

Final Project Report

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Project title

Estuaries Research Programme (ERP) Phase 1 Uptake Project

DEFRA project code

FD2110

Contractor organisation
and location

Posford Haskoning Ltd, Rightwell House, Bretton, Peterborough, PE3 8DW

Total DEFRA project costs

£ 172,500

Project start date

01/02/02

Project end date

30/11/02

Executive summary (maximum 2 sides A4)

The Estuaries Research Programme Phase 1 (carried out by the EMPHASYS consortium) evaluated a wide range of methods capable of predicting changes in the shape (morphology) of an estuary and parameters related to the morphology. Different classes of method were tested, in various estuaries around the UK, in terms of their ability to predict morphological responses to variables such as sea-level rise, changes in flows and tidal conditions, and engineering works. The data for predictive method testing was compiled in a database for use by the EMPHASYS consortium.

It was recognised that Phase 1 produced useful results that should be more widely used. The Estuaries Research Programme Phase 1 Uptake Project was designed to disseminate these outputs through a programme of workshops and to deliver several reports and other products to fulfil this uptake.

The Uptake Project was carried out in seven main tasks: consultation, demonstration projects, guidance notes, experimental interactive software, dissemination workshops, database and estuary data management (best practice guidelines and workshop).

- To aid the wider guidance objectives of the Uptake Project, the generic outputs of Phase 1 were illustrated using examples or “demonstrations” in two estuaries: the Mersey and the Blackwater. These demonstrations have been designed to provide worked examples of good practice in undertaking estuary studies. Consultation was undertaken to establish the issues that would be used as a basis for the demonstration projects. The consultees were from a wide range of backgrounds covering many different interests in each estuary. The Blackwater Estuary demonstration utilises the predictive studies that led to a recently adopted managed realignment scheme at Abbots Hall. The Mersey Estuary demonstration describes the approaches to evaluating the morphological impact of a hypothetical adjustment to the training walls in the outer estuary. The stages presented in the demonstrations are applicable to a

large number of UK estuaries and provide valuable worked examples of how a proposed strategy or scheme can be approached.

- Guidance Notes for Assessing Morphological Change in Estuaries were produced and distributed during the project. The primary objective of these is to introduce best practice guidance to those with a management or decision-making role in estuaries, on the choice of approach for assessing dynamic and morphological change. They go through the essential steps of the estuary management process including defining the issues in hand, data requirements, the choice of short- or long-term predictive methods and synthesis of available information.
- An experimental interactive software programme has been developed to invoke a rule base or decision tree. The software is designed to lead the user through a series of stages starting from an issue, through the topics affected by the issue to types of generic methods that could be used in the appraisal of the issue. The software is strictly a prototype intended to illustrate a thought process and not to be a comprehensive package to predictive method selection. The generic methods included in the software are drawn exclusively from ERP Phase 1.
- A series of one-day workshops were carried out to bring together all the relevant results from ERP Phase 1 and the products of the Uptake Project (see above), and disseminate the information to a wider audience than previously. A total of 116 individuals attended the five one-day workshops in London, Peterborough, Newcastle, Exeter and Warrington. Each workshop was structured to provide advice on how to specify a programme of studies to address estuary issues and how to interpret the results. The workshops drew conclusions relevant to practical estuary management arising from the Uptake Project, using the demonstrations on the Blackwater and Mersey as core examples.
- The original Phase 1 database has been updated with new information and a public version of the database created on CD. The CD contains diverse environmental data from six key estuaries; the Humber, Blackwater, Mersey, Ribble, Southampton Water and Tamar. A GIS software package (STEMgis) is supplied with the CD to enable the database to be quickly and simply queried and detailed metadata facilities provide access to key information about each dataset, such as creator and scale. A digital report on the CD provides a more detailed description of the datasets within the database and advises on how to get the most out of them when using the STEMgis viewer.
- A set of Best Practice Guidelines for Scientific Data Management by Project Consortia has been published. The aim is to ensure that those individuals both commissioning the project as well as those actually undertaking the work have a reference for what is involved. To accomplish this, this guide presents principles for data management for each lifecycle state. These principles give pointers for action as to what more detailed procedures should take account of. Examples are given from the experience of compiling the database as part of ERP Phase 1. The database CD and principles for estuary data management were discussed at a one-day workshop in London, attended by 46 individuals.

Scientific report (maximum 20 sides A4)**1. INTRODUCTION****1.1 Estuaries Research Programme Phase 1**

In 1997 a scoping study was undertaken to establish a programme of research for developing techniques to predict long-term large-scale morphological change in estuaries. The study recommended a three-phase project, lasting between 9 and 12 years, with the aim of developing an integrated suite of estuary management tools. The scoping study led to the development of the UK Estuaries Research Programme Phase 1 (ERP Phase 1), a two-year programme of research into predicting estuary morphology and processes. The work was undertaken during 1999 and 2000 by a consortium of organisations consisting of consulting engineers, research laboratories and universities. The consortium was known as EMPHASYS (Estuary Morphology and Processes Holistic Assessment System) and its composition was as follows.

- HR Wallingford
- Posford Haskoning
- Royal Holloway University of London
- University of Newcastle
- ABPmer
- Proudman Oceanographic Laboratory
- Plymouth Marine Laboratory
- Centre for Ecology and Hydrology
- British Geological Survey
- CEFAS
- Delft Hydraulics
- University of Southampton
- Prof. Keith Dyer

The research compiled a suite of methods and models to predict estuary morphology and related parameters, upgraded these methods and made recommendations regarding their applicability and accuracy. Six estuaries were selected to allow the methods and models to be tested against a common dataset. The estuaries were selected based on their data availability and their representation of the types of estuary found in the UK. Two east coast estuaries (Humber, Blackwater) were selected along with two south coast estuaries (Southampton Water, Tamar) and two west coast estuaries (Mersey, Ribble). The extensive datasets collected for each estuary were stored in a database developed in the project.

1.2 Estuaries Research Programme Phase 1 Uptake Project

Recently, the Estuaries Research Programme Phase 2 (ERP Phase 2) Research Plan has been completed, outlining a number of projects that may feasibly be undertaken within Phase 2, building on the recommendations outlined in Phase 1. Prior to the commencement of Phase 2, it was recognised that in order to realise the full benefits of the work undertaken within Phase 1 and to build on the successes of the EMPHASYS consortium the outputs of ERP Phase 1 should be more widely disseminated. This led to the commissioning of the ERP Phase 1 Uptake Project which “forms a bridge” between Phase 1 and Phase 2 of ERP.

Building on ERP Phase 1, this Uptake Project provided more specific advice on how to formulate a programme of studies to address a particular issue and how to interpret the resultant outputs. This was achieved through best practice guidance at a series of workshops across England and translation of the ERP Phase 1 outputs into workable deliverables from an end user viewpoint. The objectives of the Uptake Project were:

1. Through consultation with stakeholders, describe and illustrate some of the various user-defined problems and issues relevant to flood and coastal defence, and present in the estuaries of the River Mersey and River Blackwater.
2. Select a range of existing methods and datasets that are appropriate to examine the predicted responses of estuary systems to the user-defined problems.
3. Collate the data used or generated by consortium members within ERP 1 to allow successful uptake of the methods identified during consultation. Parameters for input to the demonstration projects will be taken from this database.
4. Prepare a version of the database that can be made publicly available on CDROM.
5. Use the relevant methods and data in demonstration projects in the Mersey and Blackwater Estuaries to examine stakeholder problems.
6. Establish a training programme to provide advice on how to specify a programme of studies to address user-defined issues and how to interpret the results.
7. Draw conclusions relevant to practical estuary management arising from this project, through a series of end user training workshops.
8. Carry out a review of the data management techniques to establish the guidance for future programmes. A workshop run by CIRIA will review data management best practice and its integration with the wider issues of assessing or predicting estuary morphological change.
9. Produce final reports on the predictive methodology training programme, the database and data best practice identifying the scope for wider application of the techniques.

This document describes the achievements of the Uptake Project. It provides careful consideration of all the main issues associated with the project, and is divided into seven sections, each dedicated to an aspect or deliverable.

1.3 Project Team

The Uptake Project was undertaken by Posford Haskoning (Project Managers) in consortium with HR Wallingford, Royal Holloway University of London, ABPmer and CIRIA within the Broad Scale Modelling Theme of the DEFRA/Environment Agency joint thematic R&D Programme for Flood and Coastal Defence.

1.4 Project Officer and Liaison Group

The Project Officer for the Uptake Project was Dan Fox (Halcrow).

The Liaison Group comprised Beth Greenaway (Science Directorate DEFRA), Jim Hutchison and Andrew Parsons (DEFRA), Philip Winn and Jane Rawson (Environment Agency) and Jon McCue (Atkins). The role of the Liaison Group was to provide assistance at progress meetings to help the project manager make the project deliverables a success and to assist in the mechanics of dissemination.

The Liaison Group met three times with representatives of the project team and Dan Fox, on 26th February 2002, 10th June 2002 and 30th September 2002. The meetings were minuted, and the appropriate actions taken.

2. CONSULTATION

2.1 Introduction

A consultation phase with stakeholders of the Mersey and Blackwater Estuaries was carried out between February and April 2002 to establish the issues or concerns that could form a basis for the demonstration projects (as described in section 3). The consultation took place in two stages.

2.2 Initial Consultation

Stage 1 entailed initial meetings with local representatives from the Environment Agency and English Nature and the manager of the Estuary Strategy for each estuary and identified a number of preliminary broad issues. The product of these initial “brainstorming” sessions was two Consultation Reports.

2.3 Wider Consultation and Workshops

In Stage 2, the relevant Consultation Reports were sent to around 70 local stakeholders in each estuary with an invitation to provide written responses. An invitation to attend one of two stakeholder workshops, to discuss and expand the range of issues, was also provided. A total of 9 written responses were received that raised issues for discussion at the workshops.

Of the 69 invited to the Mersey Estuary workshop, 17 attended. The workshop took place on 8th April at Liverpool University. Representatives from Posford Haskoning introduced ERP Phase 1 (Alun Williams) and the Uptake Project (David Brew), and Jeremy Spearman from HR Wallingford introduced the application of the uptake project to the Mersey. This was followed by a short stakeholder “soapbox” session, where Ceri Jones (Sefton Metropolitan Borough Council) presented a brief overview of the Mersey Waterfront Regional Park.

The rest of the workshop was dedicated to a discussion of the issues of importance to those attending. Debate was lively and a general understanding of the project was apparent. All agreed that issues related to changes in estuary dynamics that would occur if the training walls at the mouth of the estuary were altered would provide a useful demonstration.

Of the 79 invited to the Blackwater Estuary workshop, 29 attended. The workshop took place on 9th April at Five Lakes Golf and Country Club, near Maldon. The format was the same as the Mersey workshop, except that Tim Cheshier from HR Wallingford introduced the application of the Uptake Project to the Blackwater. The “soapbox” session comprised Graham Downing (Essex Joint Council of Wildfowling Clubs) who described wildfowling on the Blackwater Estuary, Iden Wickings (Maldon Barge Operators Group) who presented navigation and economic issues on the upper Blackwater and Roger Lankester (Tollesbury Mud Club) who outlined his views on recreational navigation and estuary morphodynamics.

The rest of the workshop was dedicated to a general discussion of issues of concern to the stakeholders, not only issues in the Blackwater, but also of the project itself. A consensus was reached on the type of demonstration project that should be implemented. A suggestion to use the Abbot’s Hall managed realignment methodologies, as a basis for demonstration, appeared favourable to the attendees.

2.4 Stakeholder Champions

The consultation exercise and workshops also enabled selection of two representatives from the stakeholder community to be stakeholder champions, one for each estuary. The nominated persons were Caroline Salthouse (Mersey Strategy Manager) and Karen Thomas (Environment Agency) for the Blackwater. The Mersey Strategy is a public, private and voluntary sector partnership to take forward the issues addressed in the Mersey Estuary Management Plan. Both Caroline and Karen accepted the invitation.

The role of the stakeholder champions was to provide information and guidance on the benefits of the project from an end-user perspective to the delegates at the dissemination workshops.

3. DEMONSTRATION PROJECTS

3.1 Introduction

To aid the wider guidance objectives of the project, the best practice was illustrated through the use of worked examples or “demonstrations” in two estuaries: the Mersey and Blackwater. The Mersey and Blackwater Estuaries were chosen as demonstrations for several reasons.

- They provide strong contrast in terms of their associated problems and issues
- Both have a good range and quality of data
- Both estuaries were modelled and analysed at an earlier stage of ERP Phase 1

The demonstration projects were designed to provide a means of illustrating elements of good practice in approaching an estuary study, whilst meeting the needs of the stakeholders at consultation. The consultation provided guidance on the types of specific issues that the Mersey and Blackwater stakeholders are interested in. However, it was recognised that most of the workshops will address end users that have no direct interest in the Mersey or Blackwater Estuaries. The demonstration projects therefore carefully balanced the desire for demonstrating the details of the two selected projects with the overall requirement to illustrate the guidance to a wider group.

The demonstrations on both estuaries involved modelling both short term processes and long term change. The demonstrations related their various stages to the guidance provided by ERP Phase 1, the workshops and the Guidance Notes. In particular, the work undertaken in the demonstrations was used to illustrate:

- the scoping of a project or study
- the review of available data and collection of new data
- a description of the short-term process modelling that can be used to build up a conceptual model of an area
- the use of methods to predict long term morphological change

3.2 Mersey Estuary

Following consideration of a number of potential issues relating to the Mersey Estuary, a decision was made to examine the possible impacts of a hypothetical situation involving breaching, abandonment or removal of sections of the training walls in the mid part of the outer estuary. This issue was selected partly because, in reality, the construction of the training walls has had an undeniably large impact on the morphology and hydrodynamics of the estuary, and partly because the pattern of morphological change indicated by recent bathymetric surveys suggests that the training walls are currently preventing natural adjustments of the major channels and banks, which would otherwise occur. As a hypothetical exercise, therefore, two scenarios were selected for the purposes of demonstration. The first scenario involved an appraisal of the possible consequences of abandoning (or removing) part of the western training wall. The second scenario involved an appraisal of the possible consequences of removing part of the northern/eastern training wall.

Guidance on short-term predictive methods was illustrated by using research from an Oxford Brookes/HR Wallingford collaboration, which has extended the work undertaken by HR Wallingford on the Mersey Estuary during ERP Phase 1. This work examined the reasons for historical change in the Mersey Estuary in detail using a variety of modelling tools and formed the backbone of the demonstration project, allowing the illustration of how modelling tools and data can be used to develop an understanding of an estuary system. This resource was enhanced by further modelling of the short-term effects of the impact of breaches in the training walls on tidal currents and sediment transport. The demonstration project included a stage by stage description of the further steps necessary to provide predictive information on short-term processes once the important first stages of conceptual model development have been undertaken. The main results of this demonstration are reported in Thomas (2002).

Guidance on long-term predictive methods was illustrated using procedures and outputs of historical trend analysis. This technique was used to consider morphological changes and sedimentation patterns within the Mersey Estuary and adjacent parts of Liverpool Bay during periods before and since the construction of training walls. A second stage illustrated how this information could be combined with other data to carry out an expert geomorphological analysis which could be used to predict the likely future impacts on the estuary of training wall removal. The results of this demonstration are reported in Pye *et al.* (2002).

3.3 Blackwater Estuary

As part of a number of initiatives in the field of sustainable flood defences, the Environment Agency is using a 40 ha site in Essex for a managed realignment scheme. The location of the realignment is at Abbot's Hall near the head of Salcott Creek, within the Blackwater Estuary. Four (of a proposed five) locations within the sea wall have been breached (early October 2002) so that the low-lying land behind is inundated with tidal waters. A major objective of the scheme is to create ecologically valuable habitats including saltmarsh, mudflat and saline lagoons.

This realignment proposal is novel in that the area to be inundated is relatively large compared to the tidal area of the creek, in contrast to the two other schemes at Tollesbury and Orplands, also in the Blackwater. In order to provide information for the consent process a range of activities were undertaken to assess the extent and magnitude of the impact of the breaching on the adjacent physical regime.

This demonstration summarised the elements of this project to provide best practice in short-term predictive methods. The demonstration showed the results of the predictive testing (in this case the effects of the various breaches) and how the resulting information was further analysed to provide information on the impact of the scheme.

A key consideration in this project was the provision of LiDAR data to supplement the bathymetric (subtidal) information in order that the narrow creeks leading to the breaches could be represented. By way of example, the TELEMAC flow model was re-set up using coarser representation of the topography of the saltmarsh areas and with lower grid resolution. The study was repeated using this less detailed model, highlighting the different conclusions that may arise from this simpler approach. The main results of this demonstration are reported in HR Wallingford (2001).

Long-term predictive methods were demonstrated using an expert geomorphological assessment of the geological framework and geomorphological history of the estuary over the past 100 years. This together with the application of generic long-term method concepts, were used to predict the likely future effects of the managed realignment scheme on the estuary. It was also demonstrated how an empirical relationship derived from other natural sea wall failure sites in south-east England could be used to predict future morphological and vegetation development within the Abbot's Hall realignment site. The results of this demonstration are reported in Pye and Blott (2002).

4. GUIDANCE NOTES

4.1 Introduction

Guidance Notes for Assessing Geomorphological Change in Estuaries have been produced as part of the project and were distributed to all those who accepted the invitation to attend the dissemination workshops. The primary objective of the Notes is to introduce best practice guidance to those with a management or decision-making role in estuaries, on the choice of approach for assessing dynamic and morphological change. They are structured in the same way as the workshops and were designed to be used in parallel to the information disseminated at the workshops.

The Notes go through the essential steps of the estuary management process including defining the issues in hand, data requirements, the choice of short- or long-term predictive methods and synthesis of available information. Each section is discussed in terms of the generic requirements of that particular element of a study and then illustrated using the work undertaken on the two demonstrations. The Guidance Notes support the outputs of ERP Phase 1 by providing worked examples, from the Blackwater and Mersey Estuaries, of adopted approaches during the estuary management process. The approaches that are introduced are those that should be scrutinised in the work of the specialist consultant so that confidence in the outcome of the study is maximised. They also highlight further more detailed sources of information and guidance relating to particular aspects of estuary studies.

4.2 The Notes

The Notes are divided into five sections.

Section 1 provides an introduction to the Guidance Notes and their purpose.

Section 2 introduces the steps required to define the issues in hand. At the outset of any project or planning initiative it is important to have a clear understanding of the issues to be addressed. The Notes describe four important steps that need to be taken before deciding which types of predictive method and data are required:

- The issues have to be placed into the context of legislation
- The temporal and spatial scales of the issues have to be determined
- The issues have to be discussed through consultation
- The issues have to be defined within the framework of an initial “conceptual” model

Section 3 introduces the approaches to assessing data requirements for estuary predictive studies and the issues and problems that relate to data quality and applicability. The Notes introduce the approaches to assessing what types of data are required, and their limitations, to successfully implement predictive methods. They highlight the importance of confidence building in data quality, identification of gaps in the data requirements, and the collection of new data for input into the methods and for their calibration and validation.

Section 4 introduces the approaches to assessing the choice of short-term and/or long-term predictive methods. The purpose of this section of the Notes is not to describe the methods in detail but to focus on the approach to decide which methods are applicable given the wide range of circumstances under which they may be applied. The interpretation of the resultant outputs is introduced, and how confidence in the results can be maximised. The Notes discuss the problems of method application across space and time, and highlight their strengths and weaknesses. Calibration and validation of the methods are presented.

Section 5 summarises how the data and methods are synthesised into a conceptual model and integrated with other aspects of estuary management. The Notes discuss development of a credible conceptual model of estuary functioning as a basis for making decisions. Other areas of synthesis described include the use of risk and uncertainty principles to the data and the results of the methods, and the application of the conceptual model to assess and adopt mitigation measures.

5. EXPERIMENTAL INTERACTIVE SOFTWARE

5.1 Introduction

As an aid to the selection of the appropriate predictive methods an experimental interactive software programme has been developed. The software provides a search tool that guides a user through a thought process. The process begins with the user specifying an issue and ends with the software providing details of the methods that are applicable to that issue.

5.2 Development

The tool provides a prototype for an interactive on-line software tool to inform users about the choice and selection of methods that can be used to simulate the impacts of development scenarios in estuaries. The software illustrates an important thought process regarding the consideration of the applicability of different methods to different situations. This is a simplified thought process at present but the process is non-the-less important. The development of the software within the Uptake Project has been undertaken in the knowledge that such an approach could potentially be developed further in the future in another project to become more comprehensive in terms of its guidance and to provide a wider estuary management tool. These further developments, however, are dependent on the feedback received from users regarding the software after the Uptake Project.

The methods that are contained within the software are solely the generic types described in ERP Phase 1. These methods primarily relate to morphology although a number of principal types of hydrodynamic and sediment-dynamic methods are included.

The software itself has two windows: the search window and the method details window. Within the search window, the user specifies the criteria of interest. Details of the methods applicable to these criteria are then specified in the method details window.

The process starts in the search window where the user begins by selecting a management issue or concern. There are a total of 16 issues within the software ranging from scheme specific issues such as a managed realignment or land-claim to non-scheme specific issues such as siltation in the upper estuary. Within the second stage the user selects the temporal and spatial scales over which they are interested. In the final stage of the search the user defines the process areas they are interested in, such as morphology, hydrodynamics etc. The search is then performed according to the criteria specified, to obtain a list of appropriate methods for which further details can then be viewed, such as aims, data requirements and method basis.

The software is web hosted at the following address: <http://www.erp1software.net>. It is freely accessible from this address. During the dissemination workshops, delegates were encouraged to view the site, use the tool and provide feedback via a form contained on the web site.

6. DISSEMINATION WORKSHOPS

6.1 Introduction

In November 2002, a series of five 1-day workshops were carried out at five UK locations by the project team to disseminate the results of ERP Phase 1 to a wider audience. They formed a roadshow centred on the Environment Agency regions (Anglian, Thames and southern combined, south-west, north-west and north-east). The location and date of each workshop is shown in Table 6.1.

Table 6.1. Location and dates of workshops

Location	Date
London, DEFRA, Page Street	5th November 2002
Peterborough, EA, Kingfisher House	7th November 2002
Newcastle, Assembly Rooms	11th November 2002
Exeter, Reed Hall	13th November 2002
Warrington, EA, Richard Fairclough House	25th November 2002

6.2 Participants

It was important that the most appropriate end users were invited to the workshops. In this respect the following list was used as a basis for invitation, following advice from DEFRA.

- DEFRA/National Assembly of Wales regional (and assistant) engineers
- Environment Agency staff including
 - National Capital Programme Management
 - Regional Flood Defence
 - Area Flood Defence
 - Area Strategic Planning
 - Regional and Area Conservation
- NEECA TDG consultants
- non NEECA consultants
- English Nature/Countryside Council for Wales
- Local Authorities
- CIRIA
- RSPB
- Other NGOs (wildlife trusts, sea fisheries, port authorities, dredging)
- EAG
- Phase 1 (EMPHASYS) Consortium Members
- Academia/Researchers (eg COZONE coastal networks)
- NERC and EPSRC representatives

Perceived key and relevant staff members in each of the identified organisations were initially invited to attend. These individuals were given the option to invite an alternative individual in their organisation if they felt they were not the most appropriate person. The participant list was drawn up by a variety of methods, including web searches, Posford Haskoning client contacts, individual knowledge of the most appropriate people and guidance from key contacts at certain organisations. A total of 370 individuals were invited to attend the workshops. Of these, 148 accepted (40%) the invitation and received the Guidance Notes. The number who accepted the invitation compared to the number who actually attended the workshops is shown in Table 6.2.

Table 6.2. Acceptances and attendance by location

Location	Acceptances	Attendees	Percentage
London	35	23	66
Peterborough	30	20	67
Newcastle	15	14	93
Exeter	42	34	81
Warrington	26	25	96
Total	148	116	78

Overall, 31% (116 out of 370) of the individuals invited, actually attended the workshops. A breakdown of the acceptances by organisation is shown in Table 6.3.

Table 6.3. Invitations and acceptances by organisation

Organisation	Invited	Accepted	Percentage
Environment Agency	71	43	61
DEFRA/NAW	23	12	52
English Nature/CCW	36	19	53
Local Authorities	87	15	17
RSPB	9	4	44
Wildlife Trusts	21	4	19
Sea Fisheries Committees	13	5	38
Ports	27	10	37
Dredging	10	3	30
Consultants	47	25	53
Researchers	20	6	30
Others	6	2	33
Total	370	148	40

6.3 Programme

Each of the days comprised a structured programme of seminars providing information on approaches to adopt to predict estuary morphological change for use in estuary decision making.

For the first three quarters of an hour of each day, the delegates were provided with the background and aims of the project dissemination, introduced to the experimental interactive software package, and given an end-user perspective on the project from the stakeholder champion. These were followed by a series of presentations investigating the main steps that need to be taken to predict morphological change in estuaries; definition of the issues in hand, data requirements, the different types of predictive methods required to solve the issues (short-term and long-term) and finally synthesis of the data and results. The slides used for the Data Requirements, Short-Term Estuary Change and Long-Term Estuary Change presentations were provided as hard copy to all attendees. The data requirements session included a presentation on the database CD. All the seminars were structured to first highlight the generic principles of the particular aspect of estuary management followed by integration of these principles into the worked examples on the Blackwater and Mersey Estuaries.

7. DATABASE

7.1 Introduction

An important precursor to method and model testing within ERP Phase 1 was the selection of appropriate estuaries and compilation of respective data. The data for predictive method testing was compiled for the purposes of research, in a database for use by the original ERP Phase 1 consortium. Detailed data was collated and stored for six estuaries: Humber, Blackwater, Southampton Water, Tamar, Mersey and Ribble. This Uptake Project has updated this database with data generated within the original project and new information available since completion of the original database. Following population of the new database, a version has been prepared that is publicly available on CD.

To establish the scale of new datasets available for inclusion in the updated database, and those able to be released on the CD, a letter was sent to all the original Phase 1 consortium partners. This requested that they review the data that was supplied originally, and identify any new datasets that may be suitable for inclusion in the updated database. The letter also suggested that the partners who supplied data during ERP Phase 1 consider copyright and licensing (and other) implications of placing their data into the public domain. Issues related to the content of the public database were resolved through negotiation with both consortium partners and national dataset providers, such as UKHO and OS.

7.2 Estuaries Database 2003

The publicly available CD that has been produced contains a diverse range of data from estuary properties to detailed time series of chemical and nutrient concentrations and bathymetry. The database is user-friendly and includes a guide on its use. It is a reference document that provides an understanding of the data available, with metadata providing information on the data's collection (such as parameters, location, dates, time etc) and contact details for the data provider. The database also contains metadata links detailing other datasets for UK estuaries which can be obtained elsewhere but which are not actually held within the database. The contact details of the relevant data suppliers are included. The CD was launched at the Estuary Data Management Workshop (see section 8) held on 14th January 2003.

The CD contains a suite of National datasets:

- Bathymetry (UKHO/CMAP)
- River monitoring sites (catchment descriptions, gauging stations, river names, mean daily freshwater flows)
- River network (major rivers, secondary rivers, minor rivers)
- Detailed estuarine coastlines
- Tidal characteristics (g° of 01, height of M2, height of S2, MHWN, MHWS, MLWN, MLWS, MTL, f4, g° of K1, g° of M2, height of K1, height of 01, f6, g° of S2)
- Estuary properties (volume, plan area, cross-sectional area, MTL, MLW, MHW, geomorphological type, tidal regime)
- Chart Datum to Ordnance Datum offsets
- EA LiDAR coverage polygons

Datasets for all or some of the six selected estuaries include:

- Bathymetric profiles
- Historical bathymetry
- CASI false and true colour composite images
- CASI intertidal classification
- LiDAR terrain model image (whole estuary)
- LiDAR terrain model image (detailed)
- Instantaneous water levels
- Current data
- Saltmarsh boundary

- MLW line
- Radiochemistry
- Water quality
- Wave data
- Tide gauge measurements
- Beach profiles
- Salinity and nutrient data
- Gamma radiation contaminants in fish
- Metal contaminants in fish
- Metal contaminants in dredged material
- Hydrocarbons in sediment and water column
- Sediment properties
- Sediment texture
- Metals and trace contaminants
- Organic compounds in water
- Water column properties
- TBT levels

The database is viewed and queried using STEMgis. The 4 dimensional Spatio Temporal Environmental Mapper (STEM) was used as the data repository and viewing tool in ERP Phase 1 and the product has now been updated to provide (amongst other improvements) considerably better handling of metadata. STEMgis is included on the public database CD for use both as a viewer and a data extraction tool. The viewer allows database records to be extracted to “.csv” files, which is considered a suitable legacy format.

8 ESTUARY DATA MANAGEMENT

8.1 Introduction

Organisations operate different procedures and rules regarding data management. These often allocate roles and responsibilities to individuals in those organisations. However, when dealing across and between organisations at a strategic level it can be more effective to deal in terms of principles. Principles provide the flexibility to enable organisations to use their own procedures in order to meet best practice standards. The CIRIA best practice guide Maximising the Use and Exchange of Coastal Data recommended the adoption of five principles of good data management.

8.2 Scientific Data Management by Project Consortia: Best Practice Guidelines

These guidelines have been produced to assist organisations that are tasked as part of a project with collating scientific data. Their aim is to ensure that those organisations both commissioning the project as well as those undertaking the work have a reference for what is involved in work of this kind. This will help to derive the maximum value from the resultant data set. Whilst collating data on the physical processes of six estuaries, ERP Phase 1 reported the need to develop a standard framework for future projects.

The guidance accordingly considers the five principles of good data management in the context of each stage of the data lifecycle. This forms a powerful and easily applicable approach to support data management decision-making (Dyer and Millard, 2002). Each of the six main chapters of the report covers a stage of the data lifecycle and outlines the main issues that need to be considered, drawing on the aims and decisions taken within the scope of ERP Phase 1 and the subsequent update of the database in this project. Best practice data management for these issues is presented for each lifecycle stage in the form of the data management principles, i.e. "what should be done at each stage of the data lifecycle".

8.3 Estuary Data Management Workshop

The Estuary Data Management workshop was held 14th January 2003. The workshop introduced the extended database described in section 7 and reviewed the databasing approach, concentrating on the lessons learned in construction of the database, to provide best practice guidance on data management.

The aims of the workshop were three-fold:

- To present and review the database produced for the Uptake Project
- To demonstrate how the database links in with the five principles of good data management
- To review the approach for dissemination of the project database

A total of 192 individuals were invited to attend the workshop, of which 46 (24%) accepted (including presenters and chairs). Delegates included representatives from Government agencies, research institutes and consultants. The database CD was supplied in the workshop delegate's pack. Two breakout group sessions were held to identify estuary stakeholders, and their data needs, and to discuss the application of the best practice guidelines in data collation.

8.4 First Breakout Session

The first breakout session identified a wide range of stakeholders that required estuary data. Appendix A provides a full breakdown of these stakeholders, their roles within the management of estuaries and their data or information requirements. The session highlighted the overlap of data requirements between the estuary stakeholders. It was noted that if there were more recognition of this overlap and the benefits that can arise from working together, then more data exchange would be achieved.

This breakout session also identified the main providers of estuary data. There are a number of similarities between this list and the data users list, demonstrating the perceived cross over of roles between data users and providers. However, if the uses of data within the data supply chain are clarified, it is possible

to distinguish between the two. The key to this is to differentiate between data and information. For example, estuary forums were included as a data user but their data use is actually processed data, i.e. information. An important distinguishing feature is, therefore, what the data is required for and the level to which it is processed for this use. As such, the use of the data will affect what data is required and what state it is to be received in, i.e. the level of processing.

8.5 Second Breakout Session

The second breakout session addressed problems associated with the capture of estuary data and the application of the five principles of good data management. The problems identified, potential solutions and guidance required are summarised in Appendix B. The breakout groups identified a wide range of problems and a number of common solutions were agreed. There was general consensus that the widespread adoption of good practice in metadata use and compilation would assist in better estuary data management.

There was also discussion about archiving of data and the following points were raised:

- financial barriers exist that impede the maintenance of complete data archives
- establishment of a national data archive, acting as central location for data no longer in use, would assist in improving data storage and facilitate exchange
- data should not be archived if there will be no further use for it
- a review of the types of datasets to be archived should be carried out
- archiving procedures should be reviewed and a standardised process established

The need for suitable technologies was also identified, including a suitable capacity for data storage facilities, and software and hardware compatibility. Improved communication was suggested as a solution to better data management and exchange, ensuring that data can be found. This could involve the use of a data enquiry officer and central website.

It was concluded that guidance was required on all aspects of estuary data management and that the recent work in this area was a good start. This included guidance on the standardisation of procedures, such as archiving and metadata. Other suggestions for specific guidance included:

- communication between user and provider
- identifying the important and relevant data
- clarification of roles in data lifecycle and chain

The final part of the second breakout session identified dissemination routes and practices for the estuaries database and data management best practice guidance. This is summarised in Appendix P. Some key points in the dissemination of the project outputs include:

- need clear definition of target audience
- maximise the use of existing contacts as champions
- don't assume full understanding of an organisation's involvement in estuary data collection
- focus on roles not names to ensure that target audience does not leave organisation
- ensure sufficient funds are available for dissemination and if not identify who will fund it
- identify other work this project links with
- assess the results of the dissemination

9 CONCLUSIONS

The Estuaries Research Programme Phase 1 Uptake Project provided a mechanism for wider dissemination of the results of ERP Phase 1 (section 1 and publications 2, 3, 14 and 15). It has done this through:

- provision of detailed information on the approaches to predicting estuary morphological change at a series of five workshops across the UK
- publication of a set of Guidance Notes for Assessing Morphological Change in Estuaries
- creation of an experimental software package on the estuary management process
- distribution of a public version of an updated estuary database on CD
- publication of Scientific Data Management by Project Consortia: Best Practice Guidelines
- dissemination of Estuary Data Management Best Practice at a workshop held in London

The dissemination has been supported by the integration of the generic principles of the estuary management process into two specifically designed demonstrations on the Blackwater and Mersey Estuaries. The Mersey Estuary demonstration describes the approaches to identify the response of the estuary to a hypothetical scenario of part removal of the training walls in Liverpool Bay. The construction of these training walls in the early 20th century led to large-scale morphological change and their part removal might be considered to do the same. The Blackwater Estuary demonstration summarises the elements of the managed realignment scheme at Abbots Hall. This realignment is novel in that the area being inundated is relatively large compared to the tidal area of the creek. A range of activities were undertaken to assess the extent and magnitude of the impact of the breaching on the adjacent physical regime.

The objectives of the Uptake Project have been met, as follows:

- **Objective 1.** Consultation with stakeholders resulted in the definition of a range of user-defined problems in flood and coastal defence, leading to the development of the demonstration projects in the Mersey and Blackwater Estuaries (section 2 and publications 12 and 13).
- **Objective 2.** Existing methods, including numerical modelling and expert geomorphological assessment were selected to examine the user-defined problems in each demonstration project (sections 3 and 4, and publications 4, 8 and 9).
- **Objective 3.** Data used or generated by the consortium members of ERP Phase 1 was collated to update the original database, and was used in the demonstration projects (sections 3 and 7, and publications 4, 8 and 9).
- **Objective 4.** A version of the database published on CD (section 7 and publication 1).
- **Objective 5.** The demonstration projects were carried out in accordance with objectives 1-3 above (sections 3 and 4, and publications 4, 8 and 9).
- **Objective 6.** A training programme was established that would effectively disseminate the outputs of ERP Phase 1. This included a set of guidance notes and an experimental interactive software package (section 6 and publications 4 and 5).
- **Objective 7.** The training programme was carried out at five workshops across the UK. A total of 116 individuals attended these workshops from a range of organisations (section 6 and publications 7, 10 and 11).
- **Objective 8.** A review of data management techniques was undertaken and the results of this review were published in best practice guidelines and presented at an estuary data management best practice workshop in London. A total of 46 individuals attended the workshop (section 8 and publication 6).
- **Objective 9.** All reports have been completed (publications 1, 4, 5 and 6).

10 PUBLICATIONS ARISING FROM PROJECT

1. ABPmer, 2003 Estuaries Database 2003: a Spatio-Temporal GIS Database of Environmental Data for 6 UK Estuaries. CD (includes digital user manual).
2. Brew D S, 2002 Estuaries Research Programme Phase Uptake Project. Inception Report Updated Version. DEFRA/Environment Agency Report.
3. Brew D S, 2002 Educating the managers. The ERP1 Uptake Project. Flood and Coastal Defence Research News, 3, 8.
4. Brew D S and Pye K, 2002 Guidance Notes for Assessing Morphological Change in Estuaries. DEFRA/Environment Agency Technical Report FD2110.
5. Millard K and Williams A, (creators, 2002) Experimental Interactive Software. Hosted at web-site: <http://www.erp1software.net>.
6. Millard K, Murdock A, Panzeri M, Houghton A, Dyer B and Holliday E. 2003 Scientific Data Management by Project Consortia: Best Practice Guidelines. DEFRA/Environment Agency Technical Report.
7. Pye K (with contributions from Blott S and Van der Wal D), 2002 Long-term estuary processes and morphological change. Powerpoint Presentation for Dissemination Workshops.
8. Pye K and Blott S J, 2002 Saltmarsh Development at Abbots Hall Managed Retreat Site, Essex, UK. Surface Processes and Modern Environments Research Group, Royal Holloway University of London, Internal Research Report CS13.
9. Pye K, Blott S J and Van der Wal D, 2002 Morphological Change as a Result of Training Banks in the Mersey Estuary, Northwest England. Surface Processes and Modern Environments Research Group, Royal Holloway University of London, Internal Research Report CS14.
10. Spearman J and Chesher T, 2002 Best Practice in Estuary Studies: Data Requirements. Powerpoint Presentation for Dissemination Workshops.
11. Spearman J and Chesher T, 2002 Best Practice in Estuary Studies: Short Term Modelling. Powerpoint Presentation for Dissemination Workshops.
12. Williams A, 2002 Estuaries Research Programme Phase 1 Uptake Project. The Blackwater Estuary Consultation Report.
13. Williams A, 2002 Estuaries Research Programme Phase 1 Uptake Project. The Mersey Estuary Consultation Report.
14. Williams A and Brew D S, 2002 Outputs and Dissemination of the Estuaries Research Programme Phase 1. Proceedings of the Irish Sea Forum.
15. Williams A, Brew D S and Fox D, paper in preparation Outputs and Dissemination of the Estuaries Research Programme Phase 1.

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- CIRIA (Construction Industry Research and Information Association) 2000, Maximising the Use and Exchange of Coastal Data: A guide to best practice, CIRIA (Construction Industry Research and Information Association) Publication C541.
- Dyer B and Millard K, 2002 A Generic Framework for Value Management of Environmental Data in the context of ICZM. Journal of Ocean and Coastal Management, 45, 59-75.
- HR Wallingford, 2001 Sustainable Flood Defences. Monitoring of Retreat and Recharge Sites. Project Number MRD 21110 Abbott's Hall, Numerical Modelling. Report EX 4367. HR Wallingford.
- Thomas, C, 2002 The application of historical data and computational methods for investigating causes of long term morphological change in estuaries: a case study of the Mersey Estuary. Unpublished PhD thesis, Oxford Brookes University.

APPENDIX A – Stakeholders that require estuary data

Data user	Role	Data requirements
Research institutes (academic and government)	<ul style="list-style-type: none"> – Improving understanding of issues and processes – Analysis of gaps in information – Review – Education – R&D – Repository for data 	<ul style="list-style-type: none"> – High detail – As much information as possible – Chemical, biological, topography, bathymetry, habitat, environmental, socio-economic, hydrodynamic, defence standards, assets
Modellers	<ul style="list-style-type: none"> – Testing and development 	<ul style="list-style-type: none"> – Wide range – Spatial and time
JNCC	<ul style="list-style-type: none"> – Report on conservation 	<ul style="list-style-type: none"> – Specific to report.
CEFAS	<ul style="list-style-type: none"> – Applied research – Building on and drawing together research – Regulatory and advisory – Implementation – Monitoring 	<ul style="list-style-type: none"> – Whole spectrum
Environmental regulator e.g. Environment Agency, DEFRA	<ul style="list-style-type: none"> – Water quality – Flood defence – Environmental stewardship – Regulation – Management – Operation/maintenance – Control, e.g. erosion – Policy delivery 	<ul style="list-style-type: none"> – Specific to role – Detailed – Over long period – Monitoring data – Real time data
Internal drainage boards	<ul style="list-style-type: none"> – Drainage into estuaries 	<ul style="list-style-type: none"> – Rainfall
Institutions	<ul style="list-style-type: none"> – Training – Education – Dissemination 	<ul style="list-style-type: none"> – Wide range of needs – Specific to issues
Consultants	<ul style="list-style-type: none"> – Use data to provide answers to clients questions – Strategic – R&D – EIA – Scheme specific – Repository for data 	<ul style="list-style-type: none"> – Chemical, biological, topography, bathymetry, habitat, environmental, socio-economic, hydrodynamic, defence standards, assets
Water authorities	<ul style="list-style-type: none"> – Water resource, supply and quality management 	<ul style="list-style-type: none"> – Data for assessment of outfalls and discharge – Raw water quality
Ports authorities	<ul style="list-style-type: none"> – Management of transport, development, navigation and dredging – Conservation – Control 	<ul style="list-style-type: none"> – Data on sediment, dredging activities, navigation – Data for EIA
Local authorities	<ul style="list-style-type: none"> – Bathing water quality – Development – Bridge for information to public – Planning – Recreation 	<ul style="list-style-type: none"> – Visual i.e. mapped base – Synthesised end data – Data for EIA – Varied
NGOs e.g. RSPB,	<ul style="list-style-type: none"> – Conservation 	<ul style="list-style-type: none"> – Processed data

Wildlife Trusts, NFU, Archaeology	<ul style="list-style-type: none"> - Natural resource management - Issue/site specific - Environmental watchdog - Education - Land classification - Protection/preservation - Policy development - Legislation 	<ul style="list-style-type: none"> - Issue/site specific - Some data requirements specific only to these groups
Conservation agencies, e.g. English Nature, CCW, SNH, JNCC	<ul style="list-style-type: none"> - Designation and habitat regs. - Assistance - Consents - Management - Surveillance - Protection/preservation - Policy development - Legislation 	<ul style="list-style-type: none"> - Various - Issue/site specific - Habitat and species
Industry	<ul style="list-style-type: none"> - Provision of service or product - Monitoring of emissions/discharge - Development 	<ul style="list-style-type: none"> - Related to environmental quality, e.g., emissions, soil, water, sediment - Spatial temporal data
Dredging companies	<ul style="list-style-type: none"> - Maintenance 	<ul style="list-style-type: none"> - Bathymetry - Sediment quality - Pollution
Estuary forums/partnerships	<ul style="list-style-type: none"> - Dissemination - User engagement - Strategy 	<ul style="list-style-type: none"> - Varied - some actually do research and will require raw data, others use research and require processed information
Fisheries	<ul style="list-style-type: none"> - Commercial - Monitoring 	<ul style="list-style-type: none"> - For monitoring of water quality (algal, toxins, sedimentation) - Migration - Stock levels
Central Government	<ul style="list-style-type: none"> - Policy formation 	<ul style="list-style-type: none"> - Many and varied
Europe	<ul style="list-style-type: none"> - Planning 	<ul style="list-style-type: none"> - Information on designations
Agriculture	<ul style="list-style-type: none"> - Maintenance of land 	<ul style="list-style-type: none"> - Via environmental agencies - Information rather than data
Military	<ul style="list-style-type: none"> - Defence 	<ul style="list-style-type: none"> - Navigation - Topography - Bathymetry
Shipping	<ul style="list-style-type: none"> - Commercial 	<ul style="list-style-type: none"> - Navigation - Via ports authorities
Emergency services, including coast guard and lighthouse	<ul style="list-style-type: none"> - Provision of emergency services 	<ul style="list-style-type: none"> - Reactionary, specific to problem. - Basic and already processed into information e.g. flows, currents. - Usually an answer to the question.
Small private enterprises, e.g. marina, yacht club etc	<ul style="list-style-type: none"> - Safety 	<ul style="list-style-type: none"> - Data on water quality, flow data, currents, tides
Landowner	<ul style="list-style-type: none"> - Maintenance of land 	<ul style="list-style-type: none"> - Via environmental agencies - Specific - Information rather than data
Public, e.g. recreation and leisure	<ul style="list-style-type: none"> - User of environment 	<ul style="list-style-type: none"> - Specific, basic and already processed into information, e.g. water quality, tides. - Usually an answer to the question.

APPENDIX B - Estuary data capture problems

Problem	Solution	Guidance
Conflicting standards in data collection	– Communication of existing standards	
Availability of funding to archive data after projects completion	– National data archives identified for redundant data. – Review of archiving procedure – Identification of what data should be archived	Guidance on use of archives and selecting data to archive
Articulation of data requirements	– Enquiry officer – Central website	
Quality of metadata	– Made legal and contractual requirement – Link requirement to funding and payment – Communication of benefits	Best practice guidance on metadata (in process)
Conflict between sharing of data and protection of IPR	– Clearer guidance	Clear flexible guidance, especially on public dissemination. Build on current guidance
Availability of data – ensuring it can be found	– Audit and check as part of archive services	
Audit trail	– Metadata	
Storage of data	– Improved maintenance and technologies	
IT, including capacity and software compatibility	– Development of new and improved technologies	Guidance on what is required
Ability of users/skill levels	– Training/education	Guidance targeted to user
Security	– Procedures	Guidance on security procedures
Data fit for purpose – what data for what problem	– Foresight to identify data needs	
Confidence in quality of data	– Metadata and audit	
Responsibility for data	– Define responsibilities	
Calibration	– Document data – Standards – Quality assessment	
Harmonisation of different measurements and data types	– Generic languages – Standards – Metadata – Communication – Interpretability	
Incompatible modelling	– Metadata – Standardisation	
Unsuitable monitoring regimes	– Design for task – Metadata	Guidance on how to feedback on regimes
Communication	– Communication tools	