expected estimated economic losses (MO) 3) Political whim or 'if funds allow' (EN)
How are the costs of data collection assessed/ quantified?	1) Whole life and value added costs (MO and SRM) 2) Systems costs only; no costs of data gathering (EA) 3) Little formal costing (EN) – political decision
How would the absence of (existing or improved) data and data management impact on your business?	1) Poor investment decisions 2) Poor public and Government credibility 3) Negative impact on risk based approach to investment (EA) 4) Significant additional project costs 5) Deterioration of forecasting capability (MO)
How do you justify the need for more or improved data?	1) Maintain reputation 2) Improved forecast accuracy (MO) 3) Support statutory responsibilities (EN) 4) Investment confidence
How do you make a decision for the prioritisation of data needs?	1) Risk based (EA, MO) 2) Driven by work programme (EN) 3) Classic PAG3 BCA (SRM)
How do you assess the performance (fit for purpose) of current data?	1) Quality audit and competency training 2) Comparison with alternatives (MO) 3) Meeting statutory requirements (EN)
Do you maintain different data for different levels of decision-making?	Generally not, though differentiate between data for decisions now and data for continued monitoring into future
What are the key risks and uncertainties of collecting data, not collecting data or not improving data?	1) Risks of inappropriate decision making 2) Poor investment decisions 3) Risks to reputation 4) Inhibit future strategies and projects
How do you minimise the risks and uncertainties in collecting data, not collecting data or not improving data?	1) Training/ professional judgement 2) Detailed Work Instructions (EA) 3) Data Quality flags 4) Regular checks especially post event (MO)

2.4 Summary discussion

As users, suppliers and managers of FCERM data seek to optimise their investment in data and its management, these key challenges are faced:

- The need to obtain enough quantity and quality of data to provide the required information to support current needs of the business; and
- The need to continue to plan and capture inherent or intrinsic data for informing future trends for managing future risk.

Data requirements change as business needs change. Thus NFCDD has developed organically as the flood risk management business transformed. The original requirement as both a data repository *and* analytical tool has therefore been honed to concentrate on purely data storage and reporting. Needs also change; so that an emphasis now on visual asset condition assessment may change to an emphasis on the storage of performance based condition data following the Performance Asset Based Management system (PAMS) project due for completion in 2007/8.

Likewise monitoring of coastal processes specifically to support current investment will change both as regional monitoring exhibits economies of scale and cost savings and as the analysis of data confirms the uncertainties in knowledge. However, economies of scale in concerted and collective data monitoring should not be underestimated.

It is emphasised that justification of data is embedded in the use good quality data can be put to in the investment appraisal process. Data is just the building block with no value in isolation from the appraisal process.

Good quality data can:

- Inform technically appropriate, sound and cost beneficial investment decisions and aid prioritisation of spending; or can
- Inform and elucidate the perception of risk

With an estimated (Foresight, 2003) £1 billion Expected Annual Average Damages, rising to £27 billion by 2080 under the worst case High carbon emission futures scenario, utilising data to inform future risk to stem this growth suggests value may be worthwhile no matter what the spend. Thus there is an intrinsic benefit of collecting and monitoring data into the future to audit this increase in risk; but data must be consistent and data collection must be taken seriously to avoid misconception. Economic realities dictate however, that the available amount to spend on data is limited, suggesting the need for a consistent method of value appraisal to target resources effectively.

2.5 Suggested good practice

The Project Board was invited to comment on the emerging good practice (Appendix D) for data collection and management. The salient features of good practice as gleaned from the Literature review and stakeholder questionnaires are summarised as follows;

- Development of a Benefit Cost Model as suggested in “National Flood Defence Data & Data Management Strategy February 2004”

- Introduction of ‘conventional’ FCDPAG3 Appraisal techniques as introduced in Cell 11 (NW) Regional monitoring Strategy (Williams, 2005)

- Avoidance of ‘fire-fighting’ and development of a risk based approach to prioritising data collection

- Whole life measurement of data collection costs.

- Review of the consequences and risks of poor decisions on data collection

- Data Quality audit to be of paramount priority in Data management procedures

- Data Quality must not be compromised
- Ensure Data Ownership through dedicated ‘Custodians’
- Maintain association between data and managers

The following issues were deemed by the Project Board to be of paramount importance:

- Development of a risk-based approach to prioritising/screening data collection and management activities.
- Data quality (quality audit/control) is paramount to data management though Data Quality should be proportional to the needs of users (level of decision - Ontology), availability of data (at the time of needs), the benefits, the costs and the risks associated with collecting, improving or not collecting, reducing the level of data. The need for a proportional/rational tiered approach to data collection is fundamental.
- Development of a basic framework / conceptual model for Benefit - Cost-Risk (BCR) analysis. The risks, costs and benefits of data collection, quality control and management should be measured for whole life. The model should account for the risks of NOT collecting data (i.e. doing nothing) - and should support a more strategic approach to assessing data needs and benefits.
- Data audit of quality, consistency and completeness is of paramount priority in Data Management procedures with the development of Mandatory Quality flags. These quality flags should be related to the fitness for purpose (and hence value) of data.

3. Fundamental principles

3.1 Development of emerging good practice

The responses and the review undertaken in Section 2 demonstrate a growing awareness of the value of data. They also identified excellent examples of how the process of decision making regarding data collection, accumulation, dissemination and use is being taken forward and justified. However, there is evidence of confusion and inconsistency within this; in relation to issues such as data quality and completeness. Similarly, there are concerns that there is significant business risk[1], in not having the data and information to support FCERM.

Even in terms of risk and a risk based approach to appraising the need for data, there is some inconsistency around the concepts of risk; principally in the distinction between: a) the direct consequential risk of flood and erosion damage and b) the broader based risk associated with a lack of knowledge of physical or risk systems (source/pathway/receptor). In the first, the value of data may be seen strictly in terms of value associated with risk. Potentially, the greater the consequential risk, the greater the demand for more confidence in the decision making process and the greater the priority given to resolving this and, therefore the need for information. (This aspect is reflected in the Metrological Office's response, for example, to the first question in the questionnaire). The second may be seen in terms of complexity and uncertainty and, therefore, the need for greater investment in data to give a reliable degree of confidence in making choices (This is reflected in the Metrological Office's response to how the absence of data might impact on their business).

A further issue being identified in the review is the directness of links between data supplier, data collator and data user. Data underpins every aspect of work carried out in flood and coastal erosion risk management. The question remains, however, how collection of data is justified; to what level or quality, to what level of completeness. The emergence of data warehouses, NFCDD or the coastal observatories, bring significant benefits of data consistency, management and in the case of the observatories the analysis of data and production of information. However, they bring the added problem that, in terms of justification, the user (the role that generates the value of the data) is separated from the supplier (the role generating the cost). This is clearly even more evident because the data warehouses are providing data and information to a wide diversity of users.

In dealing with this, and the aspect of risk definition, the underlying concept that data and knowledge management needs to be driven by good purpose, or objectives, comes through very strongly. Both in terms of individual roles within the FCERM structure and in terms of assessing the value of the data warehouses, the clear definition of what is needed is essential.

[1] Business risk, the basic inability to carryout the business of FCERM.

This section of the work package report aims to establish basic principles in considering this; based on ideas coming from the review, but also aiming to resolve some of the apparent inconsistencies and concerns with respect to the way in which data or information is viewed within these different FCERM roles.

These principles are considered under the following headings:

- House Keeping and Opportunity data; considering the aspect of what data is core to any FCERM business role and what improvements can then be made, in terms of actual risk, by obtaining better data.
- Data quality; the basic assessment of data quality and the flagging process in data and knowledge management
- Data coherence; considering the approach to assessing data needs in terms of the information being produced.
- Data optimisation; the principles associated with assessing the quality of data needed.
- Data knowledge awareness; the need for data sharing and its consideration in justification of data collection.
- Appraisal process and strategic options; discussing how data appraisal fits within the normal appraisal process.

Additional elaborations and examples of the principles are referred to in the Appendix E.

3.2 House-keeping and Opportunity data

The risk of not providing data appropriate to support tasks defines data needs. It is also important to recognise that information needs change as business needs change.

Data can be distinguished into two levels according to its necessity to fulfil a FCERM remit:

1. **House-keeping data**
2. **Opportunity data**

House-keeping data is fundamental to job performance e.g. an operations delivery manager could not even start to do his/her job without knowledge of the location of assets under their remit. For every FCERM business role, a task is performed that requires a minimum level of data quality to make an informed and intelligent decision. Its need is justified by the requirement to competently carry out a FCERM business role. The risk of not holding this level of data to acceptably perform a task should be assessed. House-keeping data is not only fundamental for a task, but also for the wider FCERM business. The risk of not having this core data will cause damage to investment decisions and ultimately the integrity of the FCERM business.

On the other hand, ***Opportunity data*** allows a practitioner to improve their management of the task in hand and facilitate improved decision making to the benefit of the FCERM business. For example asset condition data or defence level data will inform decisions about levels of system maintenance required. Opportunity data enriches and fine tunes business decisions but requires a decision to justify its collection. It should be scrutinised with respect to the incremental costs and incremental benefits of improving the data.

The distinction between House-keeping and Opportunity data differs between tasks. Data is considered as House-keeping if it is below a threshold at which an informed judgement is no longer possible i.e. the uncertainty/risk is too great to base decision on experience. This base line should be defined before carrying out a data appraisal and could be aided by asking the questions below.

- Can I make an informed judgement without this data?
  - No = House-keeping data
  - Yes = not House-keeping data
- Do I require this level of data to make an informed judgement?
  - No = not House-keeping data
  - Yes = House-keeping data

3.3 Data quality

Development work was carried out within this research project to assess data quality attributes for FCERM data, with the view to developing quality flags that could be used within an appraisal framework. This work involved the identification of data attributes to decide whether selected data was appropriate for application to a particular objective or range of objectives. An important link was made with the metadata development work in Work Package 2, as it is important that the required attributes are easily obtainable from the metadata base or similar tools. A process, here called ‘flagging’ for attributing quality to data is introduced. This section outlines the development of quality attributes and their use for quality flagging.

It is recognised that different appraisal tiers (levels of decisions) require different levels of data quality (Appendix E1). Policy makers do not require the same detail of data as designers of a sea wall. Simply put, one size does not fit all. However, not knowing the quality of data can obfuscate decision making and, at worst, make the data worthless. Data quality flagging gives provenance and can then allow the practitioner to judge if it is of appropriate quality for their task. In developing an appraisal framework it is important that data quality attributes are clearly and understandably displayed when considering what data is already available. The range of data quality attributes also needs to be considered when actually looking at what additional data may be required to meet a Housekeeping level for any role or in assessing the additional benefit, which may be derived from better quality data in considering opportunities for improvement and optimisation.

Knowledge on the origin of data imparts confidence in its use. The quality of data (or dataset) is inherent in its associated attributes that define its provenance. These data attributes include:

- Accuracy – dependent on method of capture and associated quality procedures
- Age – how old the data is
- Competence – dependent on the skill and experience of the data originator or author

Where the quality of datasets is being considered, additional attributes are involved including:

- Temporal duration – how long a series of repeated records has been taken
- Spatial coverage – how wide the geographical coverage of the dataset is
- Spatial resolution – how dense the data capture is within the spatial coverage.

Assigning data quality scores (flags) to these attributes enables ranking of data and an easier judgement on the appropriateness for a particular task. In order to minimise the scope for subjectivity in assigning a value to data, the number of categories within a flag should ideally be three but no more than five. Recommended scores and further elaborations can be found in Appendix E2.

3.4 Data coherence

The concept of data coherence is fundamental to assessing what is baseline housekeeping data, and then in assessing opportunities for improving aspects of the data.

In addressing this, coherence may be considered from two aspects: the need to derive good information and the awareness of how individual data sets are used throughout the FCERM structure (i.e. used in generation of different information). The latter aspect is touched on in this sub-section and developed further in Sub-section 3.7. The focus of this section is really in relation to understanding the principles of data coherence in the production of information for a single user or role.

3.4.1 Quality of information

A dominant theme running through both the review of current practice and in responses to the questionnaire is that of data quality and the apparent desire for best quality data. This section; while acknowledging the importance of data quality and how it is identified, considers this from the slightly less clear issues of information quality. The quality of data may be quite readily assessed (and the principles in doing this are discussed in the following sub-section) but the ultimate aim is in using good or suitable quality data in generating necessary quality information.

As discussed below the attributes of data quality may be seen as being inherent in the data. It is independent of subsequent use; data accuracy may be defined, as may resolution, age or temporal duration. These are all basics attributes which are relatively clear and absolute.

Less clear is the quality of information and also how the quality of information may be improved or degraded in terms of the quality attributes of the data. Fundamentally, such an assessment decision has to be defined in terms of the use of information not its nature. This, more than the pure attributes of data quality reinforces the need for objective led decision making in appraisal of data collection.

Concern over information quality is highlighted in the review and the responses as being often obscured by the quality attributes of the data itself. The development of NFCDD is a clear example of how there is a good understanding of the need for coherent data sets if a system is to deliver competent information on defences. Knowing whether a wall is in good or bad condition needs to be considered in conjunction with other data if ones' role is in assessing risk (e.g. whether the wall is 5m high and is exposed to severe conditions, rather than being merely 0.5m high set at the back of a healthy beach). If one is considering this from a role of planning maintenance, other associated data may be more important. The quality attributes of any one data set may be more critical than others in assessing the level of confidence or the quality of information being derived. This then feeds through to assessing where effort is required to collect specific data. Where that effort needs to be placed depends on the critical choices which are associated with FCERM decision having to be made.

It may, therefore, be seen that decisions are rarely made on the basis of one data set. A decision to improve the Thames barrier would not be made simply on the basis of numbers of properties at risk below the 5 metre contour in London. Other key attributes like surge tide levels and frequencies, and asset condition of the existing infrastructure must be evaluated as part of the decision making process. It is an understanding of the perceived quality of the key data attributes in association with all other data attributes that influences the overall robustness of the decision making process. Thus will the sensitivity in tide surge levels by a few millimetres at Southend be more significant on the investment appraisal process for the future Thames barrier than an ill considered selection of property footprint areas (influencing damages)?[2] Unravelling the complexity of appraisal through sound management of data quality will greatly facilitate sound investment decisions but only goes so far. This discussion of data coherence aims at ensuring thought is given to where effort needs to be put in to improving information through the relative improvement of data quality over a range of data sets.

Figure 3.4.1 attempts to illustrate this as a guide to this thinking. In Figure 3.4.1 the main "slide" (set horizontally) represents the variation in information quality being produced by a specific role within the FCERM structure; purely for the

[2] This example is considered in more detail in Appendix

sake of illustration, the assessment of coastal behaviour. The generation of this information is based on a set of three independent data sets; the quality of each being represented by the three vertical “slides”. Again by way of illustration these might be wave climate, water levels and beach profiles.

Associated with the role or task of producing information, a minimum level of understanding of the coastal behaviour is required; a basic understanding of behaviour from which risk of erosion may be determined. This minimum “housekeeping” level is indicated on the main slide. To achieve this minimum level of information there may be a need for high quality long term beach profile data (data set three). Associated with this may be a need for general information on wave climate (determining net sediment movement) and a basic assessment of extreme water levels. The data quality to achieve this for each data set is highlighted in green on the vertical slides. The combination of these data sets gives the minimum quality of information for the role, or task, to be performed.

Assessment of the need for improving the information being produced; for example improving the assessment of probability of erosion under specific conditions, requires thought as to the critical choices which are going to be made based on that information. In particular, whether improving this information or improved knowledge about the coastal system is actually going to result in different outcomes for management. To improve the information then requires consideration of how that information may be improved. An improvement level in information is shown on the main “slide” (top of Figure 3.4.1) its need being driven by the value of the improvement in decision making. In the example, to achieve this improvement, each data set has then to be considered. There may be little need to improve the quality of beach profiling (a move to collect quarterly rather than annual data). There may, however, be a need to significantly improve the quality of wave and water level data (a change from statistical analysis to time series data) and hence increase the effort put into obtaining this data. There may even be a need to introduce other data sets.

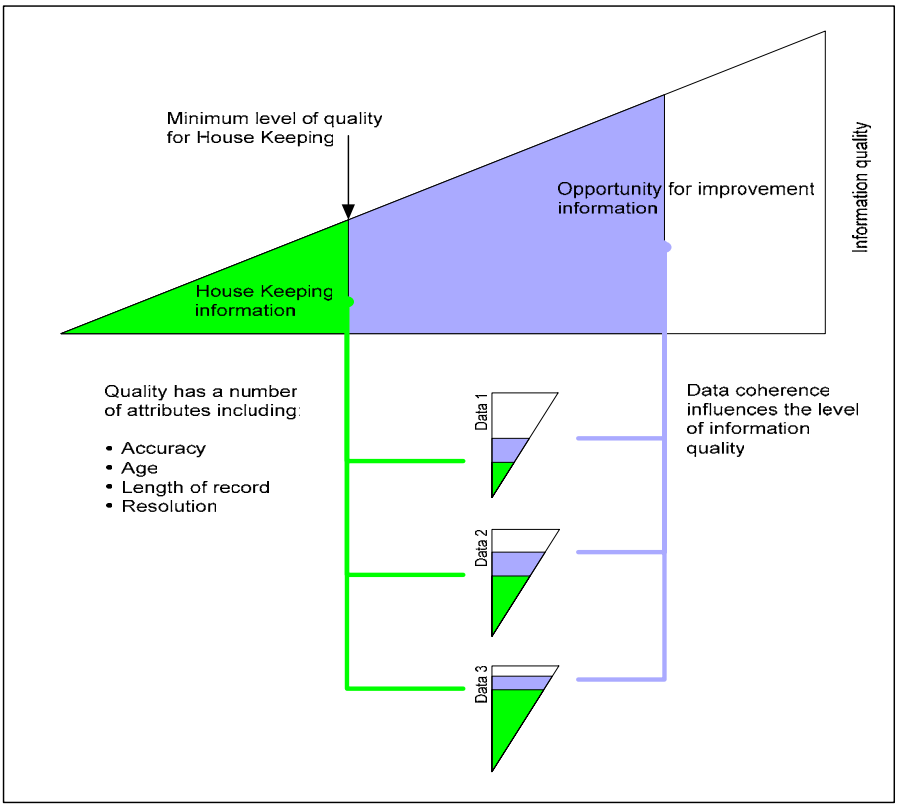

Figure 3.4.1 Data Coherence

In the simple example shown in Figure 3.3.1 it may be seen that in breaking down the analysis this way, improvements in quality of information and knowledge, may require different levels of improvement in specific data sets. This principle of data coherence needs to be taken forward in assessing the value of data. To merely improve the attributes of data quality does not necessarily improve the information which is derived or do so effectively. This is possibly highlighted most evidently in the review of practice in terms of the current lack of level data held within NFCDD. With respect to much of the information, which will be subsequently derived from data held by NFCDD, no improvement, indeed a minimum housekeeping level of information will not be achieved unless at least a basic knowledge of defence level is present. Therefore while improvements in the quality of other data sets may be undertaken, the improvements are not worthwhile if the critical data set is not improved.

Benefit Cost Analysis or other appraisal tools (such as Contingent Valuation and Willingness to Pay) can be used to evaluate the options to collect and improve data beyond the housekeeping threshold, but this has to be in a context of the overall data coherence necessary to improve information. A step change in improvement of information quality may be obtained from little improvement in quality of one data set. Similarly, there may be little improvement in information (and ultimately in decision making) through improvement in one set of data without also improving the quality or introducing other data. The process of optimisation is discussed in Sub-section 3.7.

3.4.2 Structural coherence

As with the need to consider data coherence in delivering basic or improved levels of information, so there needs to be an awareness of assessing the value of data in the coherence of data collection between different roles and levels (hierarchies) of the FCERM structure.

For any data set there may be, associated with one role a minimum level of quality required. There may be a sensible and justifiable level of improvement in that data quality associated with that role, appraised by following the principles described above. Equally, however, there may be other roles using the same data sets or sub-sets of the same data. There may, therefore be further justification in improving data as a requirement of some other role. The ontology aims to provide a means of co-ordinating this, such that an awareness of what may be needed as housekeeping by one role may provide justification, or a trigger to improvement in other data sets, to improve the information being provided by some other role within of the overall structure. This type of "joined up" structural coherence provides opportunities for efficiencies and avoids duplication of efforts in data capture and management.

3.5 Data optimisation

Related to quality of data, there needs to be a process of optimisation. The optimum level of data is attained when further costs outweigh any further or incremental benefits, Figure 3.5.1. The optimum varies from role to role. However, damage to investment decisions is increased when the prescribed level for House-keeping data quality is compromised.

In setting up a framework for assessing or justification of data, optimisation should be able to be carried out in conjunction with data quality scores through a process of data filtering. A practical scenario using this approach described in Appendix E3 highlights the close link between this and coherence. Both opportunities for improvement and reduction of quality need to be assessed during optimisation. However this process should not just look at tasks and roles in isolation, but evaluate all possible uses of data (aided by the ontology and the knowledge management tool and the principles of coherence), to ensure synergy and efficiency.

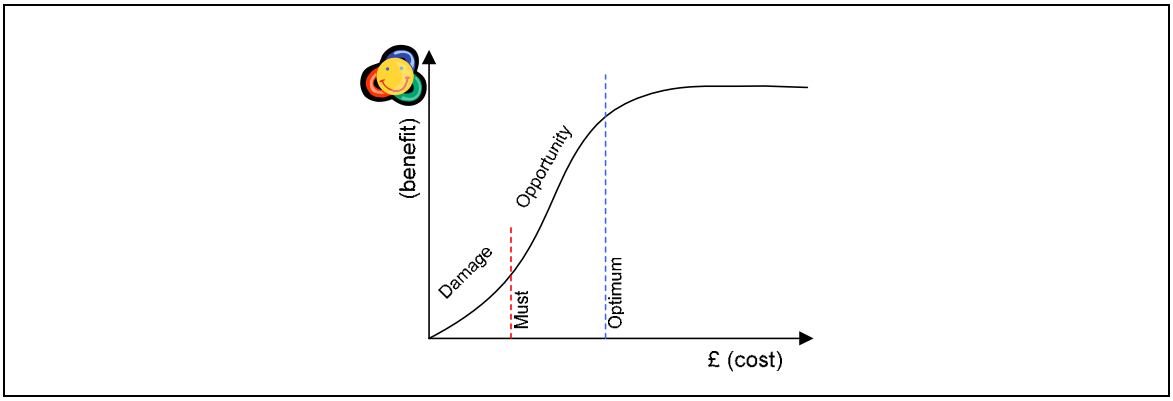

Figure 3.5.1 Data Optimisation

The optimisation of data value in benefit cost terms must reflect optimum quality with respect to fitness for purpose. Thus there is a trade off between cost of data and data quality. Threshold surveys of every property below 5 metres in London would almost certainly be not cost beneficial, but the optimal solution (for measuring property thresholds) must be robust within the appraisal context, and must not compromise quality and therefore the correct investment decision. The example of data filtering in Appendix E3 reveals that further improvements in data quality, beyond a point, do not result in best value (Figure E1).

3.6 Data knowledge awareness

The requirement for ***data*** to create ***information*** to support ***tasks*** within clearly defined ***roles*** to fulfil a specific ***FCERM remit*** (Figure 3.6.1) is complicated by the fact that different roles have their own remit drawing on **common data**. It is recognised that appropriate data will also support other flood and coastal risk management activities – flood warning, development control, capital and ongoing maintenance work – and that relevant data is not unique to any of these and should have the ability to be shared. Sharing data maximises its use.

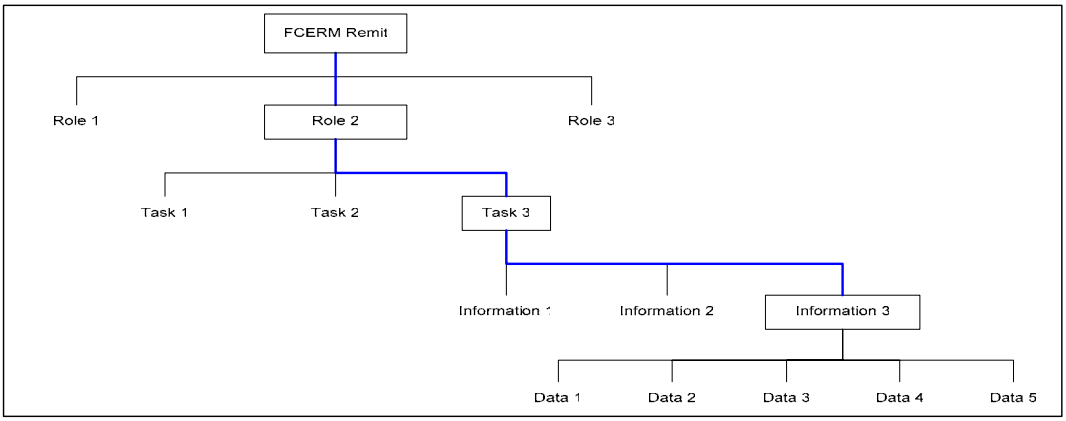

Figure 3.6.1 Conceptual data and information structure within FCERM

Any framework must, therefore, ensure that data is not only shared effectively but is 'fit for purpose' to support multiple tasks. By being aware of other users and their needs for data, efforts to collect and improve data can be optimised. This can subsequently minimise duplication and also costs. Similarly by being aware of others' requirements, then the consequences of any reductions in collection or quality (such as reduced frequency) can be assessed beforehand rather than in hindsight.

By way of illustration, two users may want the same type of data but whose optimum levels are slightly different due to differing purposes. It is worthwhile to improve the data to the higher optimum (standard) for the small increase in cost, which could be covered by the other user, Figure 3.6.2.

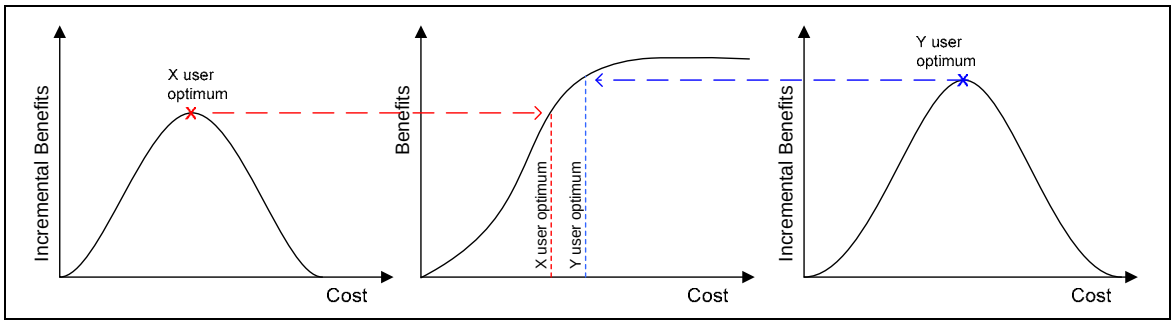

Figure 3.6.2 Optimising data through data knowledge awareness

3.7 Appraisal process and strategic options

Bringing these principles into focus with respect to appraisal, it is useful to understand where and how data appraisal fits into the project life cycle, Figure 3.7.1.

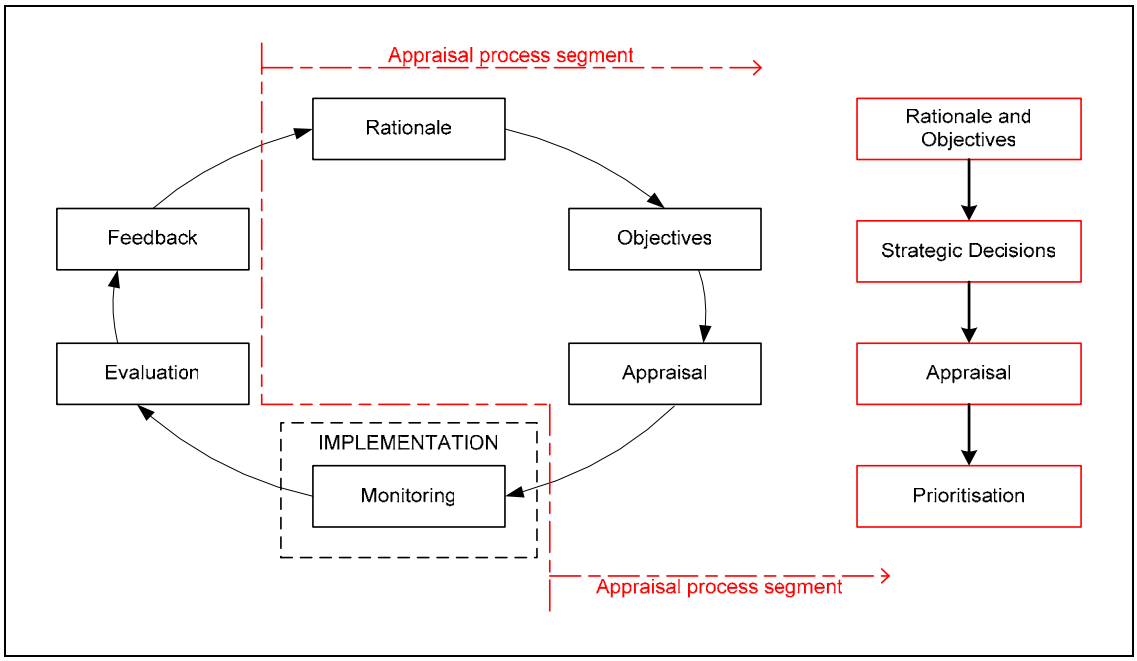

Figure 3.7.1 Project life cycle (HM Treasury, 2003) and appraisal process segment

The appraisal process for data nestles amongst the first half of the cycle. Objectives and Rationale are interrelated and so can be considered together; an objective (desired outcome/target) helps to identify the need (Rationale) for data.

Before any appraisal can occur both the overall purpose of the data collection and the specific elements, and users need to be determined. There may be a primary role (user) needing to be satisfied or equally multiple primary roles or primary and secondary roles. From the point of view of either a single role or from that of a broader application, it is important to establish not just what the different data requirements are, but also the minimum and optimised levels of quality. In the case of the multiple roles, this would provide a matrix defining the

complete range of data. Within this, it will define whether data is housekeeping or opportunity and, for each data set, what quality level provides housekeeping.

In line with HM Treasury's 2003 'Green Book' (Appraisal and Evaluation in Central Government), four fundamental strategic options should be incorporated into the appraisal process to evaluate data:

- ***Choose to Do Nothing*** (To actively answer and document the question: Do we really need data to support our objective, or at least what is the minimum requirement?);
- ***Maintain the current level of data collection*** (The base case if we are concerned with incremental value of additional data collection);
- ***Reduce the current level*** **(**e.g. reduce frequency of monitoring coastline according to risk, thus also being more cost-effective);
- ***Expand the current level*** (or make the collection of current data more efficient, but in keeping with the law of diminishing returns).

The matrix of data and data quality requirements clearly fits in with this, demonstrating for a single role or for a community of roles what is the basic minimum. It also identifies what, for each role, may be the benefits of expanding the current level or the damages of reducing the current level of data collection.

Once a strategic decision is made, as in any appraisal of public sector investments, a cost benefit assessment (CBA) is required again in line with HM Treasury's 'Green Book' with a requirement to set objectives, identify options, estimate costs and compare costs and benefits when required.

The benefits of collecting (and improving) data as part of a well co-ordinated investment programme are well founded and enshrined in conventional CBA (procedures as adopted in Defra FCDPAG3 techniques) with demonstration of benefits (both direct and indirect) through:

- Cost savings afforded by data (day to day operational and maintenance savings)
- Benefits or 'value added' to the business
- Willingness to pay for data should quantitative procedures to deliver monetary savings and benefits prove difficult.

The procedure to calculate the economic benefits of data requires an understanding of how the data translates into information that affects decision making, e.g.

- Knowing the collective condition of a flood defence asset and the standard of protection afforded by the asset system will enable the likelihood of breaching or overtopping to be assessed using models such as RASP (Risk Assessment for Strategic Planning), and

- Knowing the location (geo-reference and altitude) of properties protected by an asset system will enable the impact of breaching/overtopping to be assessed.

Combining the two sets of attributes (physical and economic) allows an understanding of the economic effect of overtopping or breaching and therefore the risk. Collecting data to improve predictions of each component of risk will assist in the reduction of property damage (loss) and especially loss of life. Also the implications of not collecting or improving data should be considered when appraising options. For example, the flood risk could be underestimated or overestimated which would affect investment decisions and subsequent costs

Benefits can also be defined in scientific and environmental terms as recognised by CERMS Regional Monitoring strategy (see Appendix B1.3). However, it is acknowledged that not all benefits of data improvements and collection can be easily quantified, such as health and safety. It is widely accepted that there is not a definitive method to use as each situation is unique; however, one should be aware of the limitations and subjectivity of particular methods.

It is important to recognise that there is this housekeeping level of data which should not require an economic appraisal, beyond that notionally provided by the role significance of the role within FCERM. Without this essential data, for example, location of watercourses, coastal cells and associated flood defence assets the FCERM business would be fundamentally and adversely affected.

After options have been appraised, then the preferred option should be chosen accordingly, tasks prioritised and then the options implemented.

4. Data Appraisal Framework

4.1 Framework overview

The framework has been developed by considering Work Packages 4 objectives, as well as acknowledging and drawing on the ideas and key issues that have been raised in the previous sections. The keys aspects to the framework are illustrated in Figure 4.1.1.

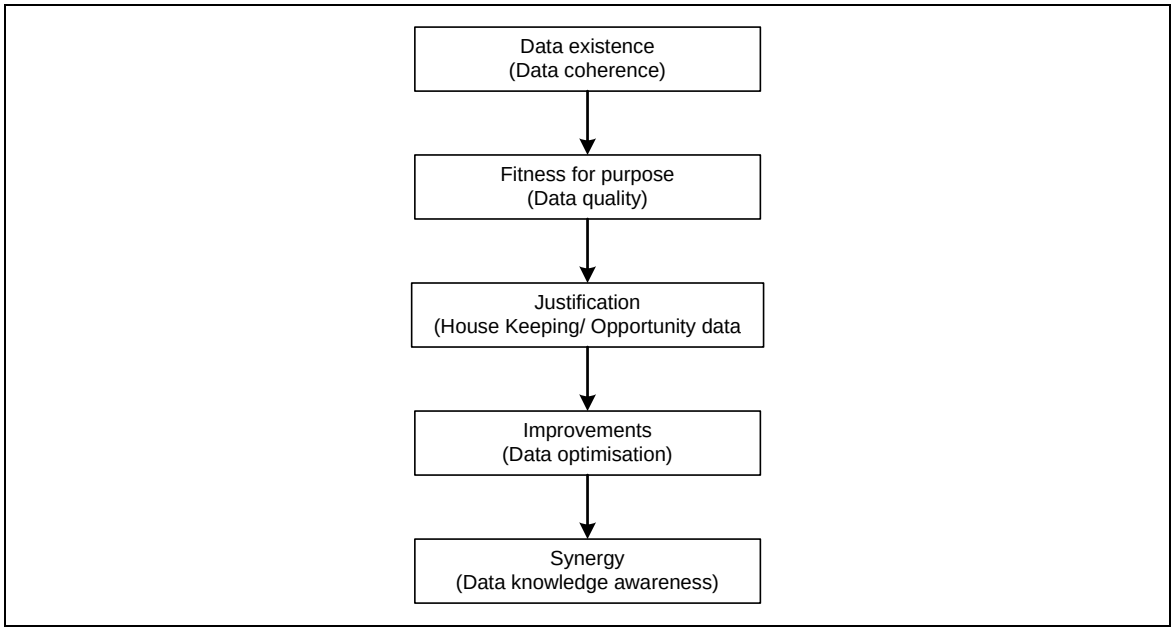

Figure 4.1.1 Key principles in the data appraisal framework

The data appraisal framework is firmly ensconced in the objective led approach. While Work Package 1 (Map of FCERM roles and data needs) provides the rationale and Work Package 4 links up with the Knowledge Management technology in Work Packages 2/3 (metadatabase and data quality flags) it is important that the framework can also be used independently outside of these packages.

4.2 Developed data appraisal framework

The Data Appraisal Framework (Figure 4.2.1) charts the proposed algorithm to optimise the strategic decisions of collection, storage, improvement/reduction/ rejection and use of both House Keeping and Opportunity data.

The first stage within the algorithm takes an objective-led approach and focuses the users mind to determine what data they would like for their task. If this data exists at their required standard (quality) then there is no need for any justification since it exists. The user is directed to an audit of the data's use and applicability in multiple roles.

Only when the data does not exist or is not at the user's required level, is there a need to determine if the data is House Keeping or Opportunity data. This

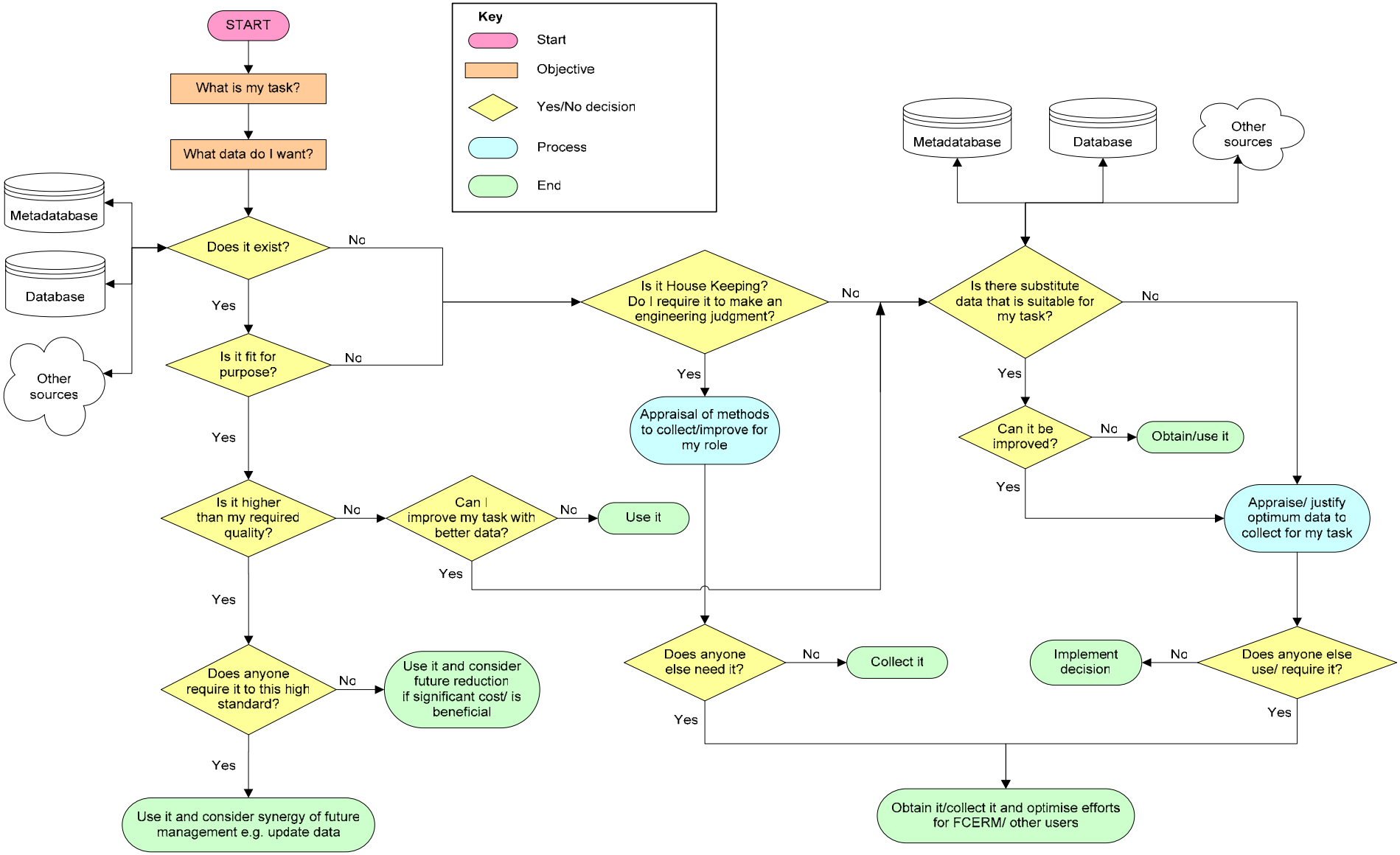

Figure 4.2.1 Data Appraisal Framework

consequently affects whether any justification is necessary to collect new data or improve existing data. Although the "Data requirements flow charts" in Work Package 1 help show the data needed for various activities, they do not show the quality of data. This has to be carried out by the user as their function defines the basic level of data required (House Keeping) for the task. An additional question is raised regarding whether the appraised data is required to make an engineering judgement. If the user is able to make a judgement without this data (i.e. using more basic data), then the data is not house keeping. If it is not possible to make a judgement without it, then it is housekeeping. This helps to remove any uncertainty when making the distinction between what is House Keeping and what is Opportunity data.

If the data wanted is Opportunity data, then in recognition that a user may have time constraints, substitute data is sought which could bridge the gap while the wanted data is unavailable/ not immediately available. This not only maximises the use of existing data, it can also minimise frivolous data collection thus saving time and money.

When there is no substitute data or it needs to be improved further, then the user should appraise and justify the data via the cost benefit appraisal optimisation track. Again its applicability for utility within multiple roles is tested and optimised for all roles within and outside the FCERM business using data knowledge awareness.

The framework also questions practitioners to seek betterment of data than they may have originally envisaged thus potentially making more informed FCERM decisions.

The knowledge management tool (Work Package 3) can help determine the availability of data and whether the data is fit for purpose using developed data quality scores and flags. "Other sources" refers to searches for data existence such as in reports, other databases or from experts since the framework has been developed for universal application and not solely with the developed knowledge management tool (Work Package 3) and metadatabase (Work Package 2).

Once options have been appraised, the most suitable one should be selected. While cost-benefit ratios are widely used, some other attributes are suggested below to help prioritise the most appropriate:

- Consequences of not undertaking the option
- Benefits of undertaking the option i.e. hitting High Level Targets
- Number of other functions it supports
- Other types of functions it supports i.e. Water Framework Directive, Water Resources, Bio-diversity

4.3 Demonstration of the data appraisal framework

The practicability of the framework is demonstrated in Appendix F using fluvial and coastal case studies. Data for calculating flood damage is appraised in

fluvial scenarios at a catchment and design level. At a catchment scale, ground levels every 2 metres were required for use in a Catchment Flood Management Plan (CFMP). This was deemed to be opportunity data since lower quality data could be used. Although this data did not exist, substitute data existed at a lower spatial resolution which was appropriate for the task. Therefore existing data was maximised and additional efforts reduced.

Similarly scenarios in the coastal environment were followed at a National level and at a local maintenance planning level. As part of ensuring appropriate coastal management is being undertaken within England and Wales, an understanding of the coastal issues is required, for this instance in the North West region. Shoreline Management Plans exist for the region but better data was felt to be necessary. Therefore Opportunity data was sought, which existed and was fit for purpose.

Although the case studies primarily demonstrate the appraisal framework, they also illustrate the use of data quality flags to help judge fitness for purpose and ranking data using the knowledge management tool, as developed in Work Package 3.

5. Conclusions and recommendations

5.1 Conclusions

SATIS 2000 recognised that, after its employees, data is the most valuable commodity the FCERM community possesses. Ensuring its fitness for purpose in developing and informing appropriate investment decisions is of highest priority. The developed Data Appraisal Framework has been constructed ensuring that it is objective-led, risk based, practical and has universal application. It recognizes that there is a minimum level of data quality required (House-keeping) to competently fulfil a remit and introduces the concept of Opportunity for improvement data to enrich and fine tune business decisions. It focuses the practitioner's mind on the overarching importance of data provenance through the development of data quality flags, data coherence, data optimisation and data knowledge awareness, recognising that data is not unique to FCERM and its collection and use should be optimised wherever possible.

The four case studies, selected to test and develop the Data Appraisal Framework as well as the concept of Data Quality Flags, leads the user in a systematic and logical manner to chose data of the appropriate provenance for the selected task, thus avoiding potentially expensive and unnecessary collection of either Housekeeping or Opportunity data. The data appraisal algorithm could be progressed, to provide a computer based system.

5.2 Recommendations

The development of a prototype Data Appraisal Framework Model is encouraged. In order to reap maximum value from this, and indeed from data itself, it is vital to actively secure the support from the FCERM industry. Also particular elements within the framework need industry-wide consensus to aid buy-in and ensure consistent approaches are followed:

- House-keeping data - for consistency of use, development of a common understanding of housekeeping data for all typical FCERM activities by practitioners is recommended
- Benefit-Cost-Risk analysis – explore and formulate cost of not carrying out options (number of properties at risk) and hard to quantify benefits (health and safety)
- Data quality flags – agree on suitable ranges for attributes
- Prioritisation scoring – determine scores and weighting for options of capturing, improving and optimising data

As well as advancing the above to improve and standardise data evaluation, it is firmly believed that the following measures should be incorporated into data management to maintain data integrity and complete data appraisal:

- Data ownership through dedicated ‘custodians’
- Maintain association between data and managers
- Regular data quality audits
- Periodic audit of cost savings following implementation of data collection

The first two bullets are dealt with, to a certain extent, in FD2323/TR2 that establishes management procedures of metadata registration following International Standards. It is recognised that NFCDD Phase 3 is encouraging the role of data custodians and their role in managing data quality and developing national Consistency in data collection methods is an essential pre-requisite in the development and application of the Data Appraisal Framework.

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APPENDICES

Appendix A – Environment Agency reviews

A1.1 Preamble

The organic development of flood defence data collection and management in the Environment Agency is as follows:

- Local Initiatives e.g. RIMS (River Information Management System) - mid 1980's
- Improvement to consistent standards via Flood Plain Information (FPI)/Flood Defence Management System (FDMS) - mid 1990's
- NFCDD Business cases 1 & 2 (circa 2000)
- Data and data management strategies (2000 and 2004)
- NFCDD Business case 3 (2004)
- Flood Defence Data Review (2005)
- Data Action Plan (2005)

The relevant literature relating to these initiatives is reviewed below and key issues relevant to future good practice are elicited.

A1.2 A Strategic Framework for Data and Information Management (SATIS 2000)

SATIS (Science and Technical Information Service) has overall responsibility for data and information management within the Environment Agency. The 2000 "Strategy on Data and Information Management" concluded that there was a lack of good data management and custodianship in the Environment Agency, with no real accountability for data quality. Local initiatives made co-ordination and ownership difficult. The Meta- database was declared far from complete and there were few consistent mechanisms for:

- developing and disseminating Best Practice across the Agency
- identifying emerging needs among practitioners and co-ordinating these with best interim system development and implementation
- co-ordinating data management initiatives across functions and across the Agency
- integrating good practice and stewardship into business activities or projects
- co-ordinating data management with the National Centre for Environmental Data and Surveillance

In short, it was recognised that uncontrolled replication of data leads to inconsistency of information, as well as inefficiency. SATIS not only recognised that data was the second most important asset after staff but that data management systems were inadequate with issues with data quality/accuracy, consistency and standards, nomenclature, metadata, version control, structure and efficiency, missing data. Ownership and custody were regarded as high priority.

Key criticism related to:

- Gross inaccuracies (especially geographical)
- Locally inconsistent data and application
- Uncontrolled data leading to inefficiencies and high costs
- Poor version control
- Difficulty with multi-functional data processing

It is here acknowledged that the decision to build NFCDD was made against this damning indictment of data management and procedures.

A1.3 National Flood and Coastal Defence Database Business Case (Issue 1.3)

Following recommendations in the 1998 Agriculture Select Committee Report on Flood and Coastal Defence, MAFF developed and published, in November 1999, High Level Targets for the operating authorities. High Level Target 4A[3] required the Environment Agency, in partnership with the other operating authorities, to develop a National Flood and Coastal Defence Database and maintain it thereafter

The initial business case for NFCDD stressed the theme of the benefits to be derived from each option from a business and technical perspective. The raison d'etre for creating and maintaining the database is emphasised as being risk based with headline figures estimated by the Environment Agency "damage savings of £2.4 billion per year" "property worth £200 billion", maintenance expenditure of "£250 million annually" felt to be reasons enough for sound data management policy.

The Business case lists some 13 key business objectives with an emphasis on:

- Improving investment decisions at all levels of expenditure
- Provision of data to support High Level Target reporting
- Improvement of data quality and easy access to data
- Developing national consistency and 'local workarounds'
- 'One-stop shop' repository for data

and in direct contrast with parochial and inconsistent systems such as DUCS, RIMS, FPI which did not serve the Agency's objectives well.

Benefits were derived following workshop sessions and were categorised as:

1. Realisable cash benefits such as reduced expenditure on temporary staff.

[3] Now superseded by Defra High Level Target 2 (2005)

2. Efficiency Improvements; Staff being able to devote more of their time on their 'real' work as a consequence of having ready access to high-quality information and also by being freed from developing work-arounds.

3. Better investment decisions; for example being certain that capital works are undertaken in the most effective places.

However, the quantification of benefits based on reducing risk by 'shifting the following Risk curve to the left', Figure A1, "by better targeting of defence asset maintenance, replacement and renewal" was arbitrarily put at 1% of operational and maintenance spend or £2.5 million per annum. The techniques to justifify and prioritise maintenance expenditure as prescribed in the Flood Defence Management Manual (FDMM) were only sporadically applied.

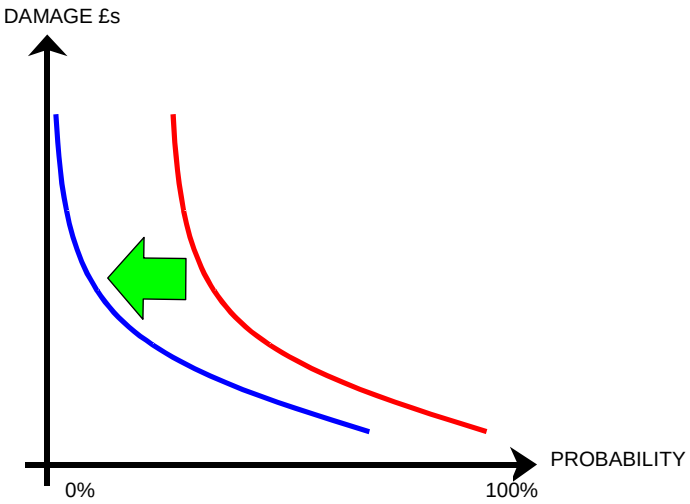

Figure A1. Risk Curve

NFCDD was announced as a pre-requisite to risk based assessments with workshop sessions "guesstimating" savings of between 1% and 5% of £200 million (i.e. the then cost of building and maintaining existing defences).

Reductions in temporary staff and eliminating 'inefficiencies' in FDMS and FPI were again 'guesstimated' at £325,000 per annum whilst more accurate and better quality data would enable a 1% saving on re-inspection or £131,500 per annum. Improved data collection including introduction of hand held devices would save £260, 000 per annum.

A non-tangible suggested benefit was that feasibility studies would be reduced by an improvement of the pre-feasibility studies.

In summary the following quantifiable benefits were perceived:

Introduction of Risk based Assessments (low estimate)	***£2,000,000***
Removal of previous data storage inefficiencies	***£ 195,000***
Savings in temporary staff	***£ 130,000***

Reduction in re-inspection rate	***£ 131,500***
Improved data Entry	***£ 260,000***
TOTAL per annum	***£2,716,500***

It is here recognised that the intriguing perspective on these 'guesstimates' is that they have never been substantiated, proven or audited once NFCDD became operational.

A1.4 National Flood Defence Data & Data Management Strategy (February 2004)

In the wake of NFCDD's many operational and functional teething problems, the purpose of the national flood defence data and data management strategy was to provide a direction and focus for information and data management in Flood Defence (Flood Risk Management) and ensure that appropriate quality data is available to make informed decisions on the management of flood risk.

There was an overarching recognition that benefits of data should be evaluated in tandem with costs with a recommendation for the development of a benefit cost model. This was never accomplished. However, quality and completeness of data was used as a yardstick against which data improvements could be measured.

Key outputs from the strategy were:

- A record of the metadata for each Flood Defence dataset
- A review of the quality and completeness of data
- An Action Plan for improving quality and completeness
- A process for handling flows of data between the different decision making levels
- Prioritisation of future data requirements
- Work Instructions for data management including training and communication

A key thrust was to appoint "Data custodians" to ensure the highest quality of data integrity and security.

Key benefits from the data strategy were seen as:

- The removal of duplication in collection and storage of data
- More efficient access to relevant data
- Improved understanding of the provenance and therefore the appropriateness of the data
- Improved information leading to improved decision making and reduced business risks
- The enhanced reputation of the Agency by being able to respond quickly and efficiently to requests for information
- A clear focus on data acquisition to meet business need and eliminating unnecessary data collection

- Allowing multiple uses of the same data at different levels of decision making
- An improved understanding of how data and information flow between different activity groups and systems

The justification for data appears to have moved from information based assessment of 'value' to a data focus value on quality and ease of access

A1.5 NFCDD Business Case for Phase 3 (2004)

NFCDD phases 1 and 2 were beset with functional and operational difficulties with concerns at the highest Governmental levels. The Business case for Phase 3 hopes to rectify unresolved issues. Failure to so do would negate many millions of pounds of development over the last 4 to 5 years.

Again it was stated that the principal benefit of having better data and information is that it will provide the Government and Operating Authorities with a clearer indication of flood and coastal defence investment needs. This will allow expenditure to be targeted at those areas that will derive the optimum benefit. Other benefits include being able to assess the extent, quantity and type of property or infrastructure at risk, to assess the condition of the defences protecting these properties and to put a value on the economic consequences to the nation associated with maintaining, improving or abandoning these defences.

Further development of NFCDD needed to take place to underpin the prioritisation of spending of the SR2004-6 additional funding for Flood Defences made available by the Government. Despite past failings it is viewed within the Flood Risk Management Business that NFCDD is the fundamental building block for future systems development.

NFCDD Phase 3 Project includes the following objectives:

- Ensure changes in the business processes are accounted for
- Ensure at least the minimum requirements for managing data regarding Coastal Flood Defence Assets are catered for, including data gathered through the Coast Protection Survey.
- Ensure issues relating to functionality and data that have been identified through the development of Phases 1 and 2 are addressed
- Consolidate the Phase1/2 system following experience gained from actual business use.
- Ensure the RASP methodology is developed into a practicable and professionally developed application that is either linked to NFCDD or a part of its functionality.
- Ensure the incorporation of the flooded property data, which is currently held in the Flooded Properties Database.

It is thus seen that the main benefits are the increase in functionality and improvement to the performance and usability of the system resulting in a greater uptake and usage of the system by both internal Agency users and those external to the Agency (particularly with introduction of COWS and application to particularly coastal authorities). It will hopefully increase user confidence in the system (which has been, and in many cases is still, very low) and the project team delivering it to them. This confidence will ensure that users continue to use the system and thus the overall benefits identified in Phases 1 & 2, which are directly dependent on the use of the system, will be realised.

Thus, apart from better data and information to provide the Government and Operating Authorities with a clearer indication of flood and coastal defence investment needs, the principal benefit is to ensure the benefits not realised in phases 1 and 2 materialise.

A1.6 Flood Defence Data Review (2005)

A key criticism of the data and management strategies and initiatives over the past 5 years concerns the completeness, consistency and quality of data. The aim of the Flood Defence Data Review, carried out by Halcrow Group Limited, was to evaluate the quality and completeness of the data that form the basis of Environment Agency flood defence data systems through asking the following questions:

- What functions / operations are these systems (NFCDD) being put in place to support i.e. what are the functional requirements of the EA?
- Is the information within them sufficient to support these functions, in terms of content, completeness and quality? i.e. is the data fit for purpose?
- If there are deficiencies in the current data that inhibit its use, what measures can be taken to improve it to make it fit for use?
- Is there a need for further information, currently not available, to be gathered and made available to Environment Agency staff?

A key issue relates to the fact that inaccuracies at Regional, National and Catchment level are more likely to go unrecognised, and therefore have a greater impact in the decision making process because of the strategic nature of the decisions they support. Accuracy of data (condition, standard of protection, crest level etc.) at asset component and defence level is vital to drive appropriate investment decisions at strategic and policy levels.

In this context RASP outputs from NaFRA are not seen as representative of the local situation. It should be recognised that RASP outputs are only as good as the completeness and quality of NFCDD data and in particular the condition of elements of the asset. The GIGO (Garbage in; Garbage out) principle is very pertinent here. For the RASP method, an incorrect defence classification results in incorrectly deriving a defence fragility curve, which is derived for each

individual defence based on ‘typical’ fragility curves developed for the defence types.

The audit concludes that the national database is populated inconsistently. This results in a large, but unquantifiable, uncertainty in results of flood risk models. Also three key elements of data – Crest level, Standard of Protection and Replacement cost – are largely unpopulated. There is a plea that Data Action Plans will allow regional consistency in data improvement (both quality and completeness).

The key issue encountered was that it is not easy to distinguish the quality of the flood defence datasets due to a lack of ***quality flags***. Two types of quality flag are suggested:

- capturing the **confidence** of a user when assigning subjective data to an asset,
- and evaluating **specific accuracy** of data in relation to predefined criteria

The Environment Agency National Flood Defence Data and Data Management Strategy (EA 2004) requires that staff must be aware of the source and quality of flood defence datasets, as well as be able to internally and externally share them. The quality of data is a vital component to successful working but it is also essential that the quality of data is documented. Knowing the quality of data provides confidence that it is fit for a given purpose or, equally importantly, that it isn’t fit for a given purpose. It does not however overcome a basic lack in the ability to collect high quality data. A pertinent question is: Is the requirement for specific data quality actually achieved?

It is suggested, for example, that the confidence ratings for condition grade are defined as follows:

- **“very confident”** would be assigned to the condition grade classification in situations where the asset can be clearly surveyed with no doubt of the condition grade classification. Ideally this flag would be assigned where the condition grade was determined or verified by a certificated specialist (accredited on the T98 asset condition assessment course).
- **“confident”** data would be assigned to the condition grade classification in situations where condition grade can be assigned confidently but not without any doubt.
- **“uncertain”** data would be assigned in situations where accessibility, visibility or identification problems prevent clear assessment of condition grade. This flag could also be used to populate the field for historical assets in NFCDD.

The report illustrates a further example of data quality flagging where the parameter has a quantifiable estimate of ***specific accuracy***, with 5 quality grades, Table A1.

Table A1. Data quality flagging (Halcrow, 2005)

Accuracy rating	Specification (e.g. Crest Level)
1	+/- 1 to 5cm vertical accuracy
2	+/- 5 to 25cm vertical accuracy
3	+/- 25 to 75cm vertical accuracy
4	Estimated
5	Unknown source

This is akin to a Data Quality Score used to determine the accuracy of socio-economic attributes of flood receptor fields (property threshold and foot print, land use and depth damage data assigned) – see Flood Hazard Research Centre "Multi-coloured Manual Handbook," 2005.

The debate as to whether quality may be acceptable better or worse at Local project scale as against national strategic or policy scale will continue, though accepting poorer quality of individual data at CSR level can at worst mislead investment decisions or at best obfuscate. Quality should be driven by land use bandings as suggested by Halcrow, and not by scale of application (Local to national Policy), Table A2.

Table A2. Quality flagging driven by land use

Flood Probability / Risk	Land use band A	Land use band B	Land use band C	Land use band D	Land use band E
Significant	99%	99%	95%	90%	90%
Medium	99%	99%	95%	80%	80%
Low	90%	90%	90%	80%	80%
Uncertain	99%	99%	95%	90%	90%

Data quality must be a mandatory field in NFCDD and that knowing the quality (provenance) of the data is at least as important as having data of good quality.

The scale of NFCDD 'completeness' is summarised by area in Table A3.

Table A3. Completeness score, percentage complete and the index showing Areas below (<100) and above (>100) the mean score

Area – Region	Score	Index	Complete
Mean Score	*363*	*100*	*60%*
ANGLIAN			
Central	359	99	59%
Eastern	320	88	53%
Northern	363	100	60%
MIDLANDS			
Lower Severn	360	99	59%
Lower Trent	401	110	66%
Upper Severn	380	105	63%
Upper Trent	389	107	64%
NORTH EAST			
Dales	425	117	70%
Northumbria	325	90	54%
Ridings	430	118	71%
NORTH WEST			
Central	280	77	46%
Northern	337	93	56%
Southern	357	98	59%

Area – Region	Score	Index	Complete
SOUTH WEST			
Cornwall	415	114	69%
Devon	423	117	70%
North Wessex	354	97	58%
South Wessex	392	108	65%
SOUTHERN			
Hampshire	287	79	47%
Kent	264	73	44%
Sussex	361	99	60%
THAMES			
North East	406	112	67%
South East	397	109	66%
West	403	111	67%
WALES			
Northern	344	95	57%
South East	344	95	57%
South West	323	89	53%

Incompleteness should not however mean that we stop making decisions but that models should adapt to what can be delivered, or decisions should acknowledge the potential frailty of input data.

Thus overall NFCDD is barely two-thirds complete (without even considering data quality of the registered data)

The audit summarised key findings as follows:

- **SoP data** are missing from an average of 90% of assets per Region.
- **Crest level** data are missing from an average of 78% of assets per Region.
- **Asset element details** are missing from an average of 2% of assets per Region.
- **Condition grade** data are explicitly planned for improvement by one Region and are missing from an average of 3% of assets per Region.
- **Replacement cost** is not explicitly planned for improvement by any Regions and is missing from an average of 90% of assets per Region.
- There is an overall lack of target dates by which to achieve asset attribute population.
- There is an overall lack of percentage coverage targets to which Regions are going to populate NFCDD attributes.
- Overall the DAPs will have a limited but positive impact on meeting the data requirements of flood defence data users. However as there is no inter-Regional consistency to the data improvement, national level studies will continue to result in areas where the study is effective (due to

the data being complete) and areas where assumptions will be required (due to lack of data).

An example from the audit illustrates, by Area, the completeness or otherwise (as against quality) of data collection on condition grade, Figure A2.

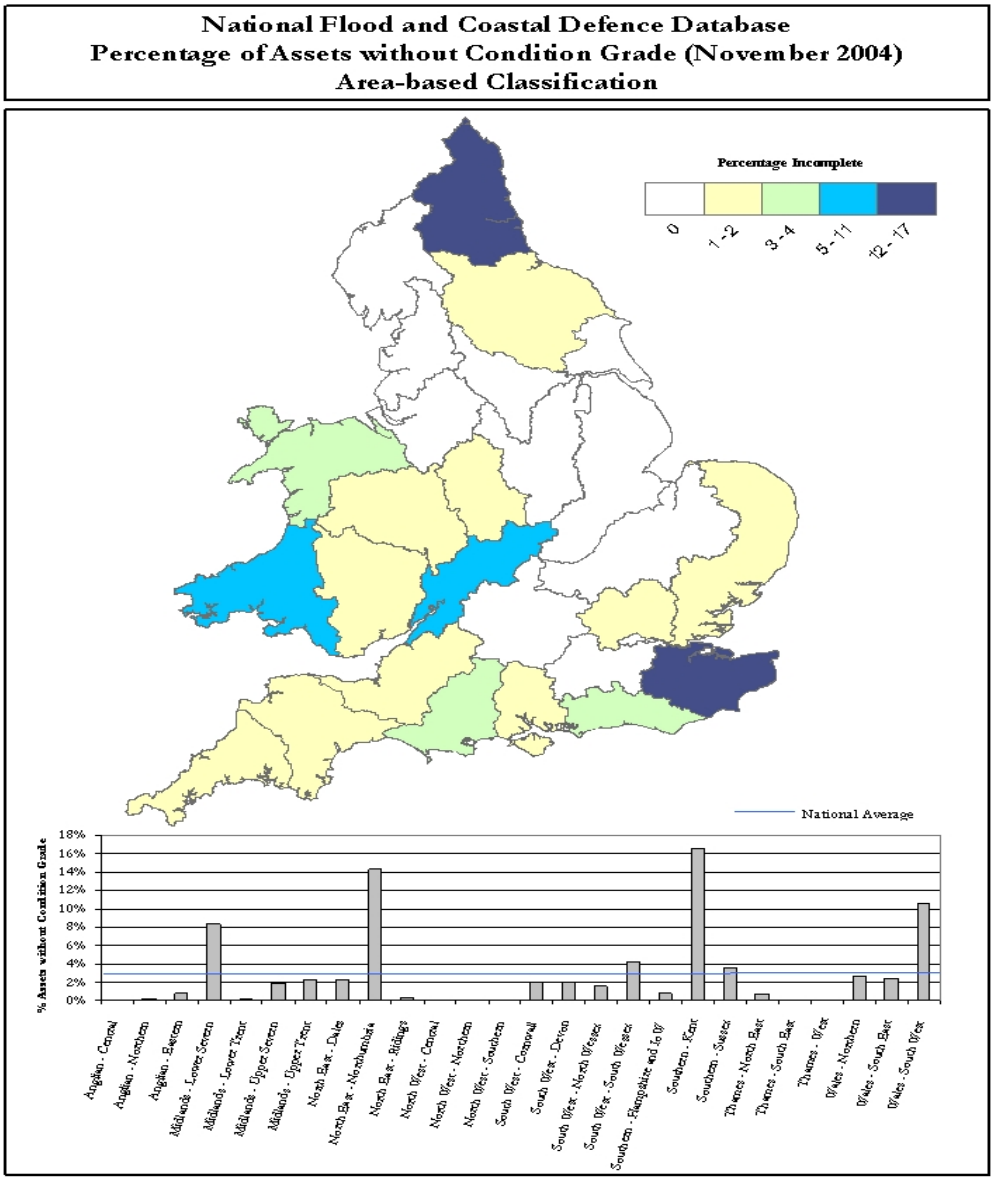

Figure A2. National Flood and Coastal Defence Database Percentage of Assets without condition grade (Halcrow, 2005)

Appendix B – Measuring and Monitoring in the Coastal Environment

B1.1 Preamble

This literature review relates to measuring and monitoring in the coastal environment where classical cost benefit methodologies have been honed successfully or otherwise to value the benefits of data collection.

B1.2 The Economics of Sustained marine Measurements

Future investment decisions in fluvial and coastal flood defences must be supported by an armoury of appropriate but continuous measurement e.g. rate of erosion, trend analysis of storm surges and other temporal trends, bathymetric measurement etc. The benefits of sustained measurement have an intrinsic as well as immediate benefit. The report, carried out by Eftec, studied the economics of co-ordinated data gathering to justify UK's long term marine monitoring programme.

Key issues addressed were:

- The development of a suitable methodology
- The effort required to define likely benefits
- Cost of collection
- Type of measurement
- Objectives and purpose of measurement
- Beneficiaries and users
- Benefits versus costs

Previous guidance (NOAA and ONR) has, as with NFCDD benefit evaluations, quite arbitrarily suggested benefits are "at least a 1% improvement in revenue" or "a 1% costs savings" due to availability of marine measurements. Eftec's research attempted to be more prescriptive in the evaluation of monetary benefits. The report evaluates Market price proxies in terms of cost savings on daily operations afforded by appropriate data collection, for example, saving money on coastal defences by postponing construction costs through detailed knowledge of erosion trends.

An alternative Market proxy is the 'value added' approach which requires the assessment of the importance of marine information as an input to economic activities at a more strategic level than simply cost savings. Thus investment decisions for SMP's as to when to re-align defences in a coastal cell will be dependent on continuous temporal trends in sea level rise.

Eftec dismissed the third alternative Market Proxy – willingness to pay – as an unstable technique for quantifying benefits in an imperfect market. Conceptually, willingness-to-pay is the "ultimate measure" that should 'capture all benefits'. Though this study has shown this approach is unlikely to be

implemented successfully. Contradictorily, however, in actuality in one case study (see below) this forms the main perceived benefit, albeit as evaluated by only 2 potential beneficiaries!

One of the case studies "Liverpool Bay Coastal Observatory Monitoring" - LBCOM - indicated that most of the benefits rely on the fact that it generates real time data making real time modelling possible for coastal waters in the UK for the first time. Though potential benefits and beneficiaries are extensive (some listed in Table B1) monetary quantification proved imprecise with estimates either derived from assumptions/guesses or limited to qualitative statements.

Table B1. Potential benefits and beneficiaries

Beneficiaries	***Measurements***	***Benefits***
Defra/LA's	Erosion and sediment movement	Real time data collection
Airbus consortium	Tides, Air draft under bridges, bed conditions	Avoid land transport; reduce risk of accident
EA/Defra	Nutrient measurement	Monitor compliance with Waste Water treatment and nutrients Directive
EA/United Utilities	Understand discharges from treatment works	Avoid/challenge fines and penalties. A 1% reduction in fines is £6,000 pa
LA's	Marine movement	Plan discharges more effectively
Port Authorities	Measurements to plan dredging	Avoidance of environmental damage

A further benefit would be the avoided cost of disparate efforts to collect the same or overlapping data. With such limited quantitative data on direct benefits the benefit cost 'analysis' was weighted heavily on 'value added' estimates and 'willingness to pay' (put at £2 million pa) for data direct from LBCOB as derived from questionnaire returns. Although the benefits appear to outweigh the costs (bolstered by a litany of qualitative 'advantages') this perceived economic justification belies the economic theory detailed in the report as a precursor to the case studies. In other words though classic economic theory was proposed as a way forward to quantify benefits through benefit cost analysis, the LBCOB case study was unable to successfully apply these techniques.

It is here perceived as the conclusion implies that although market proxies can be used to establish benefits, when applied to justifying continued or improved data monitoring the quantification of these proxies is at best guesswork.

B1.3 CERMS Regional Monitoring Strategy 2005-2010

In contrast the CERMS (Coastal Erosion Risk Management Strategy) - Cell 11 Regional Monitoring Strategy by Alan Williams (2005), with Sefton Borough Council acting as lead authority, has successfully applied PAG3 Defra methodology to developing a business case (PAR - Project Appraisal Report)

for a technically feasible and cost beneficial Regional strategy for monitoring of coastal activities.

It is recognised amongst the majority of coastal managers that monitoring of shoreline behaviour, and the natural processes influencing it, is fundamental to future understanding and hence informing sustainable management decisions both immediate and into the future.

The overall Cell 11 (Dee to Solway) regional monitoring system comprises the collection, collation, analysis, reporting and dissemination of data and information within the following generic categories:

- Defence and Shoreline Inspections
- Inter-tidal surveys - beach profiles/topographic surveys; saltmarsh surveys; sediment sampling; inter-tidal skears etc
- Hydrographic surveys - estuaries, open coast lengths
- Airborne remote sensing - inter-tidal habitats, cliffs, sand dunes, feature changes
- Primary Process Information - waves, tides, sediment movement etc
- Ecological/Biological monitoring

The report recognises that the benefits of a regional monitoring strategy broadly include:

- Scientific Benefits
- Economic Benefits, and
- Biodiversity Benefits

Scientific Benefits

The 1999 Penning-Rowsell DEFRA R & D committee suggested that increased research expenditure was required in relation to risk and that unless data collection was continued or improved, adequate understanding of coastal processes and morphology could not be made. In particular, the committee identified the need for:

- Continuation of accurate and up-to-date data acquisition to assist with planning design and implementation of effective flood and coastal defences.
- Improved accuracy of predictions as a result of using a longer time series of data;
- Examination of long-term, system wide, coastal and estuarine sediment and morphological processes.
- Long-term, systematic monitoring of bathymetric evolution of coastlines and estuaries.
- Long-term wave recording in coastal waters
- Monitoring wildlife habitat changes in response to flood defence implementation.

The approach identified within CERMS goes significantly towards meeting these needs and the development of CERMS will provide the following scientific benefits:

- Improved information to support risk evaluation and assessment
- Provision of data to support High Level Targets set by government
- Improved information in relation to future shoreline planning including strategy preparation, informing the on-going SMP review process etc.
- Better definition of coastal process behaviour for future coastal defence design
- Better definition and understanding of changes to natural defence forms and habitats
- Early identification of defects and problems and improved confidence in estimates of residual life expectancies for artificial defences
- Improved understanding of historical shoreline evolution and improved information to support prediction of future evolution of the shoreline to build on the information provided by "Futurecoast"
- Improved quality control and assurance of data collected

Economic Benefits

Economically, the potential benefits arising from implementation of CERMS, to both local shoreline managers and communities and to the nation as a whole, arise from the following:

- ***Benefits to Strategic Planning***, including
    - Savings in field data collection required for studies, coastal strategies and SMPs
    - Efficiency savings in time arising from acquisition and checking of historical data
    - Cost savings arising from improved phasing of future schemes and works

- ***Benefits in design, construction and maintenance of capital schemes***, including
    - Savings in data collection required for schemes
    - Savings due to improved confidence and efficiency of design
    - Savings arising from non-commercial supply of materials e.g. beach recharge
    - Availability of historic measured wave data for use in coastal defence studies
    - Early identification of defects and problems providing for more cost efficient maintenance
    - Reduction in damage levels to structures as a result of storms

- ***Improved efficiency of monitoring management***, including:
    - Procurement efficiency
    - Efficiency savings in contract management
    - Economy of scale in system development and refinement
    - Maintenance of data value through preservation of data

- ***Benefits from the supply of information***, including
    - The value of data being collected and made available for use by a wide range of bodies with different requirements and needs

Benefits for Biodiversity & Conservation

Recommendations from Shoreline Management Plans and flood defence coastal strategy studies have consistently identified a requirement for the development of coastal monitoring programmes. The current approach to biodiversity monitoring is generally piecemeal, being undertaken locally to meet the requirements of specific SMP or Strategy Plan recommendations. There is a real opportunity through this strategic approach to deliver a single, baseline of the biodiversity resource in the coastal zone of the North West Region, to provide opportunities for creation of coastal habitats and monitor losses and gains.

The benefits of a strategic approach to monitoring of the coastline are as follows:

- A regional approach to coastal biodiversity habitat monitoring will detect changes to coastal biodiversity and help ensure that coastal management is carried out with these trends in mind. This in turn will allow a more effective approach to spatial planning and ensure that there is a better understanding of the impact of climate change on the development of the coastal zone. This will result in a more sustainable approach to managing and developing the coastal zone.

- Strategic monitoring provides an opportunity to further develop partnerships across the Region and will allow the organisations to share experience, expertise and data. This contributes towards a best value approach to delivering protection and enhancement of biodiversity.

- The mapping and monitoring of coastal habitat will provide best value by achieving economies of scale and ensuring that an appropriate biodiversity monitoring programme is implemented across the North West

Unlike the Eftec study, the Cell 11 Regional monitoring strategy follows the principles of PAG3 economic appraisal to consider the most cost beneficial (and technically feasible) option for data monitoring and applies prescription to the cost saving percentages for a wide range of activities over the project lifetime. The benefits and cost savings are summarised in Table B2.

Table B2. Economic Benefits of a Regional Monitoring Strategy

Activities	***Benefits***	***Savings***
Strategic Planning		
Savings in field data collection required for studies, coastal strategies and SMPs	Current annual expenditure on strategic studies includes a significant proportion on data collection and processing.	20% of total costs of study
Efficiency savings in time arising from acquisition and checking of historical data	Regional monitoring will provide a consistent approach to data management, an excellent searchable meta-database, a data quality control system and rapid electronic delivery of data. Users of data will be able to find, gather and assert provenance of the data very quickly.	£5,000 to £10,000 per study
Savings arising from improved phasing of schemes	Schemes are often implemented earlier than may actually be required to maintain the necessary standard of service, because there is insufficient high quality data available to enable the scheme designer to proceed with sufficient confidence that standards will be maintained.	Deferring scheme implementation by 3 Years results would result in discounted cost savings of approximately 10%; similarly, deferring scheme costs by 5 years would result in discounted cost savings of 16%.
Benefits in design and construction of capital schemes		
Savings in data collection required for schemes	Savings arise as the result of reducing the need for scheme specific monitoring, although some such monitoring will still be needed to provide more detailed data	A range of between 2-10% of the total monitoring costs is assumed to be of direct value.
Savings due to improved confidence and efficiency of design	Significant savings can arise from use of reliable models of wave climate, water levels, and foreshore response, based upon long time series of data. Risks associated with each option may be reduced, and greater confidence provided to any factor of safety applied.	1) Cost savings made by reduction in crest level of beach recharge (=5%) 2) Cost savings made by reduction in crest level of rock armour sea walls (=3%) 3) Cost savings made by reduction in crest level of concrete sea walls (=1%)
Savings due to improved confidence and efficiency of design (continued from above)	In many cases this will result in a direct saving in project costs, since the quantities of materials can often be reduced.	4) Cost savings made by reduction in crest level of earth embankments (= 5% estuary; 1% SMP)
Availability of historic measured wave data for use in coastal defence studies	1) Historic data for use in coastal defence studies: · 2) Historic data for use in climate studies: Intangible benefits 3) Near real time data for use by EA in coastal flood forecasting 4) Near real time data for use by UKMO as input to operational wave forecasting 5) Navigation and recreation benefits	Case specific

Activities	*Benefits*	*Savings*
Strategic Planning		
Benefits in design and construction of capital schemes		
Improved efficiency of monitoring management A regional monitoring programme allows minor changes to programme to be effected efficiently by minor variations to contracts under the programme. This results in more efficient procurement.	*Benefits include*: 1) Procurement efficiency 2) Efficiency savings in contract management 3) Economy of scale in system development and refinement 4)Ability to vary programme at minimal additional cost	1) Long-term (5 year) contracts are likely to present savings. Such savings arise as contractors can plan ahead, be assured of a workload, has to tender less frequently (1 to 5%) 2) A consistent approach to contract specification will enable substantial cost savings to be made through efficient contract management. (1 to 5%) 3) Collection of data will become more efficient as the spatial distribution of data will generally be denser. Pro rata field data collection costs reduce where beach profiles are closely spaced due to time savings in data collection. Significant economies of scale arise (2 to 10%)
Maintenance of data value through preservation of data	The current approach to data management results in considerable actual loss of data due to poor storage and also minimal potential for reuse, due to a general lack of metadata	It is assumed that at present between 5-40% of data collected could potentially be lost from the system,
Benefits from the supply of information	Data produced by the strategic regional monitoring programme will be made available to the general public via the project website. This is in accordance with the Environmental Information Regulations and the Open Government Code of Practice.	It is expected that many data sets will be analysed by research institutions and that added value results will be made available through the programme at no cost. The data collected under the programme has an economic value itself, as the recipients do not have to pay for the data. The benefit of the data to the recipients is arguably equal to the cost of purchasing the data. (50 to 150% of estimated value)
Benefits from Reduced Maintenance to Coastal Defence Structures	Improved allied with more frequent monitoring of structures will allow for improved defection of defects that will provides for earlier and structure maintenance responses, dealing with problems before they have a chance to develop.	Upper and lower limits of 50% and 150% of estimated values

Appendix C – Stakeholder Questionnaires

C1.1 Preamble

Building on the issues identified in Appendices A and B, a questionnaire was designed to elicit current practice from both within the flood risk industry and outside. This questionnaire (C1.2) was emailed to Environment Agency flood risk managers, and personnel with data responsibilities in Local Authorities (with coastal process remit) and other organisations external to FCERM. Only five out of 12 circulated were returned; interestingly the two most useful replies were received from practitioners largely external to FCERM (English Nature and The Met Office). Results are detailed in Table C1. The lessons derived from the literature review and the questionnaire analysis enabled the development of an emergent good practice for improving data and knowledge management for FCERM.

C1.2 Questionnaire

Defra/Environment Agency
R&D Project FD 2323: Improving Data and Knowledge Management for Flood and Coastal Erosion Risk Management (FCERM)

Work Package 4: Appraisal of value and risk of information and data management

As part of the "Data and Knowledge Management" R&D project Work Package 4 is charged with reviewing available good practice methodologies (both inside and outside FCERM) that could be used for appraising the value, and for justifying and prioritising the need for FCERM data and information.

The collection (and improvement) of data as part of a well co-ordinated programme supported by an appropriate business case are an essential part of all FCERM activities. Assessing the value of data collection and data management and associated risks are rarely enshrined in conventional Cost Benefit Analysis procedures with demonstration of benefits (both direct and indirect) through:

- Cost savings afforded by data (day to day operational savings)
- Quantified Benefits or value added to the business
- Willingness to pay for data should quantitative procedures to deliver monetary savings and benefits prove difficult.

The review of Good Practice will relate to:

- ***Strategic options*** (whether or not to collect data at all), and
- ***Technical options*** (evaluation of the detail of how data might be measured, collected and stored, prioritised and improved and how often these activities should take place.

Within Technical Options, we are not appraising how data is collected and stored but how we justify the need for and level of data storage and management.

Again, in line with HM Treasury Guidance, 4 strategic options should be evaluated:

- ***Do Nothing*** (Do we really need data to support our objective, or at least what is the minimum requirement?)
- ***Maintain the current level of data collection*** (The base case if we are concerned with incremental value of additional data collection)
- ***Reduce the current level***
- ***Expand the current level*** (or make the collection of current data more efficient but in keeping with the law of diminishing returns).

The following questionnaire is designed to elicit your data appraisal and data management methods (strategic and technical) and the risks and uncertainties associated with data collection and management activities:

Name……

e-mail……..

Organisation…….

Data Responsibilities…….

What are main data sources used for?.....

- How do you make a business case for the collection and management of data?

- How are the benefits of data collection assessed or quantified?

- How are the costs of data collection assessed or quantified?

- How would the absence of (existing or improved) data and data management impact on your business?

- How do you justify the need for more or improved data?

- How do you make a decision for the prioritisation of data needs?

- How do you assess the performance (fit for purpose) of current data?

- How do you assess whether data is appropriate (quality and quantity) to drive policy?

- Do you maintain different data for different levels of decision making?

    - And if so, how do you justify the need for and level of data storage/ management and its improvement (i.e. data storage)?"

- What are the key risks and uncertainties of collecting data, not collecting data or not improving data?

- How do you minimise the risks and uncertainties in collecting data, not collecting data or not improving data?

- What type/ level of data do you collect without additional justification (for example Health and safety data)? And when/ how do you justify additional expenditure?

John Chatterton
Birmingham
07785 258124
0121 449 7773/3530
6th June 2005

(on and behalf of the Defra/EA Data and Knowledge Management consortium)

C1.3 Detailed Questionnaire Responses

Questions	Environment Agency: Asset Management	Met Office	English Nature	Environment Agency: Data management strategy	Regional Monitoring Project: Sefton Borough Council
What are main data sources used for?	Managing EA's Flood Risk management assets	Weather Forecasting	1) Site condition assessment 2) to underpin particular designations 3) to inform advice Government and Competent Authorities in relation to development planning.	Flood Risk management (NFCDD)	Regional monitoring of coastal processes
How do you make a business case for the collection and management of data?	Benefit cost analysis	Assess the data use with regard to the area and or population covered. The emphasis is on health and safety of the population.	Projects are submitted as part of the annual bidding process, or on rare occasions are commissioned as a matter of urgency when development planning problems emerge. There must be a specific use for the data associated with our statutory responsibilities.	NFCDD business case (phases 1, 2,3) extracts) relating to benefit of overall activity	Project Appraisal (PAR) Benefit cost analysis using PAG3
How are the benefits of data collection assessed or quantified?	Split into: cash releasing; cost avoidance; productivity; income	The data is compared against historic costs of effects, where no data was available. The effect is also compared with Insurance industry evaluations of expected costs for a weather related incident and actual costs where warnings were made	Uncertain if they are – data collection and data management is something that can fall in and out of favour according to the economics of the organisation and of course according to the degree to which the bigger political climate is favourable.	As above: Cost Savings associated with better quality data	Cost savings for: 1) Strategic Planning 2) capital schemes 3) Maintenance
How are the costs of data collection assessed or quantified?	Estimate of FTEs based on experience, questionnaires and (soon) timesheet data	Records are kept of all the infrastructure costs required to provide the data. This is split into cost of raw data. Costs for data processing. Costs for adding value by skilled analysis.	In essence, if the costs are high, there is less chance of data collection happening. There are past data management projects that have been shelved or passed on to management by other organisations to reduce costs and staff resources.	NFCDD "£4-5 millions" but data collection costs are 'tip of iceberg'. Inspection and re-inspection respond to Government HLT's and are not costed; Ruggedised laptops again add to costs. No total costing other than NFCDD development costs through Gateway reviews	Whole life costs of infrastructure to enable regional monitoring

Questions	Environment Agency: Asset Management	Met Office	English Nature	Environment Agency: Data management strategy	Regional Monitoring Project: Sefton Borough Council
How would the absence of (existing or improved) data and data management impact on your business?	1) Poorer / or reactive decision making on investment rather than planned, risk targeted investment 2) Lack of credibility - affects government view of us and ultimately our funding	The accuracy of short term forecasting would deteriorate.	Improved data management such as digitisation of past habitat surveys would greatly improve the speed with which we can advise Government and assist in programmes such as the current work on access to the coast. Currently, some data are comparatively inaccessible, making decision-making difficult. At a broader scale, many data are rapidly becoming old and may need to be renewed – this is an issue as costs of data acquisition are significant.	Total negative impact on the new risk based approach to management; Fundamental to risk based approach. Data allows business to operate systematically and avoids the costs of fire fighting.	Significant additional costs added to project planning because of both inadequate data and need to collect/duplicate data
How do you justify the need for more or improved data?	By assessing the effects of not having good and sufficient data in monetary and reputation terms	Comparison of costs related to the accuracy of the data. Specifically with Weather Radar the data accuracy of the entire data field is 5km (i.e. a single amount representation is used for an area 5000 metres by 5000 metres). The added accuracy available within 50 km of the radar (2km (2000 metres by 2000 metres)) gives greater clarity of local events enabling more specific short term forecasts.	A convincing Business Case but must be relevant to the work programme and our statutory responsibilities.	Enables objectivity in the 'perceived risk'. Creates a better understanding of Flood Zones. Directs investment decisions. Improves consistency; defines risk in a consistent way. Funding decisions can be made with more confidence	Whole life costs set against discounted savings over life of project
How do you make a decision for the prioritisation of data needs?	Biggest benefit / impact first eg target urban asset data first	By comparing the population density with the possible benefits (in general the greater the population per area the higher the value)	On the basis of cost and relevance to the work programme and priorities.	To secure maximum national funding. The Risk Decision Matrix of risk allows comparison of community risk, but position on Decision Matrix is wholly dependent on quality and consistency of input data	Through cost beneficial option appraisal of technically feasible options set against a Do Nothing Baseline
How do you assess the performance (fit for purpose) of current data?	Coverage / completeness Quality – trained collectors, recent data?	By comparison with alternative data sources (rain gauges (only possible over land)).	Whether data makes it possible for us to meet our statutory requirements.	See Halcrow audit but Crest levels at 10mm accuracy for scheme appraisal versus lower level accuracy for RASP higher level risk assessments. Do we need 2 levels of data?	High quality data requirement as part of evaluation process

Questions	Environment Agency: Asset Management	Met Office	English Nature	Environment Agency: Data management strategy	Regional Monitoring Project: Sefton Borough Council
How do you assess whether data is appropriate (quality and quantity) to drive policy?	As above	By comparison with alternative sources and uses (i.e. Satellite data and rain gauges)	We use specialists whose job it is to make such evaluations – a question of working by experience.	Emphasis on consistency in training for asset inspectors; Need for Quality flags	As above
Do you maintain different data for different levels of decision making?	Use same data but at different levels ie all data used at operational levels, lesser detail at tactical and strategic levels of organisation. Try to collect once and use many times.	No	Inevitably – data are generally split into meta-data and more detailed data. Again, the justification is based on our ability to meet statutory responsibilities – there is little lee-way and no collection of data for the sake of data collection.	Define minimum data quality requirements. Differentiate between: • data collection to drive investment decisions now • Monitoring (e.g. tide level trends) which has a bequest value to assist in correct future investment strategies wrt climate change and other temporal fluctuations	No
What are the key risks and uncertainties of collecting data, not collecting data or not improving data?	1) Risk of failure of assets – and hence life and property 2) Risk to reputation and hence funding	Data is not of a sufficiently good quality to achieve forecasts with a greater accuracy than persistence.	Rely on existing data but the historic legacy is inadequate to meet needs. Leads to future problems. The risks are increased if we have to counter an alternative approach by, say, a developer or opponent to site designation on the basis of old data – "how can you be certain that what you describe is still there?"	Quite simple: wrong investment decisions	Failure of comprehensive monitoring will seriously inhibit the need and access of comprehensive and good quality data for both strategic and project planning and feasibility studies
How do you minimise the risks and uncertainties in collecting data, not collecting data or not improving data?	1) Training of data collectors 2) Standards and processes for all to use (Work Instructions) 3) Data collection in field electronically (Project Checkmate)	Regular post event analysis, to check data quality. Continuous checking of data streams for timeliness and Quality. Off line analysis and production of test data streams to check for possible upgrades	Data collection is not always in favour – one just has to do one's best and use professional judgement as to the most important data – which is usually based on the pressing needs of the time.	Understand quality of data through Data Quality Flags and audit	Training and quality of highest calibre
What type/ level of data do you collect without additional justification (for example Health and safety data)? And when/ how do you justify additional expenditure?	Probably only H&S comes into this category.	None	No answer	Logical to put PSRA onto NFCDD	None

Appendix D – Emerging Good Practice

Following the Literature Review, the questionnaire analysis and subsequent discussions with key stakeholders have enabled the emergence of suggested Good Practice for data collection and management:

- **Development of a Benefit Cost Model as suggested in "National Flood Defence Data & Data Management Strategy February 2004"**

- **Introduction of 'conventional' FCDPAG3 Appraisal techniques as introduced in Cell 11 (NW) Regional monitoring Strategy, to:**
    - Compare technically feasible data improvement options against 'status quo' existing data collection methods
    - Consider incremental benefits of data improvements to establish 'law of diminishing return'
    - Do not use Do Nothing as a Baseline as the presumption is for improvement not whether data is needed at all
    - Develop cost saving scenarios within carefully scripted 'workshops' rather than 'guesstimates' or assumptions (unsubstantiated) of fixed savings against revenue or capital costs of FCERM activities
    - Strategic Cost savings scenarios should consider the following topics:
        - Strategic Planning
            - Savings in bespoke, project specific data collection
            - Better supply of high quality data
            - Efficiency savings from high quality database development
            - Efficiencies from improved phasing of schemes
        - Benefits in design and construction of capital schemes
            - Savings in bespoke data collection required for schemes
            - Savings due to improved confidence and efficiency of design
            - Procurement efficiency
            - Efficiency savings in contract management
            - Economy of scale in system development and refinement
            - Ability to vary programme at minimal additional cost
        - Benefits from Reduced Maintenance to Coastal Defence Structures
            - Improved and earlier detection of defects
    - Consider the effect of 'Value added' effects of data in improving the 'science' of FCERM, whilst acknowledging difficulties in accurate quantification
    - Use Willingness-to-pay techniques with caution if deriving monetary values of the value of data to stakeholders

- **Introduce periodic audit of cost savings following the implementation of data collection strategy (ies)**
  - Measure actual savings against target estimates
  - Feedback to future data collection and improvement appraisals

- **Avoid 'fire-fighting' and develop a risk based approach to prioritising data collection**
  - with SPA's and SAC's and densely populated flood plains (Land Use Bands A, before B, before C) taking precedence.
  - Data required for statutory obligations and data to comply with Governmental targets should take overall precedence.

- **Data collection costs should be measured as whole life costs to include:**
  - Data collection and storages
  - Systems (Database) development and maintenance
  - Cost of hardware including data loggers
  - Costs of Inspections and re-inspections
  - Costs of adding value to the data by skilled analysts

- **Review the consequences and risks of poor decisions on data collection**
  - Measure the effect on Investment decisions on future strategies and projects
  - Measure the effect on poor public and Government credibility
  - Estimate the scale of negative impact on the risk based approach to management
  - Estimate the scale of increased project costs (flip side of cost savings)
  - Assess the effect on deterioration of monitoring capability and future implications for future investment decisions

- **Data Quality audit to be of paramount priority in Data management procedures**
  - Develop Data Quality Flags to include:
    - Capturing the confidence of a user when assigning subjective data to an asset,
    - Evaluating specific accuracy of data in relation to predefined criteria
  - Use Data Quality flags to eliminate or minimise both 'systematic' and 'measurement' errors in data

- **Data Quality must not be compromised**
  - Introduce 'Kite mark' for datasets to indicate fitness for purpose
  - The provenance of data should be transparent to the decision maker with quality flags embedded within databases such as NFCDD.
  - Data Action Plans to achieve National consistency are of highest priority

- National training in competency is fundamental to collection of high quality and Nationally consistent datasets, to include:
  - Visual asset condition assessments through T98
  - Technical training in data collection and recording equipment
  - Register of accredited data collectors/asset inspectors
  - Re-accreditation at agreed intervals
  - Training in Database use, access and reporting
  - Training in use of data loggers

- **Ensure Data Ownership through dedicated 'Custodians'**
  - Custodians to have total accountability for data quality, to :
    - Avoid inconsistencies
    - Eliminate inefficiencies
    - Reduce replication
    - Ensure completeness
  - Local data collection initiatives to be restricted and carefully monitored
  - Managers should understand the context of data, through;
    - Ensuring Awareness
    - Avoiding misuse, misunderstanding or mis-use
    - Being responsive to information

- **Maintain association between data and managers**
  - Data collectors have to understand the value of data, by
    - Ensuring better quality
    - Ensuring fitness for purpose

Appendix E – Development of Fundamental Principles

E1 Appraisal Tiers

Within FCERM there are six appraisal tiers:

Table E1 FCERM appraisal tiers

Tier	Function	Intent
National policy	WHAT is at Risk?	Establishing associated policy commitment. Appropriate investment and impact of damages. Audit management
CFMP/SMP	WHY is there risk?	Long term avoidance of risk. Risk and benefit transfer. Sectoral integration.
Strategies	HOW can risk be managed?	Management of residual risk
PAR	WHICH options are optimal/ sustainable?	Efficient use of national resource
Design	WHAT needs doing?	Effective, robust implementation
IFRM (Systems Performance)	WHEN is maintenance appropriate to sustain acceptable risk?	Minimisation of whole life cost. Efficient use of local resources

In an ideal world where resources, and individual capacity to manipulate information, were infinite the same data sets used for detailed scheme justification would be used to determine National Policy. Alternative datasets of differing qualities and completeness can obfuscate the appraisal process leading to mis-information and false premise, further obscuring the decision making process. Colloquially the principles of GIGO (Garbage In Garbage Out) and DID (Drowning in Detail!) apply.

A number of introductory questions are here posed to assist with the development of the data appraisal principles:

Question 1:

Should same NFCDD (asset) data (asset condition, weighting, standard of protection, defence level, replacement cost etc.) be utilised to inform decisions at all levels.

- IFRM (Incident and Flood Risk Management) through systems performance specification relies on visual condition grading to inform maintenance decisions; looking at the specific need for repair as well as building an understanding of the mechanisms and rates of deterioration.
- Design teams need specific criteria and parameters, in addition to variability of such conditions and combination of conditions.
- Project Appraisal Reports (PAR's) and strategies rely on condition grading to inform asset replacement decisions and also inform on probability of defence failure and or overtopping

- CFMP/SMP's do not require the same prescriptive data on asset condition but do require sound, if necessarily estimated, information on overall residual life and associated geomorphologic impact or influence. The CFMP/SMP also needs to look to broader different sectoral influences bringing in a more integrated approach; taking this process in part beyond the focus on FCERM.
- National Policy is driven by NaFRA, NADNAC, Foresight, which inform Government Spending Reviews, but "What is at Risk?" is collectively determined by aggregating asset data using a bottom up approach. The Headline banner *'1.04 billion annual average damages under existing defence scenarios'* [Foresight 2004] obfuscates for example the quality and comprehensiveness of the baseline data on asset condition.

Defra has reviewed the High Level Targets in 2005 to reflect these developments but in the meantime it is necessary to seek full effectiveness of the National Flood and Coastal Defence Database (NFCDD) and that arrangements remain for data acquisition including the results of inspections. The arrangements for establishing the NFCDD and for inspections were set out in the 1999 Targets and are regarded as being rolled forward for the purposes of the new target 2 which takes effect from April 2005:

A Record all base information to EA specifications *(by 31st March 2006)*
B Record on new or altered defences (by 20 days of completion)
C Record results of inspections on assets and watercourses *(10 working* days after inspections)
D Record results of privately owned assets (10 working days after inspections)

Accurate data is therefore essential for setting future output and performance measures and targeting resources on risk reduction irrespective of the tier of evaluation. With such detailed prescription of data entry requirements into NFCDD, there is little sense in 'dumbing down' of data to support high level strategic or policy driven initiatives.

Question 2:

Should the same Physical or Source data (hydraulic, hydrographical, hydrological, terrain) be utilised to inform decisions at all levels

- IFRM decisions for maintenance activities are rarely informed by detailed physical modelling
- On the contrary Design is strongly driven by modelling
- SMP's and CFMP's take a high level approach to physical data requirements with a 'mix and match' philosophy depending on available data and models

PAR's and strategies are informed by a 'pot pourri' of modelling tools and data and the results - HOW can risk be managed? and WHAT are the optimal options - are driven wholly by quality of base data and time and resources

poured into modelling and appraisal. Thus choice in the use of Lidar for terrain modelling or more sophisticated DTM tools will significantly influence the choice of option (see Lower Thames study at end of Appendix E).

Question 3:

Should the same economic data (cost, damages, benefits, property at risk, property valuations) be used to inform decision making at all levels?

- IFRM decisions are based on detailed costs but very high level decisions relating to economic justification and prioritisation of maintenance work; but also monitoring expenditure against the long term worth.
- Design focuses on cost in delivering the technical intent of the prepared option within a budget derived from very broad economic justification.
- PAR's and strategies use combinations of broad scale modelling (high level economic data) and precise data depending largely on whim and budget.
- SMP's and CFMP's use high level 'look up tables' to inform on damage
- National Policy (e.g. NADNAC) uses high level and aggregate data on costs and damages avoided (benefits) and property valuation to inform.

Likewise it is the abuse or misunderstanding of socio-economic data parameters that leads to inappropriate choices of aggregate or so-called representative data in high level strategy studies (again see Lower Thames study), which can lead to inappropriate investment decisions.

Improved modelling and associated data collection can indeed influence "What is at Risk?" Thus, the current flood zone map on the EA web site, based on modelling data circa. 1993, suggested some 12,000 properties were exposed to flood risk (Flood Zone 3) on the left bank of the tidal Trent downstream of Gainsborough. Detailed hydraulic and terrain modelling in 2005 by EA framework consultants has eliminated two-thirds of these properties from Flood Zone 3. Ironically therefore better data and modelling can achieve high level targets (aiding the reduction of properties at risk) without introduction of either structural or non structural intervention measures. Improved data fed into improved modelling can therefore change the perception of Flood Risk.

In conclusion, objectivity and professionalism in the face of ever improving data collection techniques and analytical techniques are key to the process. Management of perceived data errors is also crucial. Thus:

Measurement errors (resolved through time, resource and capability)

and

Systematic errors (resolved through conceptual thinking and understanding)

Must be fully recognised, transparent to the user and understood. Further to this is the need to recognise that there may be uncertainties which cannot be improved by monitoring, modelling or expert assessment.

E2 Proposed data quality scores and flags

Accuracy is defined as the closeness to reality (CIRIA C541, 2000). Accuracy scores can relate to the technique in either collecting the data or analysing the data. A descriptive set of values, such as ones in Table 2 (developed by Chatterton Associates and Haskoning), provide an self explanatory reference rather than vague High, Medium Low categories.

Table E2 Proposed accuracy quality flags

DQS	Description	Explanation
1	'Best of Breed'	No better available, unlikely to be improved on in near future
2	Data with known deficiencies	To be replaced as soon as third parties re-issue
3	Gross assumptions	Not made up but deduced by the project team from experience or related literature/data sources
4	Heroic assumptions	No data sources available or yet found
5	Unknown	Accuracy unspecified

Competence relates to the skill of the data's author. Data collected or processed by an experienced person has more value than if an inexperienced person collected it, even if a 'Best of Breed' technique had been employed. Although it is agreed that most operating bodies and contractors should be competent, it is important to record and know. Proposed categories are listed below.

1. High - Experienced and trained
2. Medium - Experienced only/ Trained only
3. Low - Neither experience nor training

Unfortunately competence is not recognised in the ISO19115 schema and so can only be inferred from the reputation of the data's author/organisation.

Age, together with length of record, can reveal the completeness of data and thus affect the confidence in the dataset. Data older than 5 years old can be considered past its prime but still useful. Suggested categories are shown below.

Table E3 Proposed age quality flags

DQS	Description
1	< 5 years
2	5 – 15 years
3	15 – 50 years
4	> 50 years

Length of record only shows its value when describing monitored data such as water levels, beach profiles, waves and rainfall. The greater the length of the record, the more likely that trends/patterns can be observed or carry out more accurate extreme analysis. For example, having a 20 year record of

river water levels gives more confidence in calculating a 100 year flood level than a short record of 5 years. The reverse scores for age can be used:

Table E4 Proposed length of record quality flags

DQS	Description
1	> 50 years
2	15 – 50 years
3	5 – 15 years
4	< 5 years

Spatial resolution refers to frequency of collection in space such as every 5 metres or every 100 metres. It is agreed that it is not possible to score since the there are too many units to sensibly create scores consisting of less than 5 categories. However, it is important to know and can affect the suitability. Therefore this metadata should be made available.

Temporal resolution refers to frequency of collection over time such as every 15 minutes or every month. However, we are faced with similar problems as with Spatial resolution quality and so cannot assign a suitable score/ranking system. Although the frequency of recording is only relevant to a small proportion of data, it does have an impact upon the applicability of the data. Therefore this metadata should be made available.

E3 A practical scenario in data quality flags and data filtering

Data quality and data provenance is crucial to ensure correct investment decisions are made. Both the Halcrow audit of NFCDD and the Multi-coloured Manual Handbook 2005 stress the need for data confidence scores in Source, Pathway and Receptor datasets.

Additionally data requirements need to adopt a filtering approach (see SMP2 Guidance). A ***High level filter*** makes the case for data collection i.e. what should be collected and what data fields are enumerated (for example, the impacts (both positive and negative) of a series of Shoreline Management strategies: *Hold the line, re-alignment of defences etc*. A **Low level filter** will then iterate data measurement until data of an appropriate quality is available to support a robust appraisal of costs and benefits.

High level filtering tells us what data to collect and enumerate (e.g. significance of impacts, likelihood) in a flood intervention strategy, and what should be measured. Just because it cannot be measured does not mean it is less important. Thus the role of Multi Criteria Analysis in high level filtering must be debated

Low level filtering tells us the sensitivity of the intervention strategy to data measurement/quality (i.e. LiDAR versus DTM, or property area measurement versus application of national average statistics on property area).

Low Level filtering is iterative until the BCR of the preferred technical option is stabilised. We need confidence that the data gathered is therefore fit for purpose. Thus the Halcrow Data Quality Flags give confidence as follows:

- **"very confident"** would be assigned to the condition grade classification in situations where the asset can be clearly surveyed with no doubt of the condition grade classification. Ideally this flag would be assigned where the condition grade was determined or verified by a certificated specialist (accredited on the T98 asset condition assessment course).
- **"confident"** data would be assigned to the condition grade classification in situations where condition grade can be assigned confidently but not without any doubt.
- **"uncertain"** data would be assigned in situations where accessibility, visibility or identification problems prevent clear assessment of condition grade. This flag could also be used to populate the field for historical assets in NFCDD.

Again, where a physical data parameter has a quantifiable estimate then of ***specific accuracy***, 5 quality or accuracy rating grades may be determined, e.g. for defence Crest Level as shown earlier in Table A1.

Clearly confidence is again related to the assigned accuracy and will influence the confidence in an appraisal whether at project, strategic or policy level.

Likewise Flood Hazard Research Centre (2005) have devised Data Quality Scores to measure the confidence in receptor or socio-economic data. Thus the table below is employed with a filtering algorithm to ensure that investment decisions are made only when data quality (for socio-economic parameters, i.e. land use, depth damage data applied, threshold levels, footprints of properties) is of such a standard that the benefits of Investment (wholly reliant on the quality of the multifarious input data) are stabilised.

Table E5 System of Data Quality Scores (DQS)

DQS	Description	Explanation
1	'Best of Breed'	No better available, unlikely to be improved on in near future
2	Data with known deficiencies	To be replaced as soon as third parties re-issue
3	Gross assumptions	Not made up but deduced by the project team from experience or related literature/data sources
4	Heroic assumptions	No data sources available or yet found; data based on purely educated guesses

This (and the data quality flag approach) must be formalised and developed for all source, pathway, receptor, consequence datasets not just for socio-economic data. For example, are the methods employed to estimate water surface levels and inundation extents for example more important to the investment decisions than the accuracy of threshold levels of property? And is there a need for a decision matrix to indicate the mode of data collection for different circumstances, not just because appraisers have the inclination, political will or have the budget, or have always done it this way.

In short, the variables that are most sensitive to investment decisions should be identified in assessing investment decision to optimise the quality of data. For example, the variation by a few millimetres in water levels for extreme tide levels in Thames Estuary (see Thames Estuary 2100 appraisals) may have a minor impact on the investment decision but inappropriate estimations of property foot prints from secondary source data relating to tens of thousands of properties may change results by an order of magnitude, and yet more money will often be spent on getting hydraulic modelling correct, perhaps with large incremental costs and possibly little incremental benefits).

The stark significance of data quality is illustrated by the Lower Thames Feasibility study, in the Teddington, Kingston area of south west London. Data quality was systematically improved using the filtering process until 'Do Nothing' Baseline damages were stabilised at an order of magnitude below initial data assumptions, Figure E1. The data assumptions for each 'CUT' or Filter are summarised in Table E6.

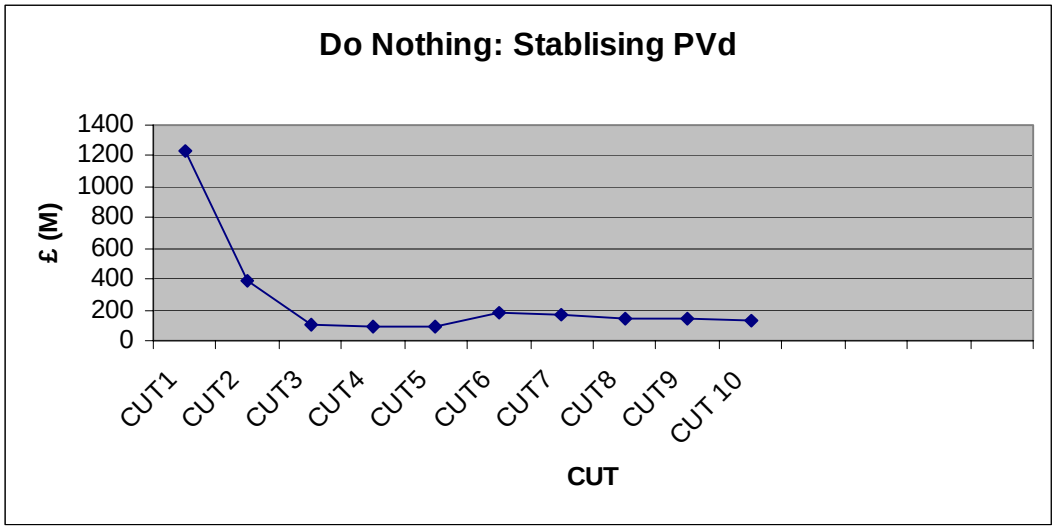

Figure E1 Stabilising PVd using filtering process

The volatility of LiDAR data for simulating property thresholds, erroneous interpretation of land use from the Environment Agency National Property Dataset (NPD) without field checks, regional (not actual) property footprints and sparse spatial representation of water surface levels with limited return period analysis combine to exaggerate significantly the Present Value of damage estimates (£1,229 million for first cut to £132 million for the preferred (stabilised) cut (Table E6). The implication for inappropriate allocation of scare flood risk management resources is stark in this example.

Table E6 Data assumptions for each cut/ filter

Cut N°	PVd £ millions	Data Characteristics								
		Water Surface	Property Threshold	DQS	Footprint Area	DQS	Land Use Code	DQS	Depth Damage Data	DQS
1	1,229	2 water levels for 3 return periods; U/s level linked to D/s; with no intermediate	LiDAR	4	Areas from MDSF mean values	3	NPD, no field checks	2	NPD Approx C	Various

2	387	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS MasterMap	1	NPD, no field checks	2	NPD Approx C	Various
3	104	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS MasterMap	1	First Field checks	1 & 2	NPD Approx C	Various
4	90.2	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS MasterMap	1	Further field checks, reducing properties, confirming land use	1 & 2	NPD Approx C	Various
5	91.6	103 co-ordinates for 7 return periods	Mean of levelled thresholds within each of 20 sub-areas	3	OS MasterMap	1	As 4	1 & 2	Weighted Mean of all NRP D/D in Approx C	2
6	181	110 co-ordinates for 7 return periods with increased water levels	Mean of levelled thresholds within each of 20 sub-areas	2	OS MasterMap	1	As 4	1 & 2	NPD Approx C	Various
7	175	110 co-ordinates for 7 return periods with increased water levels	Mean of levelled thresholds from increased sample	2	OS Mastermap	1	As 4	1 & 2	NPD Approx C	Various
8	139	110 co-ordinates for 7 return periods with increased water levels	Threshold adjustments from Halcrow LiDAR Analysis	1 or 2	OS Mastermap	1	As 4	1 & 2	NPD Approx C	Various
9	147	819 water Level Points for 7 return periods	Threshold adjustments from Halcrow LiDAR Analysis with corrections to spurious geo-references	1 or 2	OS Mastermap		As 4	1 or 2	NPD Approx C	Various
10	132	819 water Level Points for 7 return periods. 7 sub-areas and water profile adjustments		1 or 2	OS Mastermap	1	As 4	1 & 2	NPD Approx C	Various

A suggested 'filtering' procedure for benefit appraisals as endorsed by FHRC is as follows. Its credibility and application in improving datasets at all levels should be urgently considered in association with the data Quality Flagging system suggested by Halcrow (2005).

'The use of 'Filtering' to guide data quality improvements

The objective is to improve the quality of the data that makes most contribution to calculated benefits. The description below is for calculating the benefits of flood risk management.

A. Data assembly and DQS scores

Assemble the following for each property in the benefit area. The National Property Dataset (NPD) is a useful source of land use data.

1 The land use category

2 The floor area (Non Residential Properties) only: seeMCM Chapter 5)
3 The threshold height of the property
4 The most appropriate depth/damage damage data (from the MCM CD-ROM)
5 The hydrologic/hydraulic profile data (or similar)

Assign Data Quality Scores (DQS 1-4 as above) for each of the five elements of dataset above

B. Procedure

1. Calculate the Present Value of damages (PVd) for each property and rank all properties by PVd
2. 'Cap' PVd at each property's market value. Market value data sources include:
   - Residential: Land Registry website, etc, for the property's post code
   - Non-residential: from NPD (rateable value) or from www.voa.gov.uk (rateable value); NPD indicates the yield factor to convert rateable value (NRP) to an approximate market or capital value
3. Highlight properties contributing individually more than a pre-determined percentage of total PVd (usually1% for schemes with up to 250 properties; 0.1% with more properties)
4. If the total DQS for any of these highlighted properties is > 10 then re-visit their data sources and improve the data items with the highest DQSs
5. Re-calculate PVds and re-rank the capped PVd list
6. Repeat steps 2 to 5 as a 2nd iteration
7. Repeat iterations until total PVd stabilises

.

Appendix F – Demonstration of Data Appraisal Framework

F1.1 Objective

The aim of the case studies was to demonstrate the Data Appraisal Framework and as part of this, illustrate the use of data quality flags for ranking data and judging if data is "fit for purpose." The framework has been described in Section 4 of this report.

F1.2 Methodology

The tool and metadatabase had already been populated with some data for case studies in Work Packages 2 and 3. Therefore scenarios were chosen that appraised varying levels of data for different tasks, whilst also maximising the already skeletally populated system:

(a) Fluvial
- (i) Environment Agency carrying out a CFMP within Ancholme and Grimsby catchments – Would like to assess ground levels every 2 metres in order to calculate flood damages.
- (ii) Environment Agency carrying out an appraisal study on flood defence options in Market Rasen – Would like to know the type of buildings and property within the flood risk areas to calculate flood damage.

(b) Coastal
- (i) Defra ensuring appropriate coastal management is taking place in England and Wales – Would like to understand coastal issues for North West region from Great Orme's Head to Solway Firth.
- (ii) Sefton District Council carrying out coastal defence management planning – Would like to assess change in shoreline to help plan maintenance

For the fluvial case studies, metadata from the Ancholme and Grimsby CFMP was entered into the metadatabase. However, in some instances mock metadata was used. Coastal metadata from Sefton District Council had already been entered previously for case studies in Work Packages 2 and 3.

F1.3 Results

F1.3.1 Fluvial Results

(i) Q. What is my task?
A. To calculate flood damages for Ancholme and Grimsby CFMP.

Q. What data do I want?
A. I want to have ground levels every 2 metres.

Q. Does it exist?
A. No, it does not exist. Used the knowledge management tool to search the metadatabase, filtered original results of 13 using keywords "Topography" and "Elevation data" thus leaving 3 results (see print out below).

Organisation selected:	**Environment Agency**
Scale selected:	**Local / Anglian - Northern**
Activity selected:	**Develop policies & regulate activities alongside, in, on & over the watercourse**
Sub-activity selected:	**Develop Catchment Flood Management Plan (CFMP)**
Task selected:	**Identify large-scale urban development issues**

Number of results:	**3**
Information required used in search:	**«Flood/erosion damage»**
Additional keywords used in search:	**«Topography» «Elevation Data»**

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Metadata available:

Title: North Lincolnshire SAR
Alternative Title:
Abstract: Digital topographical data (Synthetic Aperture Radar) which is a coarse version of LiDAR
Distributor: Environment Agency

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: Not quite best of breed
Age Of Data: <5 years old
Spatial Resolution: Captured every 25m
Temporal Duration: <5 years Start: 01/10/2003 End: 01/10/2003
Relevance Ranking: 1(«Flood/erosion damage»)

Title: Ordnance Survey 1:50K maps
Alternative Title:
Abstract: 50K maps for West Lindsey District
Distributor: Ordnance Survey

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Robust methodology
Age Of Data: <5 years old
Spatial Resolution: 50m
Temporal Duration: <5 years Start: 01/09/2003 End: 01/09/2003
Relevance Ranking: 1(«Flood/erosion damage»)

Title: Anglian Water Manhole covers
Alternative Title: North Lincolnshire Assets
Abstract: Digital maps showing elevation and location of manhole covers in North Lincolnshire
Distributor: Anglian Water

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Ground survey with GPS
Age Of Data: <5 years old
Spatial Resolution: precision +/-50mm
Temporal Duration: <5 years Start: 05/06/2003 End: 05/06/2003
Relevance Ranking: 1(«Flood/erosion damage»)

Q. Is it House Keeping? Do I require it to make an informed judgement?
A. No, it is not house keeping as an informed judgement can be made using coarser ground level data.

Q. Is there substitute data that is suitable for my task?
A. Yes, SAR data exists for the area

Quality Flags: Accuracy: 2 – Data with known deficiencies
Age: < 3 years old
Resolution every 25m

Resolution seems out of proportion. Contacted distributor who advised that it is an error; it should say every 5 metres. This is an acceptable level to carry out task. Also the data was collected recently and so there is less risk that terrain has altered. Manhole cover levels data also exists that has a higher accuracy rating than SAR. This could be used to calibrate SAR levels to gain more confidence in ground levels.

Q. Can it be improved?
A. Yes, but not required for my purpose

Outcome: Obtain both pieces of data and use them.

Discussion: Although the search did not return ground levels at requested standard (such as LiDAR), other topographic data appeared and the quality ratings helped the user to appraise if it was suitable to carry out their task. "Length of record" was not required for such data. Also despite not having a "Competence" rating, it could have been inferred from the accuracy rating and the organisation that had collected the data. If data exists at a suitable level of quality then no justification or appraisal should be required, only if it does not exist, or requires improvement.

(ii) Q. What is my task?
A. To appraise flood defence options against the cost of flooding in Market Rasen (EA North Anglian)

Q. What data do I want?
A. I want to know the type of buildings and property within the flood risk areas.

Q. Does it exist?
A. Yes, the National Property Database (NPD) exists. Used the tool and filtered original results of 25 using keywords "Land use" and "Urban areas" thus leaving 2 results (see print out below).

Q. Is it fit for purpose?
A. Yes. Although it has an accuracy rating of 3, it was created for the Environment Agency which gives more confidence in the data. While it is not very recent data (> 5 years) it is still recent enough to calculate flood damage in the area. (For the purpose of demonstrating the appraisal framework, the metadatabase has only been partially populated and some of the data has been fabricated. In reality NPD is < 5 years old, managed by Halcrow on behalf of EA not Defra and could be seen as accuracy rating 2).

Q. Is it higher than my required quality?
A. No.

Q. Can I improve my task with better data?
A. Yes. Would have more confidence in answer if had more accurate data and knew specific types of residential properties (terraced, bungalows, brick, stone etc) and their age.

Q. Is there substitute data that is suitable for your task?
A. No, no other suitable data available.
Therefore need to carry out an appraisal and justification to improve this data and prioritise which is best method to improve it, such as site visit.

Q. Does any one else require this data?
A. No one else requires it within FCERM but it might help insurance companies to cross check their own data for claims.

Outcome: Obtain it and optimise efforts.

Discussion: Although the existing data was appropriate for the task, using the quality flags, the framework encouraged the user to seek betterment for their task. The user is then directed to search for the data again since the user was focused on different data in the first search and so might not have explored all the possible avenues. This data automatically becomes opportunity data as it is better than the data originally sought, therefore justification of collection and improvement is required. In this case insurance companies may want this extra level of detail for their use and so efforts and data could be optimised. As before "Temporal duration" was not required for such data and further confidence in the data could be inferred from the organisation that had collected the data.

F1.3.2 Coastal Results

(i) Q. What is my task?
A. Ensure appropriate coastal management in England and Wales

Q. What data do I want?
A. Understanding of coastal issues in North West region from Great Orme's Head to Solway Firth

Q. Does it exist?
A. Yes, in the form of 2 SMPs but some are missing for the area. (SMPs do exist in reality, but appear to be missing since metadatabase partially populated). Used the tool and filtered original results of 26 using keywords "Coastal behaviour", "Shoreline behaviour" and "Shoreline characteristics" thus leaving 8 results (below).

Q. Is it fit for purpose?
A. Yes. The SMPs that exist are of a suitable quality for this broad-scale task.

Q. Is it higher than my required quality?
A. No.

Q. Can I improve my task with better data?
A. Deferment until obtain SMPs. Yes, they can be improved with more recent data.

Q. Is there substitute data that is suitable for my task?
A. Yes, FutureCoast exists that is within the same age range of 3 – 10 years as SMPs but it is 3 years more recent than the SMPs.

Q. Can it be improved?
A. Yes, but no need for this purpose

Outcome: Obtain it and use it

Title: Futurecoast
Alternative Title: Shoreline Behaviour Statements
Abstract: Consists of three elements: 1. Coastal Behaviour Statement. 2. Assessment of shoreline behaviour. 3. Local-scale Shoreline Response Statements
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: road Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/10/2002 End: 01/10/2002
Relevance Ranking: 3(«Geomorphology»«Coastal evolution»«Climate change»)

Title: SMPs: A Guide for Coastal Defence Authorities
Alternative Title:
Abstract: Document identifies the requirements for developing future SMP's. It provides the aims and aspirations for future SMP's based on the results of a review of the first generation SMP's.
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: Broad Scale datasets assembled at a national level
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/06/2001 End: 01/06/2001
Relevance Ranking: 1(«Geomorphology»)

Title: Liverpool Bay SMP Sub Cell 11a:
Alternative Title: Great Ormes Head to Formby Point. December 1999
Abstract: SMP for stated length of coastline aimed at providing the basis for sustainable shoreline management policies over the next 50 years within a sediment cell or sub-cell(s) and to set the framework for the future management of risks along the coastline.
Distributor: Metropolitan Borough of Wirral

Accuracy: 3 - Gross assumptions
Reason For Decision On Accuracy: Variety of data sources used to compile strategic level document
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/12/1999 End: 01/12/1999
Relevance Ranking: 1(«Geomorphology»)

Title: Ribble Estuary SMP Partnership. Sub Cell 11b:
Alternative Title: Formby Point to River Wyre. June 1999
Abstract: SMP for stated length of coastline aimed at providing the basis for sustainable shoreline management policies over the next 50 years within a sediment cell or sub-cell(s) and to set the framework for the future management of risks along the coastline.
Distributor: Blackpool Borough Council

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: Variety of data sources used to compile strategic level document
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/06/1999 End: 01/06/1999
Relevance Ranking: 1(«Geomorphology»)

Title: Procedural Guidance for Production of SMPs
Alternative Title:
Abstract: This document was developed to establish the most appropriate, best practice methodologies to deliver the SMP's in accordance with the 2001 SMP Guidance. This document is supplementary to the 2001 SMP Guidance.
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: Broad Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/05/2003 End: 01/05/2003
Relevance Ranking: 1(«Geomorphology»)

Title: Futurecoast
Alternative Title: Cliff behaviour assessment
Abstract: Assessment of the nature of coastal cliff behaviour
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: road Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/10/2002 End: 01/10/2002
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: Futurecoast
Alternative Title: Coastal geomorphology reference manual
Abstract: Brief reference guide to assist coastal engineers and planners in gaining an improved understanding of the general principles of coastal geomorphology.
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: road Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/10/2002 End: 01/10/2002
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: Futurecoast
Alternative Title: Coastal Processes
Abstract: Consists of two elements: 1. Macro Review Report: Large scale overview of the hydrodynamics and sediment transport processes around England and Wales for both onshore and offshore regions. 2. Regional Review Reports: Reports for east, south and west coas
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: road Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/10/2002 End: 01/10/2002
Relevance Ranking: 1(«Geomorphology»)

Discussion: In this instance the question “Is it fit for purpose?” could return both “Yes” and “No” answers depending on the user’s perspective. Although the existing data is good enough according to the accuracy and age, there should be more SMPs for the region. Subsequently the user could follow the other route and, instead of using other data like FutureCoast, they would commission studies to cover the gaps. However, they would find that in answer to “Does any one else need/use it?” several organisations would be interested in it (see print out below) and so could optimise efforts. So either path would lead to some form of optimisation, of other existing data or of efforts.

Finding Other Interested Parties Based On Information Required Categories

Information category selected: Geomorphology

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Organisations and associated activities from the web tool that may provide or use similar information

Organisation	Activities	Sub-activities
Environment Agency	Develop policies & regulate activities alongside, in, on & over the watercourse	Coastal Defence Management Planning (i.e. develop SMP policy)
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Environment Agency	Develop policies & regulate activities alongside, in, on & over the watercourse	Coastal Defence Management Planning (i.e. develop SMP policy)
Environment Agency	Develop policies & regulate activities alongside, in, on & over the watercourse	Develop Catchment Flood Management Plan (CFMP)

Organisations that may provide or use similar information

English Nature
Environment Agency
Local Authority
Ministry of Defence
Research Bodies
Riparian/Land owners/Occupiers
RSPB

(ii) Q. What is my task?
A. Coastal defence management planning for Sefton District Council

Q. What data do I want?
A. Long record of shoreline change to help plan maintenance.

Q. Does it exist?
A. Yes, annual beach profiles exist. Used the tool, filtered original results of 35 using keywords “Survey data” and “Shoreline response” thus leaving 10 results (see print out below).

Metadata available:

Title: 2004profileline
Alternative Title: 2004 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/2004 End: 01/08/2004
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 2003profileline
Alternative Title: 2003 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/2003 End: 01/08/2003
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: Futurecoast
Alternative Title: Shoreline Behaviour Statements
Abstract: Consists of three elements: 1. Coastal Behaviour Statement. 2. Assessment of shoreline behaviour. 3. Local-scale Shoreline Response Statements
Distributor: Defra

Accuracy: 2 - Data with known deficiencies
Reason For Decision On Accuracy: road Scale datasets assembled at a national level
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/10/2002 End: 01/10/2002
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 2002profileline
Alternative Title: 2002 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: <5 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/2002 End: 01/08/2002
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 2001profileline
Alternative Title: 2001 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/2001 End: 01/08/2001
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 2000profileline
Alternative Title: 2000 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/2000 End: 01/08/2000
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 1999profileline
Alternative Title: 1999 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/1999 End: 01/08/1999
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 1998profileline
Alternative Title: 1998 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/1998 End: 01/08/1998
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 1997profileline
Alternative Title: 1997 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/1997 End: 01/08/1997
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Title: 1996profileline
Alternative Title: 1996 Beach Profiles
Abstract: Point data of Sefton Coast beach profile topographic surveys recorded using GPS
Distributor: Sefton Council Coastal Defence

Accuracy: 1 - Best of Breed
Reason For Decision On Accuracy: Technique uses GPS
Age Of Data: 5 - 10 years old
Spatial Resolution:
Temporal Duration: <5 years Start: 01/08/1996 End: 01/08/1996
Relevance Ranking: 2(«Geomorphology»«Coastal evolution»)

Q. Is it fit for purpose?
A. Yes. It has been recorded since 1996 and so is fit for purpose.

Q. Is it higher than my required quality?
A. No.

Q. Can it be improved?
A. No. The beach profiles date back to 1996 and have been assigned an accuracy flag of 1 since the technique used is GPS, and so are the best available data.

Outcome: Obtain and use them.

Discussion: If the profiles had been entered as a single entry then the "Length of record" would have returned a useful value. This would have helped determine the appropriateness of the data. The value of data in this case is the monitoring of the beach, therefore this value can be used to justify the continued programme of profiles. Also once the data has been viewed, a decision can be made to take profiles more frequently should the user discover that the coastline is particularly dynamic from using other data (considering the data coherence principle).

F1.4 Conclusions

The case studies illustrate the usefulness of knowing the quality of data, in that it allows the practitioner to assess whether the data is appropriate or not for their task. Although there is no ISO field for competence, it can be inferred by assessing both the accuracy rating and the organisation that collected or created the data. The data age categories clearly showed how old the data is and could also show a need for more recent data. Resolution was called upon within the fluvial CFMP case study. Knowledge on how often ground levels were recorded allowed a judgement on existing data suitability and also prevented unnecessary procurement of further data. However the field was not always populated since it only relates to certain types of data. Similarly the length of record flag only becomes useful for monitored data. In order to realise the full potential of this flag, then such data should be entered as one record in the metadatabase or database rather than being split up.

The data appraisal framework leads the user in a systematic and logical manner. The initial additions steered the user to take advantage of existing data where possible, thus avoiding potentially expensive and unnecessary collection. The betterment query within housekeeping data appraisal presents the opportunity to carry out the user's task with better quality data. Although the house keeping data is fit for purpose, the user might be able to fulfil their role better with improved data. Subsequently the data being appraised surpasses the house keeping threshold. However, the framework should lead the user to ask if this better quality data exists, rather than proceeding straight to justification.

Overall the data quality flags give an insight to the appropriateness of existing data, via ranking, as well as revealing data gaps. Moreover the framework succeeds in guiding the practitioner to optimise existing data and also seeking to optimise efforts to collect new and improved data.

The case studies have also tested the tool and metadatabase further. They reinforce the importance of strict management of keywords, checking entries and the need for steer on populating the metadata. Following through the scenarios has also confirmed that there are added dimensions to the data needs charts and information fountains in work package 1, such as quality of data.

PB 12527/18

Ergon House
Horseferry Road
London SW1P 2AL

www.defra.gov.uk