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National Groundwater Modelling System

Phase 2 - Det. architecture design (NFFS Change Control Note 2005/03)

User Requirements Document

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Preface

Groundwater Models have been in use by the Agency and its predecessors for many years and these have been initiated and implemented at Regional level. These models were not linked in a national context. Groundwater models are also costly and have not been easily linked to the needs of operational customers. The fragmented approach to modelling was highlighted by the development of source protection zones in the early 1990's. It was recognised that a centrally co-ordinated, strategic approach was required to avoid duplication and reduce the risk of challenge.

To address this situation, a Strategic Review of Groundwater Modelling (R&D Project W6-034, R&D Technical Report W214; Brown and Hulme, 2001) was undertaken. The main output of the Strategic Review was the *Environment Agency Framework for Groundwater Resources Conceptual and Numerical Modelling* (R&D Technical Report W214) which contained a nationally consistent technical approach and programme for regional groundwater resources assessment and modelling.

The Head Office Hydrogeology Team presented a summary *Implementation Plan* for this work jointly with the Science Group which was accepted by the national Water Resource Management Team (WRMT) in October 2004. Regional modelling strategies were also recognised by WRMT as strategic Water Resources capital programmes. This work therefore supports the Streamlining Abstraction Processes (SAP) and Restoring Sustainable Abstraction (RSA) programmes managed by the national Water Resources Regulation team.

The Head Office Hydrogeology team is now developing a more detailed *Implementation Strategy* comprising a series of measures to support groundwater modelling, ensuring appropriate national consistency, improving efficiency and accessibility by customers. The Implementation Strategy will address concerns like national planning of model development, benefit realization, succession planning, business efficiency, IS performance, and customer accessibility to models.
An *IT Strategy for Groundwater Resource Assessment and Modelling* is being prepared to address the infrastructure and IS performance issues.

The National Flood Forecasting Projects (NFFS) is currently implementing an IT architecture for a centrally hosted flood forecasting system for the Environment Agency (EA). It is recognised that there are strong links between the proposed IT Strategy for Groundwater Modelling and the NFFS. A feasibility study has been conducted which concluded that the IT-backbone, named National Groundwater Modelling System (NGMS), can be based on the NFFS architecture (and software components) if some minor modifications and extensions are implemented. This outcome was the starting point of phase 2, the detailed architectural design. In this phase the required modifications and extensions need to be made explicit.

Phase 2 of the NGMS will produce the following documents…
1. Update of phase 1 User Requirements Document (URD)
2. Update of phase 1 Software Requirements Document (SRD)
3. Architecture Design Document (ADD)
4. User Interface Specification Document (UISD)

5. Interface Definition Document (IDD)
6. Hardware and Infrastructure Design document (HID)
7. Update of Project Implementation Plan (PIP)

This document presents the User Requirements based on the discussions of 20 May 2005, 20-21 June 2005 and the written feedback provided by EA.

Guide to the reader

The User Requirements Document gives an overview of the requirements with respect to the IT architecture for groundwater modelling.

In Chapter 1 an introduction is given and the context for groundwater modelling within the EA is discussed. Chapter 2 identifies the various roles with respect to the use of groundwater models. In Chapters 3 to 7, the typical user requirements are described in high level use cases. Chapters 3 to 7 have been modified as a result of the discussions in Phase 2.

In the appendices to this report the information is presented that has been provided by the groundwater modelling community within the EA.

New in this version

This User Requirements Document has been updated in Phase 2 of the National Groundwater Modelling System project, based on discussions and written feedback from EA during the period 20 May 2005-22 June 2005

Modifications from 1.2 to version 2.0 are mostly related to detailing of steps and associated (meta) data issues. Modifications from version 2.0 β are mostly based on combination similar use cases for different actors and inclusion of system relations. UC numbering has been synhcronised with the numbering of version 1.2. Any new Use Case of Phase 2 has been added at the end of the list.

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1 Introduction

Groundwater resource assessment and modelling currently accounts for £ 3 million per annum of water resources capital and revenue investment. Groundwater modelling has been undertaken by the Environment Agency (EA) for many years both in house, and by involving external consultants to develop models which are owned and run by the EA. There has, however, been no national consistency for the groundwater modelling software and hardware platforms for running models. Currently a range from free standing, partially or fully networked PCs is used. To enable the EA to fulfil its duties and allow models to be used effectively whilst using best science and technology, the EA must have access to appropriate software tools and hardware platforms. It is thereby important to recognise the considerable size and complexity of modern groundwater models which require high performance PCs.

Groundwater science is advancing at a pace, which is mirrored by software developments. Groundwater specialists within the EA should - as a community - be able to select the best tools to do the job. A means of updating of software is needed to be able to keep up with the state-of-the-art. In its current form, modelling involves a range of different software packages that are interlinked to deliver the final modelled product. The supply of IT facilities for specialist applications such as hydrogeological modelling is intended to be resolved at a national level through development of an IT Strategy for groundwater modelling. This strategy should be developed for the coming 5-10 years.

It is recognised that there are strong links between the proposed IT Strategy and the existing National Flood Forecasting System (NFFS). Efficiency savings are expected to be made by making use of the NFFS system architecture in the IT strategy for groundwater modelling as far as possible. A need exists therefore to carry out a feasibility study investigating whether the NFFS architecture (and software components) is applicable as the IT backbone in the above mentioned IT strategy.

Object-oriented groundwater modelling codes (e.g. ZOOMQ3D) are currently in development by the Agency's Science group (Air, Land & Water). The IT strategy should give consideration to operational implementation of these object-oriented codes in future.

At present, many of the models are run from stand-alone computers which do not receive support from CIS, and do not permit access to the model outputs by EA users in other teams (e.g. Regulatory, Groundwater & Contaminated Land). The IT Strategy should promote the wide use of the models in future to ensure the maximum return on the EA's capital investment.

Legislation such as the European Union Water Framework Directive (WFD) increasingly requires the EA to manage groundwater resources at a larger scale (river basin management plans) crossing area and region boundaries. The IT strategy will enable the development and use of models across these boundaries in future, but will require protocols to be in place to enable this to be managed properly.

The WFD also requires integrated management of groundwater quantity and quality, along with surface water quality and ecology. Groundwater quantitative status is determined by the status of dependent terrestrial ecosystems (wetlands). The WFD (Annex 5, p.60) states that "the level of groundwater is not subject to anthropogenic alterations such as would result in any significant damage to terrestrial ecosystems which depend directly on the groundwater body". It also requires that groundwater quality must not compromise the quality of a connected surface water body. These dependencies will require increasingly that groundwater and surface water models are linked in future, and implementation of these linked models should be via the IT strategy.

Much of the EA's groundwater modelling is currently undertaken by consultants external to the EA. The IT strategy will be developed in consultation with these consultants including Entec UK Ltd, Atkins Global, Water Management Consultants, Environmental Simulations International and Mott MacDonald. The consultants may require access to the Agency's modelling system in order to perform major maintenance operations or upgrades on models.

Many of the models have been developed in consultation with external stakeholders including Water Companies, farmers, conservation organisations and industry. It may be necessary for water abstraction licence applicants to use the models as part of the licence application process, to ensure that a common technical framework is adopted. Consideration should be given to developing protocols to ensure the integrity of the models during such use by third parties.

The activities of the groundwater modellers within the EA can be divided in two distinct groups:

1. Development of groundwater models
2. Application of groundwater models for
   - Strategic planning (incl. scenario studies)
   - Regulation / licensing
   - Drought forecasting (to a limited extent)

Development of groundwater models is generally a process of 2-3 years. For development of often model specific tools, GIS plays an important role in the preparation and management of data required for the model schematizations.

When developed, models can be applied over long periods (10-20 years) for the purposes listed above. Activities are to a large extent repetitive. Only minor changes are made to the model schematisations (for example adding an abstraction). Generally the same (or very similar) sets of boundary conditions are applied to run scenarios.

It is assumed that user requirements related to the development of groundwater models do *not* need to be covered by application of the IT architecture. There no specific user requirements with respect to development of groundwater models are considered in the document.

Groundwater Modelling System (NGMS)

The IT infrastructure will be referred to as *National Groundwater Modelling System* – abbreviated to *NGMS* - in the Feasibility Study. It is recognised that this name is somewhat misleading because the system does explicitly not offer typical module dataset development functionality.

Scope of this document

The user requirements assessment of the feasibility study has provided good scoping of the system and its required functionality. However, more detail is needed to identify the exact modifications and extensions of the NFFS architecture. Two workshops and an inventory have been conducted to get more grip on the requirements. The kick-off workshop on 20 May 2005 (London) has identified the focus points where more appropriate requirements were needed. A written inventory has been conducted to obtain the views of the various stakeholders. Based on this written material, a two day workshop has been organised (20-21 June 2005 in London) in which the requirements have been discussed in more detail and decisions have been made.

The following information is used to prepare this version of the URD:

- User Requirements document v.1.2 (result of Phase 1)
- Minutes of meeting: 20 May 2005 (see Appendix B)
- Minutes of meeting 20-21 June 2005 (see Appendix C)

The purpose of this document is to enable the design of the NFFS architecture modifications and extensions.

2 Roles and system setting

2.1 Roles

The user requirements are discussed on the basis of Use Cases. A Use Case Model describes the required functionality of a system in formal terms. A Use Case represents a discrete unit of interaction between a user (human or machine) and the system and is a single unit of meaningful work like 'running a groundwater model' or 'archiving model results'.

Each Use Case has a description which defines the functionality that will be built in the proposed system. A Use Case may 'include' another Use Case's functionality or 'extend' another Use Case with its own behaviour. Use Cases are typically related to 'Actors'. An Actor is a human or machine entity that interacts with the system to perform meaningful work.

Actors (types of users) have been identified for whom use cases will be defined in the next chapters. The number of actors is kept limited. It is however recognized that within the defined groups, variations in usages will exist.

The following actors are identified:

- *Viewer*
  Viewers require access to the results of groundwater modelling studies for example to verify a procedure that concerns them or to obtain data for related studies. A viewer needs to access to the processed output of model runs but will not need to be able to run models. A viewers can be EA staff and from other organisations (like water companies)

- *User*
  A user runs existing models in the framework of for example abstraction licensing procedures or scenario studies (like CAMS). The user needs to be able to apply minor changes to the model boundary conditions (like defining abstractions) or run what-if scenarios. The user requires some degree of freedom in the post processing of the output from the models. The majority of the users will be EA staff but also staff from other organisations (like consultants and water companies) is expected to be users. Within the EA organisation, the number of users is currently up to 10 per region and in the Science Group.

- *Custodian*
  The custodian is a regional super user with complete access to the functional modules of the system. A custodian develops new modules datasets or makes changes to existing module datasets and uploads these into the system. Therefore he also needs to able to perform tests on a parallel system to check the consistency of the module datasets. A custodian also carries out more complicated groundwater modelling studies that require changes to the module dataset (like changing conductivities or grid size). In addition the

custodian applies major changes to boundary condition sets (e.g. extend the boundary condition sets when new data becomes available in time). In addition, the custodian needs to be able to change data pre and post processing procedures, and the output formats. Custodians will typically decide on critical module runs to be archived. The custodians will be – beside EA staff - also consultants. Within the EA organisation the number of users is currently up to 15 in total.

- *National Super User*
  In the group of administrators, a distinction can be made between administrators with a regional responsibility (i.e. the custodians) and national super users. The latter are responsible for the operation and maintenance of the national system and the coordination between the regions in the field of modelling strategy and procedures. A national super user will be responsible for development and configuring of new modules and new system functionality. The national super users will also maintain national consistency in certain fields like data types and dimensions, and standard output formats. The National Super User has overall responsibility for the archiving strategy and disk allocation.
  It is foreseen that three EA-units will have to share the roles of the National Super User. The Science Group is expected to have a national role being responsible for testing and operationalising for example new modules and processing techniques. CIS will have a systems operation related responsibility including disk allocation. Head Office is likely to have an overall responsibility for development and acceptance of new system functionality as well as archiving strategy. Those three units will have to agree on these responsibilities.

- *System Manager*
  A system manager is responsible of the support and maintenance of the IT architecture (hardware, system software and application) and the communication between IT architecture and other systems (like WISKI, NALD, GIS databases). The system manager is staff of CIS. It is likely that this role will map to a number of roles within CIS.

It is noted that custodians are often also modellers. The role of *modeller* is not defined within respect to this system as it is assumed that development of (new) module datasets is done external to the system.

2.2 System setting

Similar to the NFFS, the NGMS is foreseen to be available at four application levels:
- a centralized web server holding published model results
- a centralized online system application used for operational management (the 'production' system).
- a centralized offline system application for acceptance of new modules, module data sets and configuration updates etc. (the 'test' system)
- a stand alone application, i.e. a non-shared, single-user desktop version without data synchronization, user data access management etc. (the 'development' system)

Figure 2-1 provides an general overview of the various actors and their application relations. The web server will typically be used Viewers to view results, while Users will provide the information for the websites. The 'production' system will typically be used by the Users to define and run scenarios, while Custodians will upload new data sets and update the configuration. . The 'test' system and stand-alone development system will typically be used by Custodians to test new data sets and upload them (including associated configuration updates). The National Super User will typically test new software (on the stand-alone and 'test' system) and update the production system. System Manager will typically manage the centralized systems (i.e. web server, production and test system).

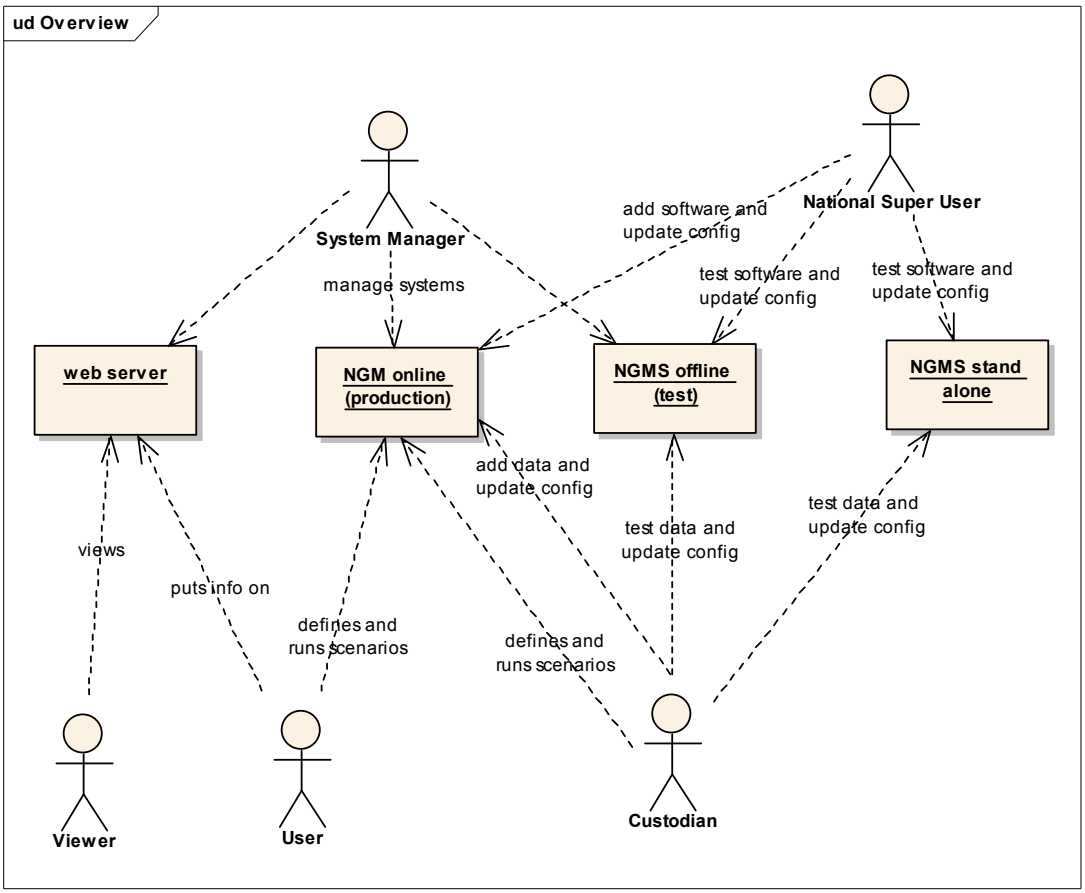


Figure 2-1 Main roles and associated systems

3 Use Cases: Viewer

The following use cases are presented for a viewer:

1. Access to model results – viewer within EA network
2. Access to model results – viewer outside EA network

3.1 Access to model results within EA network

Use Case 3.1	**Access to model results within EA network**
Description	View, download and print model results that have been published to a web server. The results can be individual tables, graphs and reports.
Actors	Viewer User Custodian National Super User
Assumptions	• Viewer is logged into harmonised desktop with password • A standard internet browser is available to viewer • Web server is available • Model output is published on web server by authorized user
Steps	1. Viewer go to website (access on the basis of the EA password) 2. Viewer can select the output required on the basis of… a) Geographical location b) Type of groundwater modelling study c) Production time d) Source 3. Viewer can download output from website for further processing 4. Viewer can print output in proper layout
Variations	-
Non-functional	• The number of simultaneous viewers (transactions) is expected to be less than 50. • The number of potential viewers is 800. • Finding information on the website should be relatively straightforward. Viewers are not always groundwater experts. • The webserver content and upload will be managed by a user via standard EA protocols • Internal Users can propose content and layout of materials to be published (layout based on pre-defined options) • NGMS can deliver content in web-compatible formats (text in HTML, figures in JPEG, GIF or PNG)

Issues	• Given the planned changes in content management, EAsinet (Andrew Robertson, AMS support team) should be contacted when defining the intranet-publication methodology

3.2 Assess to model results from outside EA network

Use Case 3.2	**Access to model results from outside EA network**
Description	see UC 3.1
Actors	Viewer (non EA) User (non EA) Custodian (non EA)
Assumptions	• see UC 3.1
Steps	• see UC 3.1
Variations	-
Non-functional	• The number of simultaneous viewers is: 80 ? • The number of potential viewers is: 800 ? • Finding information on the website should be relatively straightforward. Viewers are not always groundwater experts. • NGMS can deliver content in web-compatible formats (text in HTML, figures in JPEG, GIF or PNG)
Issues	• Not all data can be made available to all viewers. The actual abstraction data is for example classified. This means that access levels need to be defined but at the same time the website should remain easily accessible. • The results that will be made available must comply to EA standards. • Given the planned changes in content management, the internet team (Nick Squire) should be contacted when defining the internet-publication methodology

4 Use Cases: User

Among the anticipated users is beside staff from the EA also staff from external parties like consultants and water companies. Three types of users are therefore identified:

- User (EA)
- User (consultant) – being non-EA but contracted to run groundwater models
- User (external) – users running models for their own purposes

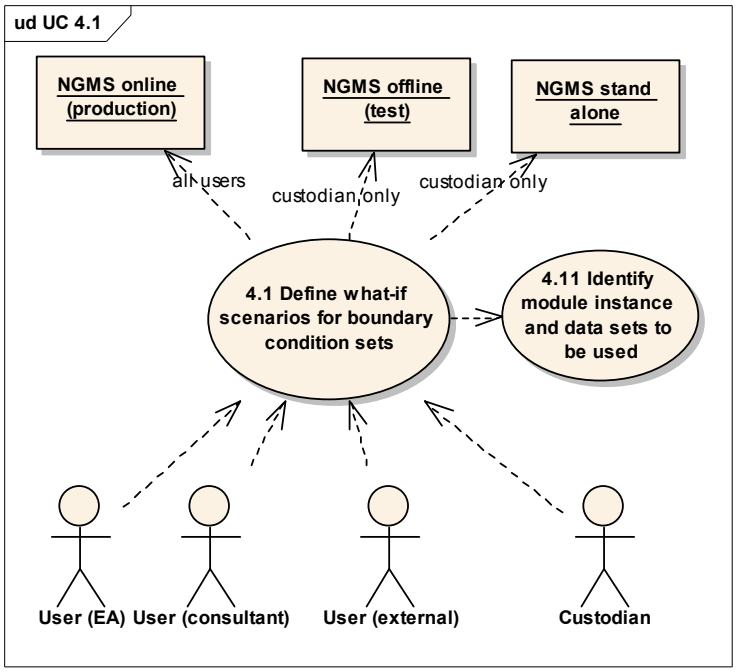
Table 4-1 Overview of user roles variations for use casesases

ID	Name	User (EA)	User (consult.)	User (ext.)	Cust-odian*
4.1	Define what-if scenarios for boundary conditions sets (includes modifications)	x	x	x	x
4.2	Define a specific modification to the boundary condition sets	-	-	-	-
4.3	Run module dataset on server	x	x	x	x
4.4	Run module in stand-alone mode	-	-	-	x
4.5	View model results in predefined formats	x	x	x	x
4.6	View user defined selection of model results	x	x	-	x
4.7	Export model output	x	x	x	x
4.8	Archive module run (input, module data set, output)	x	-	-	-
4.9	Retrieve module runs from archive	x	-	-	x
4.10	Select model results for publishing on web server	x	-	-	x
4.11	Identify module workflow and module data set to be used	x	x	x	x
4.12	Define spatial slicing template	x	x	x	x
4.13	Define post-processing template	x	x	x	x
4.14	Temporary storage of non-critical module run	x	-	-	x

* Use Cases for custodian that are available in the off line (test) system and in the stand alone system

4.1 Define what-if scenarios for boundary condition sets

Use Case 4.1	Define what-if scenarios for boundary conditions sets
Description	Define what-if scenario for studies and assessments. What-if scenarios are applied to boundary conditions sets (dynamic datasets) of for example abstraction or recharge data. What-if scenarios are predefined types of operations for the user the define settings (e.g. apply 25 % more recharge for a selected area) This use case includes specification of abstraction locations and

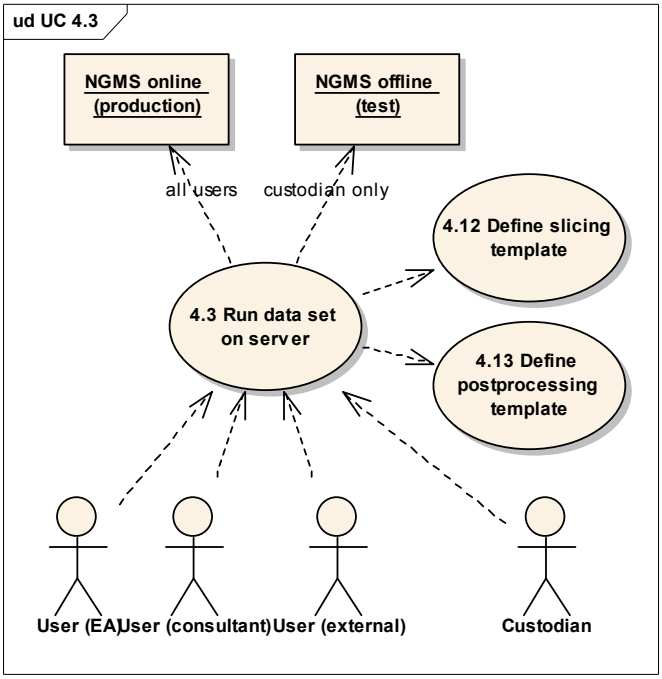
Use Case 4.1	Define what-if scenarios for boundary conditions sets
	modifications of dynamic boundary conditions data. These actions can be carried out from outside the EA network by a third party contracted by EA.
Actor/system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select module dataset to be used. (see UC 4.11) 3. Review available what-if scenarios (including pre-defined boundary data sets) for selected module dataset and check whether required scenario is available. Contact custodian in case no appropriate pre-defined boundary condition set is available 4. In case the required what-if scenario is not available, review if required area/location is available for the selected scenario variable 5. For abstractions only: If area/location is not available in the list, define new area/location (and save) 6. Define what-if scenario by a) Selection of variable b) Selection of Area/location of interest c) Specification of modification (time series transformation or new profile) d) Save what-if scenario
Sub-case step 3	User-selectable (i.e. custodian defined) boundary condition sets refer to: 1. recharge (Q_rech) in m/d (meters per day) NB. custodians can add recharge options to the list

Use Case 4.1	**Define what-if scenarios for boundary conditions sets**
	User-defined boundary condition data sets refer to the following scenario variable to be selected for modification: 2. abstraction (Q_abs) in Ml/d (megaliters/day = 10^3 m^3/day) 3. surface water levels (SWL) in maOD (meters above Ordenance Datum) NB for assessment of recharge scenarios, custodians may modify the following scenario variable: 1. rainfall (P) in m/d (meters per day)
Sub-case step 5	If the desired abstraction area/location is not available in the location list, users can define add a new abstraction location (set) as follows: 1. the topographical data of the abstraction (name, xy-coordinate) is specified in a form 2. the system displays the abstraction location on the map 3. the system assigns the abstraction to nearest calculation entity (model node/cell/element/grid point) 4. The system allows the user to assign the abstraction to any other adjacent calculation entity that surrounds the abstraction's xy-coordinate 5. The system must warn if the selected entity is a static head-dependent boundary condition (e.g. a river element). It must allow choosing another location. 6. for any calculation entity, the system can show the following calculation entity properties: a) nr.aquifer layers b) for each layer: i) conductivity ii) top-bottom elevation of layer (for unconfined aquifer the top is the groundwater level equilibrium) 7. Based on this information, the user can decide on the z-property of the abstraction location 8. The system allows the user to save the xyz data of the abstraction location under a user defined name. The xyz-position of the associated calculation entity is stored under the name <abstraction_location>_calc_entity NB Users cannot add new locations for other purposes (e.g. surface water levels)
Sub-case step 6	Boundary conditions can be defined by modifying (add, multiply etc.) existing time series or by defining a new time series. Users can specify surface water levels only at pre-defined locations (i.e. predefined by the custodian while uploading module data set)
Variations	-
Non-functional	• The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network
Issues	-

4.2 Define specific modifications to boundary condition sets

Use Case overtaken by sub-step 4 and 5 in UC 4.1.

4.3 Run module dataset on server

Use Case 4.3	**Run Module Dataset on server**
Description	Run a module dataset for a given for a user defined period of time with selected boundary condition set (what-if scenario) and selected output post-processing. The user should be able to select a what-if scenario and/or a user defined modification, and select from a series of preset output options (post processing template). These actions can be carried out from outside the EA network by a third party contracted by EA.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select module dataset to be used 3. .Select a what-if scenario 4. Define the run period and time step (if applicable) 5. Select slicing template (see UC 4.12) 6. Select a post processing template 7. Run module dataset (including post processing)
Variations	• A user should be able to specify a batch of module runs by repeating steps 2 to 7 a few times selecting different combinations

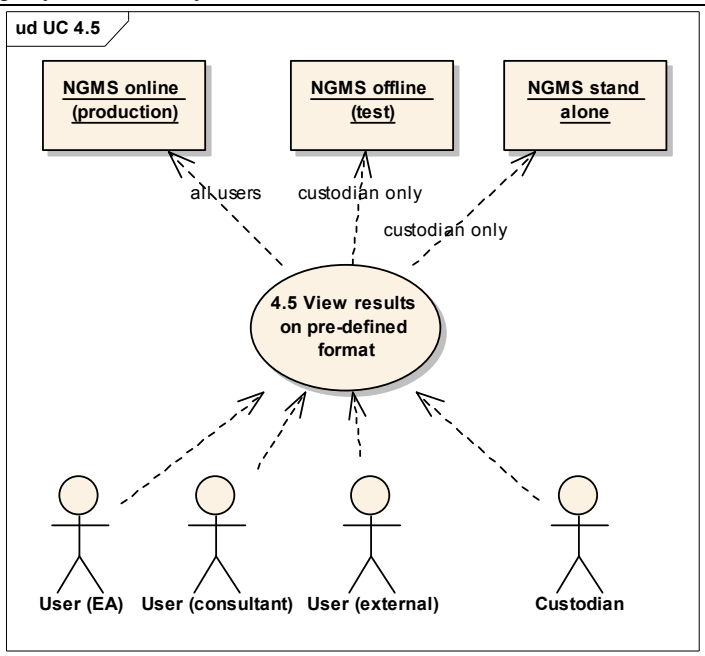
Use Case 4.3	Run Module Dataset on server
	before initiating the run
Non-functional	• The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network
Issues	• Modification of time stepping data and simulation horizon might not be supported by all groundwater and recharge codes

4.4 Run module dataset in stand-alone mode

Skipped. Stand-alone applications are designed for development purposes. They are not available to regular users. Only custodians may operate stand-alone applications. See UC 5.8.

Skipping is based on a remark by Martin Shepley. Is this correct or thus the UC still apply e.g. for external users

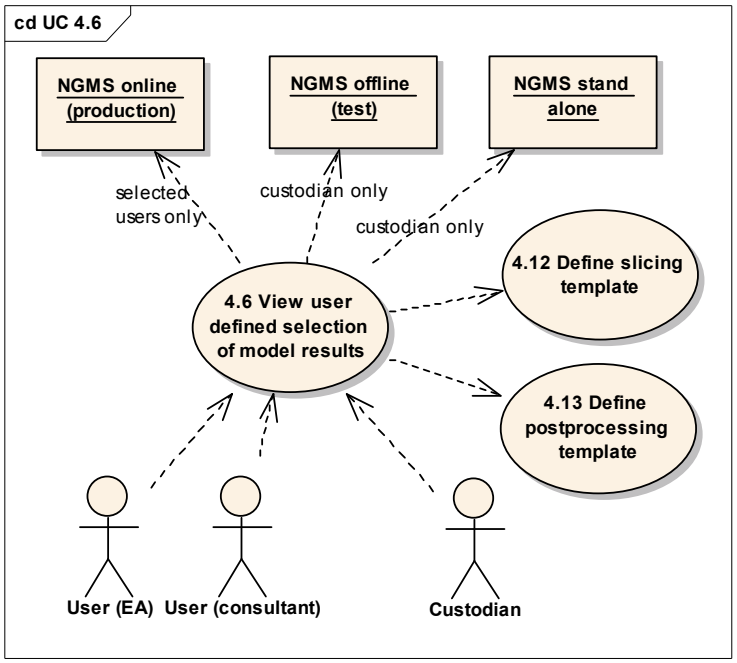
4.5 View module results in pre-defined formats

Use Case 4.5	View module results in pre-defined formats
Description	The user should be able to view the module results in pre-defined formats depending on the selected post processing template. These actions can be carried out from outside the EA network by a third party contracted by EA.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password

Use Case 4.5	**View module results in pre-defined formats**
	• User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select a module run or runs (for comparison) 3. View and print output for selected locations/areas and type. a) The following graphing options may be available in the model run: i) stream accretion ii) stream outflow hydrograph iii) splodge plots iv) winterbourne signature v) groundwater unit budgets – horizontal map view vi) groundwater unit budgets – vertical section vii) duration curves viii) frequency curves ix) bar charts x) contour plots b) The following table options are available: i) stream outflow ii) ground water budget – vertical section 4. View and print module diagnostics
Variations	1. Run of alternative post processing template 2. Repetition of steps 3 and 4
Non-functional	• Data generation for viewing purposes should have a high performance • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network
Issues	• Data access restrictions may apply for different actors

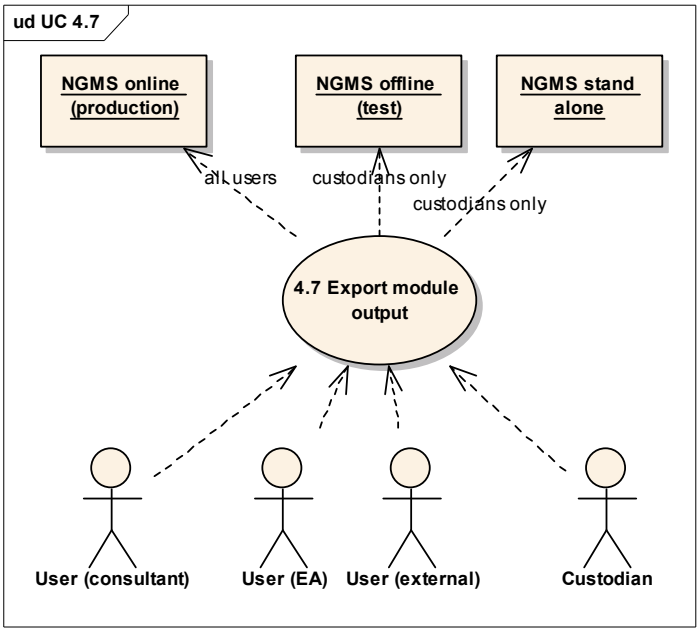
4.6 View user defined selection of module results

Use Case 4.6	**View user defined selection of module results**
Description	The user should be able to define (a limited number) of additional views on the data. These actions can be carried out from outside the EA network by a third party contracted by EA.

Use Case 4.6	**View user defined selection of module results**
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select a module run or runs (for comparison) 3. Define data set (variable, temporal & spatial extent) 4. Define data manipulation functions to be chosen from a) temporal statistics (mean/min/max/std.dev/accum) b) spatial statistics (mean/min/max/std.dev/accum) c) threshold exceedance (temporal/spatial) d) frequency e) classification f) basic mathematics (difference/proportion/change over time) 5. Define graphic layout (map, graph, table) 6. Create output 7. View and print the output for selected locations/areas and type.
Sub-step 3	see UC 4.13
Sub-step 4	see UC 4.14
Variations	• If the slicing template for the data set is not available, one should be able to add a slicing template
Non-functional	• Data generation for viewing of data should have a high performance • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network

Use Case 4.6	View user defined selection of module results
Issues	• Saving templates for user defined selections may require substantial modification of NFFS capabilities • Data access restrictions apply for different actors

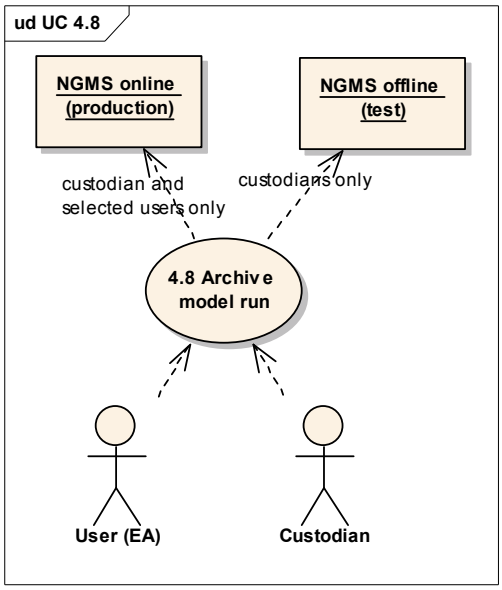
4.7 Export module output

Use Case 4.7	Export module output
Description	The user should be able to export data slices for further processing. These actions can be carried out from outside the EA network by a third party contracted by EA.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select a module run 3. Select the part of the standard model output (generated with the selected post processing template) that should be downloaded. 4. Select an appropriate download format (shp, xls, PI) 5. Select the export destination 6. Export the data.

Use Case 4.7	**Export module output**
Variations	Alternatively a user defined data slice can be exported… 1. Select a module run 2. Define data slice (location/area, period, data type), see UC 4.14 3. Select an appropriate download format (shp, xls, PI) 4. Select the export destination 5. Export the data slice
Non-functional	• Exporting data should have a reasonable performance • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network
Issues	• Data should be exported in an agreed standard format. Standards are the EA TimeSeriesDataExchangeFormat, other relevant PI-formats, Shape files and Excel files (xls). EA application design must comply to the specified XML format for data exchange (for new applications) • Model output data should provide an audit trail based on metadata pertaining to input data sets used and referenced by the model and the version of the model being run. • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network • Data access restrictions may apply for different actors

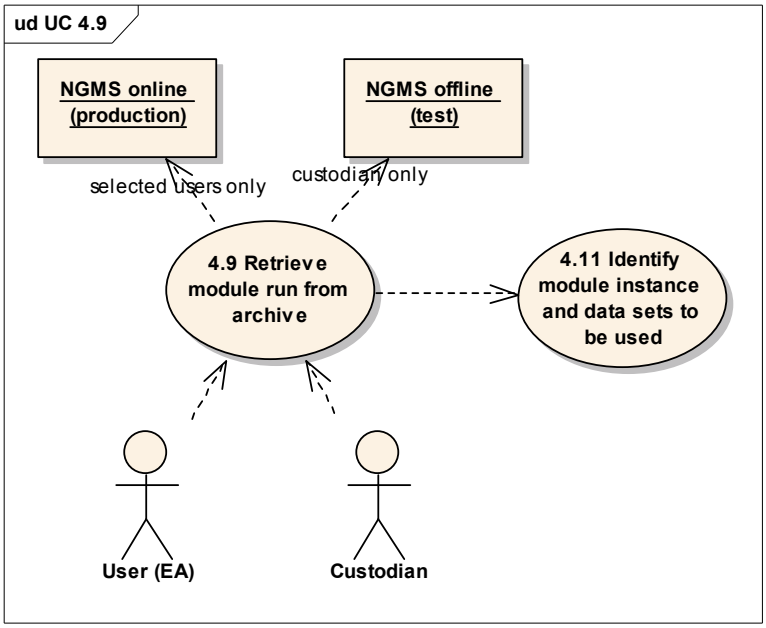
4.8 Archive module run

Use Case 4.8	**Archive module run**
Description	Critical module runs are archived by custodians. Users may archive non-critical module runs associated to specific projects. Critical model runs to be archived are: Standard Scenarios • Naturalised (zero abstraction) • Historical • Fully License (predictive) • Recent Actual (baseline) Other • EA-approved Climate change scenarios • Essential calibration runs (other than historical). Please note that an archive is a targeted backup that can be retrieved by the user. Non-critical model runs are all deviations from standard scenarios.

Use Case 4.8	**Archive module run**
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Production system is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select a module run 3. System completes the logbook with missing items filled in by user: a) Minimum contents logbook critical model run i) Run name/Number ii) Date of upload iii) Date of last run iv) Module (code) version v) Module data set version vi) Comments: Purpose of run. Brief summary of change from previous critical run version vii) Custodian viii) Standard Scenario Name ix) Reference to associated documentation (PDF) x) Run start end date xi) Link to input files (incl. date + time created and by whom) xii) Link to output files (incl. date + time created) b) Optional extensions i) Agency project number 4. Compress and archive the following contents of a module run as critical a) run-time log by executable of critical meta-data (no in/output) b) modellers log book (see below) c) all module input files (recharge) d) all module object code (executable) e) all module output files

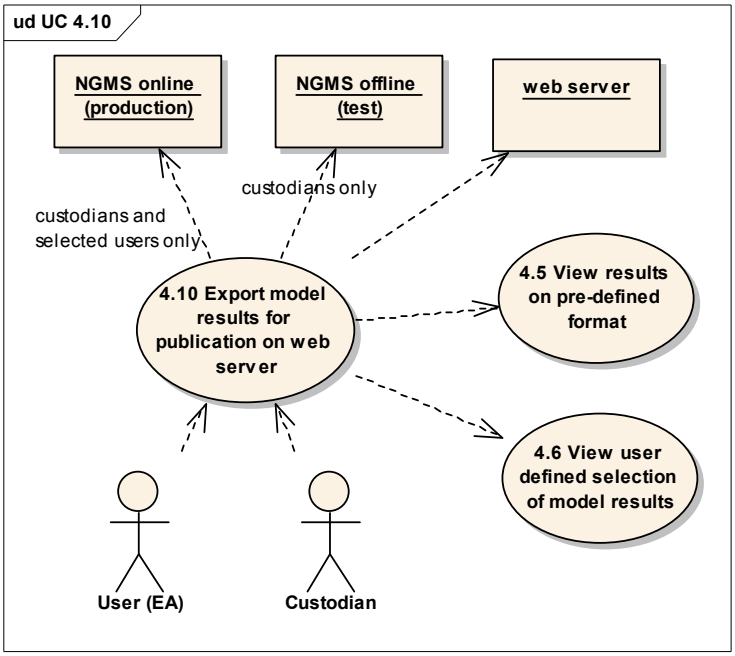
Use Case 4.8	Archive module run
	5. Mark the module run as archived (which allows deletion by the system manager)
Variations	-
Non-functional	• Archiving decisions for non-Standard Scenarios are made by custodian in consultation with Nat.Super User (Head Office) • Nat.Super User (Head Office/CIS) has overall responsibility for archiving strategy and disk allocation
Issues	• Preferably, the NGMS should assist in naming consistency for archived model runs (e.g. archiving form contains individual fields for area, scenario etc. while full model name becomes concatenation) • Archiving is always a centralized storage facility and therefore will not be done in stand-alone mode.

4.9 Retrieve module runs from archive

Use Case 4.9	Retrieve module run from archive
Description	The user should be able to retrieve an archived module run and its associated data.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available

Use Case 4.9	Retrieve module run from archive
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select an archived module run 3. Retrieve the module run and it associated data into the system.
Variations	-
Non-functional	• The archived module run and the associated data will be moved to the temporary store under the account of the user. The default policy will be applied for availability for temporary stores (see UC 4.11) • Retrieval of critical module runs
Issues	• For completeness sake, archives also contain the module dataset. The module datasets can only be rerun in case the module (in its correct version) is still operational in the system. • Retrieval of critical module runs based on the most recent scenarios should be fairly quick (e.g. within the hour). Retrieval of other runs may take more time (preferably less than a day).

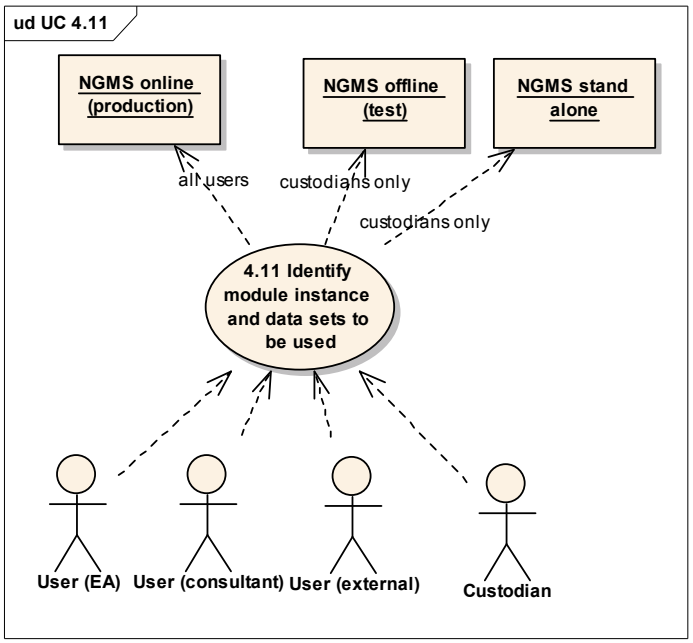
4.10 Export model results for publication on the web server

Use Case 4.10	Export module results for publication on the web server
Description	The user should be able to select model results that will be published on the web server and becomes accessible by viewer groups.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected

Use Case 4.10	Export module results for publication on the web server
	password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select an module run from the temporal store 3. Select the data to be published on the website (see UC 4.5 or UC 4.6) 4. Select the destination to save the web-compatible files (html, jpeg/gif/png) 5. Perform a manual check on the results in a web-browser 6. Move the content to the web server content system according to EA-standard website procedures
Variations	-
Non-functional	Step 5 may be supported by NGMS by launching a web-browser Step 6 may be supported by the NGMS upon request of the user
Issues	Consult with EAsinet (Andrew Robertson), EA Internet team (Nick Squire) and CIS

4.11 Identify module workflow and module data set to be used

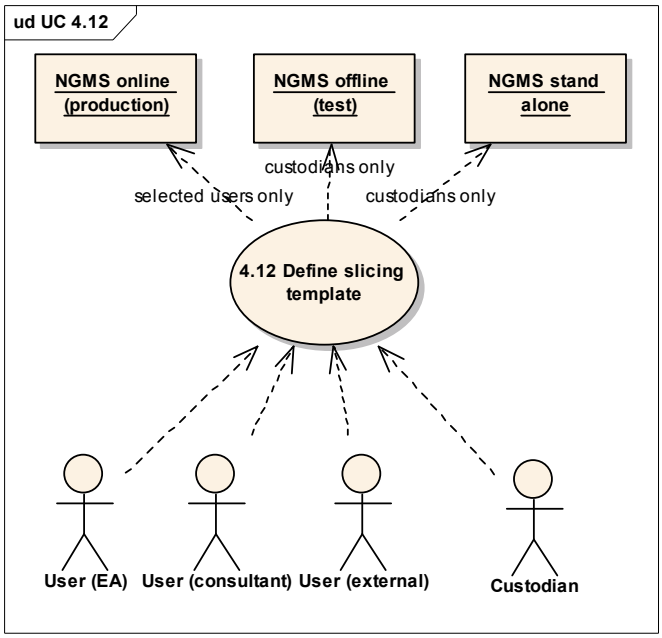
Use Case 4.11	Identify module workflow and module data set to be used
Description	Browse through module data sets and view input data to enable decision on the data to work with These actions can be carried out from outside the EA network by a third party contracted by EA.

Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Browse through module data sets. 3. Selection is done on the basis of primary identifiers (available via tooltip or direct in explorer) a) Geographical location(name of the model area + model boundary display on map) b) Module datasets type c) Custodian: name, organisation/department Secondary identifiers (information window available via a hypertext link): d) Geology (chalk, Permo-Triassic sandstone, Magnesian Limestone, Lower Greensand …) e) Module Data Set Statistics i) Number of aquifers ii) Available module code (incl. code version) iii) Modelling grid (size, density,..) iv) typical run-time duration for a transient run (e.g. per year of data) v) Time series length f) Module Data Set History i) Year of creation ii) Module data Set version identifier iii) Original purpose of module dataset iv) History log v) References to model studies vi) Link to quality audit log (e.g. HarmoniQuA) g) Spatial Coverage of Module Data Set

	i) Env.Agency Area(s) ii) CAMS area(s) iii) WFD river basin district(s) iv) Local Authority areas (for contaminated land purposes) v) WFD groundwater body reference number(s) vi) National Grid Reference h) all data should be available in map format (shape or PI) for display/overlay on the Ordinance Survey base map
Variations	-
Non-functional	• The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network
Issues	• Data access restrictions may apply for different actors

4.12 Define spatial slicing template

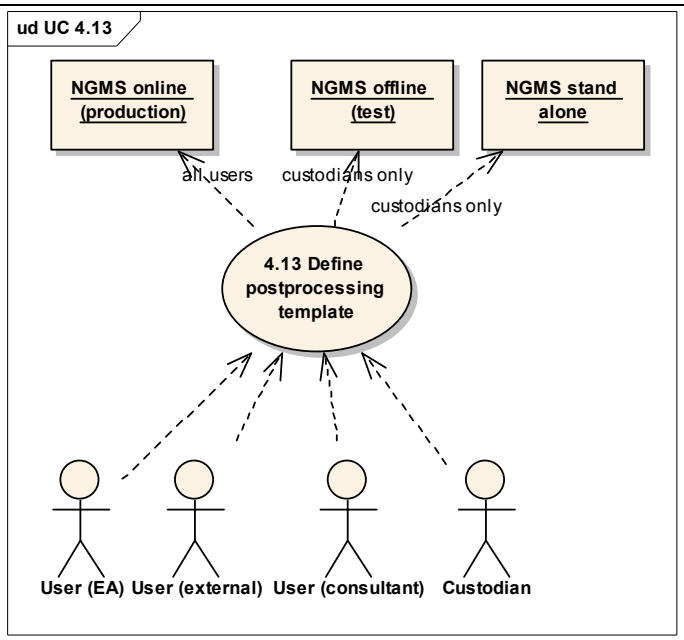
Use Case 4.12	**Define spatial slicing template**
Description	Define the spatial data slicing template to be attached to one or more output variables. NB.1. This spatial slice needs completed with information on selected variable, time frame etc to become full slicing. The UC might also be addressed by defining the complete slice instructions. NB.2. This slicing profile will be used to create a sub-set of data that will be used for visualizations and downloads. Slicing profiles are typically applied in combination with data manipulation functions to generate condensed visualizations These actions can be carried out from outside the EA network by a third party contracted by EA.

Use Case 4.12	**Define spatial slicing template**
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Step	1. Review if horizontal location set/area is defined. If not… 2. Define area/location in horizontal plane on a map 3. Save location set name as spatial slicing template
Variations	Define location set by 1. point (location/xy-coordinate in form, pointed by mouse) 2. multi-point selection (location set in form + pointed by mouse) 3. streamline (end node pointed by mouse) 4. entire model area 5. polygon sub-area (outer 3+ points pointed by mouse) 6. circular sub-area (centre pointed by mouse, radius by form edit) 7. upstream catchment area (downstream cell pointed by mouse, for top layer only) 8. import slice boundaries overlay from shape file (custodian can limit nr. of polygon overlays, as well as size of data slice) Low priority: • straight line (begin + end pointed by mouse)
Non-functional	-
Issues	• The slice specifier needs to incorporate vertical and temporal slicing information • All cells whose cell centres are within the slicing boundaries will be included in the data slice • The performance for execution of those activities from outside the

Use Case 4.12	Define spatial slicing template
	EA network should not be significantly reduced in comparison with performing these action within the EA network

4.13 Define post-processing template

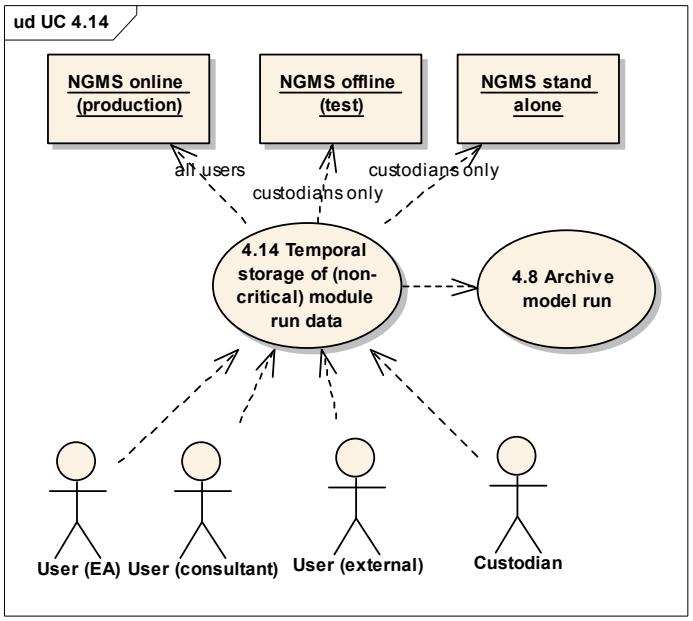
It should be decided if this is a separate GUI-template or whether it is a template that is inherited from the visualization selection.

Use Case 4.13	Define post processing template
Description	Define the post processing functions to be applied for a given data set which is defined by variable, spatial extent, and time frame (begin, end, step) These actions can be carried out from outside the EA network by a third party contracted by EA.
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Define output data set a) Select module variable b) Select spatial extent i) Select horizontal slicing template

Use Case 4.13	Define post processing template
	ii) Select vertical extent (single layer / multi-layer / all layers) c) Define time frame (begin, end) 3. Define graphical layout a) stream accretion b) stream outflow hydrograph c) splodge plots d) winterbourne signature e) ground water unit budget - horizontal map f) ground water unit budget - vertical slice g) duration curves h) frequency curves i) bar charts j) contour plots k) classification l) differences m) proportions n) change over time where required, provide additional information to complete the specification (e.g. thresholds, comparison cases, classifications) 4. Save post-processing template
Variations	-
Non-functional	-
Issues	Is the relation with visual output specification satisfying? Should the user-defined additional manipulation functions also be captured in post-processing templates? • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network

4.14 Temporary storage of non-critical module run

Use Case 4.14	Temporary storage of non-critical module run
Description	Non-critical module runs need to be available in the system for a limited time. This will enable the user to complete his project work and prepare the materials that need to be archived (by the custodian) Non-critical model runs are all deviations from standard scenarios. These actions can be carried out from outside the EA network by a third party contracted by EA.

Use Case 4.14	**Temporary storage of non-critical module run**
Actor / system setting	
Assumptions	• User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online System (production system) is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select module run data and define new expiration date 3. Complete the logbook (see UC 4.8) and assign similar expiration date
Variations	-
Non-functional	Module runs automatically expire at their expiration dates Availability policy for non-critical module runs • Users receive a limited disk storage account which they have to manage. • Default expiration period for a module run is two weeks • After two weeks the user is send an email (cc. custodian) through which he can request for an extension up till 3 months • After three months the custodian is end an email (cc.user) to handle accordingly. • If a user is sending out a computation batch which will result in an overflow of the allocated disk account, the user will be requested to do its housekeeping before the batch is started. Default policy will be that a computation job is executed only if disk space is available on the users account. (A parameter of each module instance is the expected execution time and the expected size of the output)
Issues	• Preferably, the NGMS should assist in naming consistency for

Use Case 4.14	Temporary storage of non-critical module run
	archived model runs (e.g. archiving form contains individual fields for area, scenario etc. while full model name becomes concatenation) • The performance for execution of those activities from outside the EA network should not be significantly reduced in comparison with performing these action within the EA network

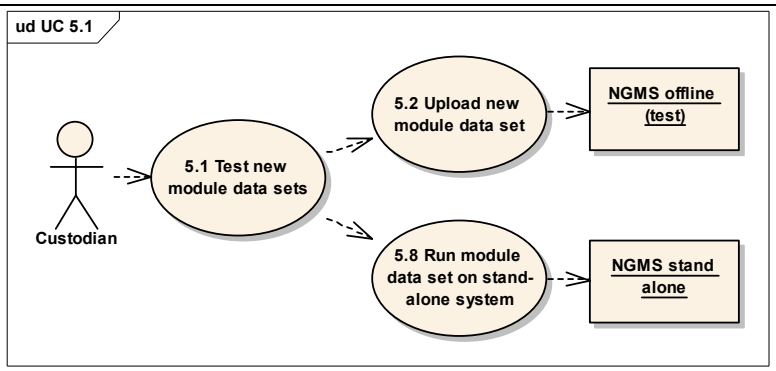
5 Use Cases: Custodian

Most use cases of chapter 4 apply for the custodian on the offline test system or for the stand-alone system. The following use cases are presented for a custodian. They typically apply for the online production system and/or the offline test system and/or the stand-alone application:

5.1 Test new module datasets
5.2 Upload new module datasets
5.3 Export module datasets
5.4 Test new boundary condition sets
5.5 Upload new boundary condition sets
5.6 Export boundary condition sets
5.7 System configuration (regional aspects)
5.8 Run module data set on stand-alone system

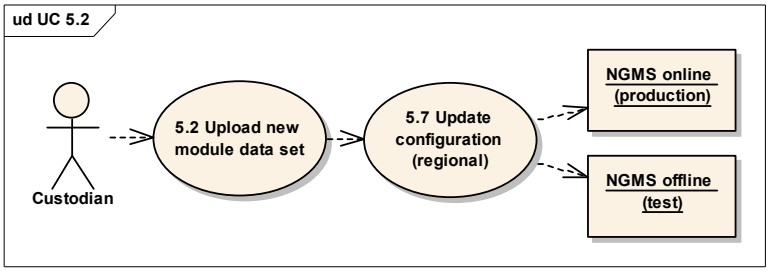
Please note that an important part of the custodian's tasks focuses of the development of module datasets and boundary condition sets. These tasks are not facilitated by the IT architecture but by dedicated (module specific) tools and general purpose software like GIS and spreadsheets. These tasks are therefore not described in the use cases below.

5.1 Test new module datasets

Use Case 5.1	**Test new module datasets**
Description	Before making a new module dataset available on the system the module dataset has to be operationally tested on consistency and functionality on test system not to affect the production system. Testing on the off-line system should only be done after a testing procedure in stand-alone mode (see UC 5.8).
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • User has access to NGMS client functionality • Off-line test System is available

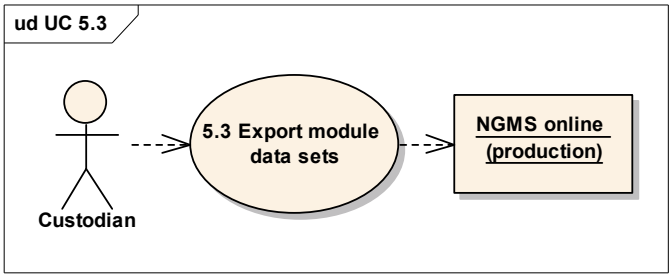
Use Case 5.1	**Test new module datasets**
	• Module is configured
Steps	1. Log into test system (access level defined on the basis of the EA password) 1. Prepare module dataset to be uploaded. This involves: a) Module input files (native format) b) meta data specification including: i) Identification of module data set ii) Shape files that reflect module data set to allow inspection by user iii) Logbook (contents see UC 4.8) a) Configuration (updates of module data set references) 2. Upload module dataset (see UC 5.2. but applied on test system) 3. Test the modified system configuration 4. Test the system functionalities 5. Report to the national super user
Variations	-
Non-functional	-
Issues	-

5.2 Upload new module datasets

Use Case 5.2	**Upload module datasets**
Description	Modified and new module datasets need to be uploaded into the online production system to become operationally available. The upload of module datasets will be carried out in conjunction with an upload of boundary condition sets and an updated system configuration. Upload into the offline testing system should only be done after a testing procedure on a stand-alone system (see UC 5.8). Upload into the online production system should only be done after a testing procedure in the offline testing system.
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality

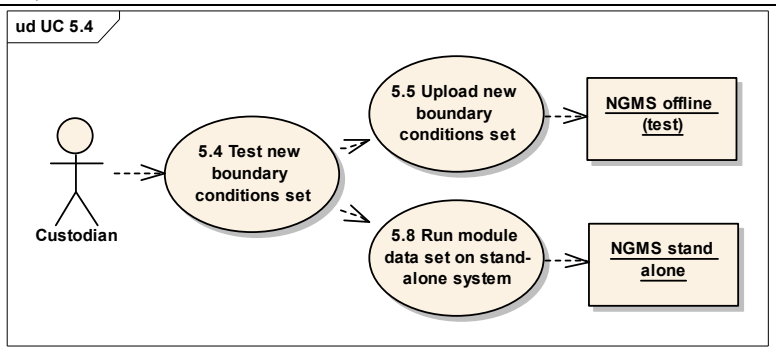
Use Case 5.2	**Upload module datasets**
	• System (Offline test system/Online production system) is available • Module is configured • Custodian is authorized to approve new data sets and configuration updates
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Prepare module dataset to be uploaded. a) See UC 5.1 Test new module datasets. b) Update logbook 3. Upload module dataset and system configuration (see UC 5.7) 4. Test the modified system configuration 5. Approve new data set and updated system configuration 6. Report to the National Super User
Variations	-
Non-functional	-
Issues	• The dimension of the module datasets determines whether a direct upload into the system is feasible. If not, the module dataset is copied to an FTP site and uploaded from there.

5.3 Export module datasets

Use Case 5.3	**Export module datasets**
Description	A custodian should be able to export module datasets to implement modifications. Generally the export of module datasets will be carried out in conjunction with export of boundary condition.
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality • Online production system is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select module dataset to be exported

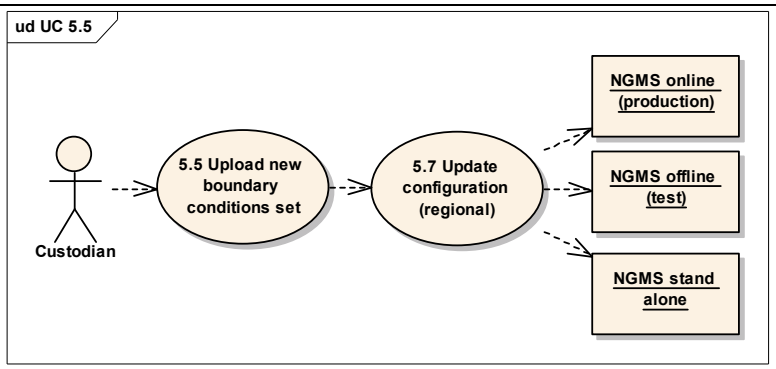
Use Case 5.3	Export module datasets
	3. Select destination on disk 4. Export module dataset
Variations	-
Non-functional	• The module data set should be available in the native format of the module core
Issues	• The dimension of the module datasets determines whether a direct download to a client is feasible. If not, the module dataset is copied to an FTP site from the administrator can retrieve it.

5.4 Test new boundary condition sets

Use Case 5.4	Test new boundary condition sets
Description	Before making a new boundary condition set available on the system the boundary condition set has to be operationally tested on consistency and functionality on the test system in order not to affect the production system. NB this need for testing does not apply for user-defined boundary condition set modifications such as abstractions and surface water level changes. Testing on the system only should be done after the new boundary data set has been tested on the stand-alone system of the custodian (see UC 5.8)
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality • Offline test system is available • Module is configured
Steps	1. Log into test system (access level defined on the basis of the EA password) 2. Prepare boundary condition set to be uploaded a) New boundary condition input files (native format)

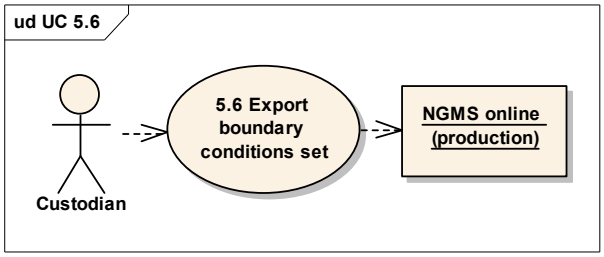
Use Case 5.4	**Test new boundary condition sets**
	b) meta data specification including: i) Identification of new boundary condition data set ii) Shape files that reflect new boundary condition data set to allow inspection by user iii) Logbook (contents see UC 4.8) a) Configuration (updates of data set references) 3. Upload boundary condition set (see UC 5.5) and system configuration (see UC 5.7) 4. Test the modified system configuration 5. Test the system functionalities 6. Report to the national super user
Variations	-
Non-functional	-
Issues	-

5.5 Upload new boundary condition sets

Use Case 5.5	**Upload boundary condition sets**
Description	Updated and new boundary condition sets need to be uploaded into the production system to become operationally available. Upload into the offline testing system should only be done after a testing procedure on a stand-alone system (see UC 5.8). Upload into the online production system should only be done after a testing procedure in the offline testing system.
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality • Offline test system is available • Corresponding module dataset is configured
Steps	1. Log into System (access level defined on the basis of the EA

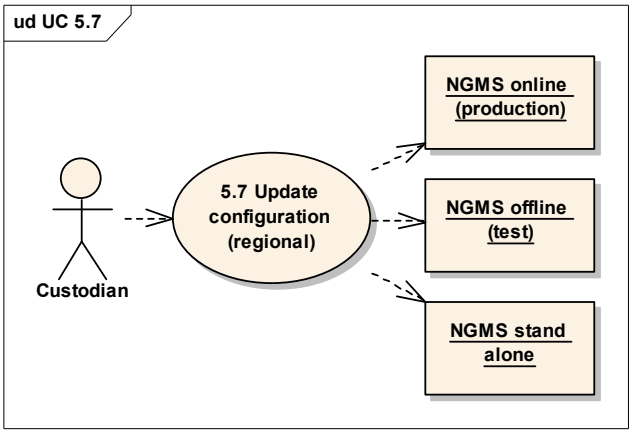
Use Case 5.5	Upload boundary condition sets
	password) 2. Prepare boundary condition set to be uploaded. See UC 5.4 including update logbook 3. Upload boundary condition set and system configuration (see UC 5.7) 4. Test the modified system configuration
Variations	• Potentially, part of the boundary condition set could be uploaded to replace the corresponding part of an existing boundary condition set.
Non-functional	-
Issues	• The dimension of the boundary condition sets determines whether a direct upload into the system is feasible. If not, the module dataset is copied to an FTP site and uploaded from there.

5.6 Export boundary condition sets

Use Case 5.6	Export boundary condition sets
Description	A custodian should be able to export boundary condition sets to implement modifications (like extension of the sets with new data).
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality • Online production system is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select boundary condition set to be export 3. Select destination on disk 4. Export boundary condition set
Variations	• Potentially, part of the boundary condition set could be exported.
Non-functional	-
Issues	• The dimension of the boundary condition sets determines whether a

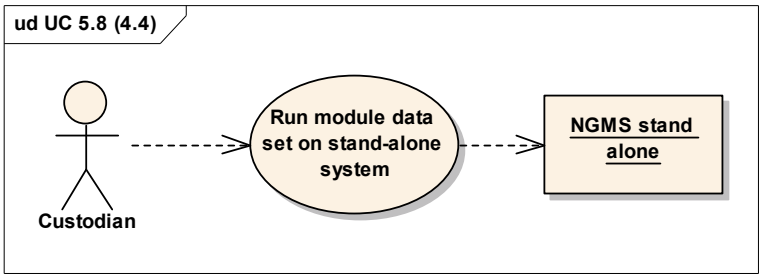
Use Case 5.6	Export boundary condition sets
	direct download to a client is feasible. If not, the boundary condition set is copied to an FTP site from the administrator can retrieve it.

5.7 System configuration (regional aspects)

Use Case 5.7	System configuration (regional aspects)
Description	The custodian needs to set up and update the region specific parts of the system configurations. This includes setting up of: • pre processing steps • module instances • workflows ('batches of activities') • module datasets configuration • slicing templates • post processing templates • display options • report options System configuration includes multitude of activities which could in principle be split up in a range use cases of a similar nature. Here is therefore chosen to present only a single use case.
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with password • Custodian has access to NGMS client functionality • System (offline test resp. online production) is available • Modules, module datasets and boundary condition sets have been uploaded • The 'national' configuration files are uploaded
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Update regional configuration files to reflect new locations, data sets, workflows, postprocessing and display options

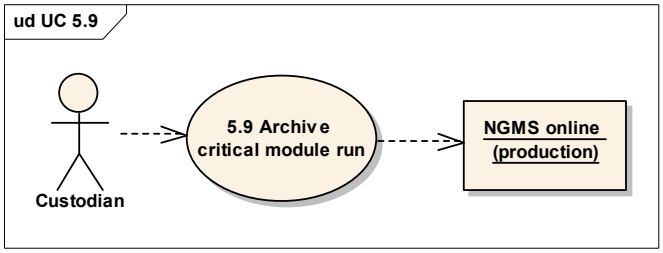
Use Case 5.7	System configuration (regional aspects)
	3. Upload individual or complete sets of system configuration files 4. Test the modified system configuration
Variations	-
Non-functional	-
Issues	• A clear distinction is required between region specific and national configuration files

5.8 Run module dataset on stand-alone system

Use Case 5.8	Run module dataset in stand-alone mode
Description	New module data sets, boundary conditions sets and slicing templates are typically prepared by a custodian on a stand-alone system before they are tested in the off-line system. Therefore the custodian needs to be able to run a module dataset *in stand-alone mode* for a given for a user defined period of time with selected boundary condition set. The user should be able to select a what-if scenario and/or a user defined modification, and select from a series of preset output options (post processing template). This requirement may be practical for custodians that use the system for developing module datasets.
Actor / system setting	
Assumptions	• Stand-alone system is installed on desktop of user
Steps	1. Select module dataset to be used. 2. Select a what-if scenario/boundary condition set 3. Define the run period and time step 4. Select/define raw output generation template 5. Select a post processing template 6. Run module dataset (including post processing)
Variations	• A custodian should be able to specify a batch of module runs by repeating steps 2 to 7 a few times selecting different combinations before initiating the run

Use Case 5.8	**Run module dataset in stand-alone mode**
Non-functional	
Issues	• Data cannot be archived if run on a stand-alone system • Data can not be submitted for publication on the web server if generated by a stand-alone system • In both cases, the custodian need to define and run the computation on the server.

5.9 Archive critical module run

Use Case 5.9	**Archive critical module run**
Description	Critical model runs to be archived are: Standard Scenarios • Naturalised (zero abstraction) • Historical • Fully License (predictive) • Recent Actual (baseline) Other • EA-approved Climate change scenarios • Essential calibration runs (other than historical). Please note that an archive is a targeted backup that can be retrieved by the user. Non-critical model runs are all deviations from standard scenarios.
Actor / system setting	
Assumptions	• Custodian is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Online production system is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Select a module run 3. Complete the logbook a) Minimum contents logbook critical model run i) Run name/Number ii) Date of upload iii) Date of last run

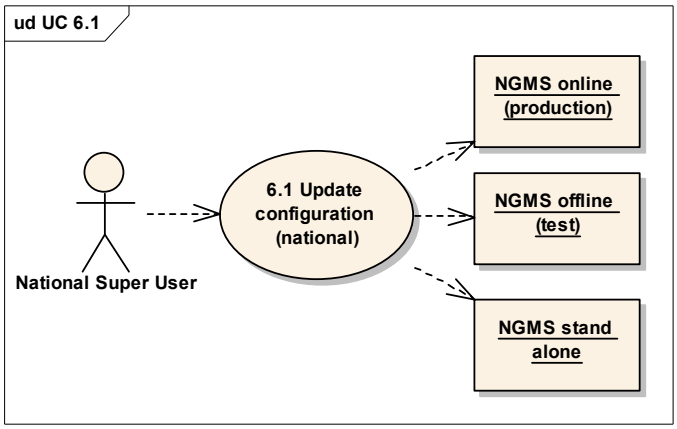
Use Case 5.9	**Archive critical module run**
	iv) Module (code) version v) Module data set version vi) Comments: Purpose of run. Brief summary of change from previous critical run version vii) Custodian viii) Standard Scenario Name ix) Reference to associated documentation (PDF) x) Run start end date xi) Link to input files (incl. date + time created and by whom) xii) Link to output files (incl. date + time created) b) Optional extensions i) Agency project number 4. Archive the following contents of a module run as critical a) run-time log by executable of critical meta-data (no in/output) b) modellers log book (see below) c) all module input files (recharge) d) all module object code (executable) e) all module output files 5. Mark the module run as archived (which allows deletion by the system manager)
Variations	
Non-functional	• Archiving decisions for non-Standard Scenarios are made by Custodian in consultation with Nat.Super User (Head Office) • Nat.Super User (Head Office/CIS) has overall responsibility for archiving strategy and disk allocation Archiving duration/strategy critical model runs • Last critical model run version should be completely available and quickly accessible and thus stored on hard disk (HD) • Previous critical model run should be completely available; storage may be external to the system (e.g. tape or HD). To be decided by custodian and Nat.Sup.User • Older critical model runs should contain sufficient info to repeat and check the run → logbook, run-time log, input files, object code and one module output file to enable check of rerun
Issues	• Preferably, the NGMS should assist in naming consistency for archived model runs (e.g. archiving form contains individual fields for area, scenario etc. while full model name becomes concatenation) • Archiving is always a centralized storage facility and therefore will not be done in stand-alone mode.

6 Use Cases: National Super User

The following use cases are presented for a national super user:

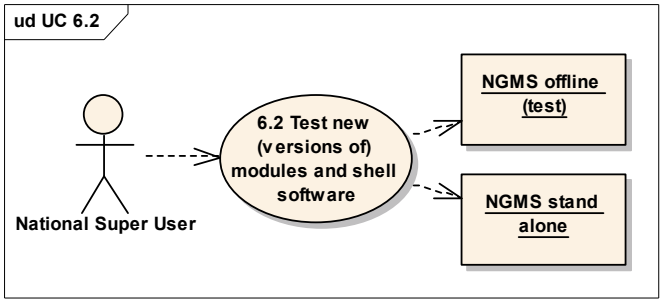
1. System configuration (national aspects)
2. Testing new (versions of) modules and programmes

6.1 System configuration (national aspects)

Use Case 6.1	**System configuration (national aspects)**
Description	The national super user needs to set up and update the 'national' parts of the system configurations. This includes setting up of: • Client configuration • Standard output formats (reports) System configuration includes multitude of activities which could in principle be split up in a range use cases of a similar nature. Here is therefore chosen to present only a single use case.
Actor / system setting	
Assumptions	• National super User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • System is available
Steps	1. Log into System (access level defined on the basis of the EA password) 2. Update system configuration files to reflect new software packages, workflows, output options etc. 3. Upload individual or complete sets of system configuration files 4. Test the modified system configuration
Variations	

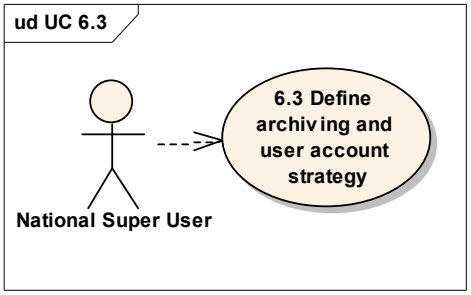
Use Case 6.1	System configuration (national aspects)
Non-functional	
Issues	• A clear distinction is required between region specific and national configuration files

6.2 Testing new (versions of) modules and shell software

Use Case 6.2	Testing new (versions of) modules and shell software
Description	The national super user is responsible for the testing of new (versions of) modules and shell software. It is necessary to check on a test system whether new versions of modules and programmes generate the same results as the current system versions. A decision has to be taken whether or not and for how long old versions are kept available on the system.
Actor / system setting	 National super user: • Science for new modules • Head Office for new shell functionality
Assumptions	• National super User is logged into harmonised desktop with user ID and protected password • User has access to NGMS client functionality • Test system is available
Steps	1. Log into test system (access level defined on the basis of the EA password) 2. Prepare module or programme to be uploaded 3. Upload module or programme 4. Test the modified system configuration 5. Test the functionalities of the module or programme 6. Report to the system manager
Variations	-
Non-functional	-

Use Case 6.2	Testing new (versions of) modules and shell software
Issues	• Considering the available manpower it is assumed that the actual testing also can be carried out by a custodian. However the responsibility will maintain at the level of the national super user. • The national super user should inform the system manager on the test results. The national super user has to decide (formally) whether or not as well as how long old (versions of) modules and programmes will stay available on the system.

6.3 Define archiving and user account strategy

Use Case 6.3	Define archiving and user account strategy
Description	The national super user is responsible for defining and implementing an archive and disk allocation strategy
Actors	
Assumptions	• This strategy is defined on paper and handed over to the system manager to be implemented
Steps	-
Variations	-
Non-functional	• Archiving decisions for non-Standard Scenarios are made by custodian in consultation with Nat.Super User (Head Office) • Nat.Super User (Head Office/CIS) has overall responsibility for archiving strategy and disk allocation Archiving duration/strategy critical model runs • Last critical model run version should be completely available and quickly accessible and thus stored on hard disk (HD) • Previous critical model run should be completely available; storage may be external to the system (e.g. tape or HD). To be decided by custodian and Nat.Sup.User Older critical model runs should contain sufficient info to repeat and check the run → logbook, run-time log, input files, object code and one module output file to enable check of rerun
Issues	-

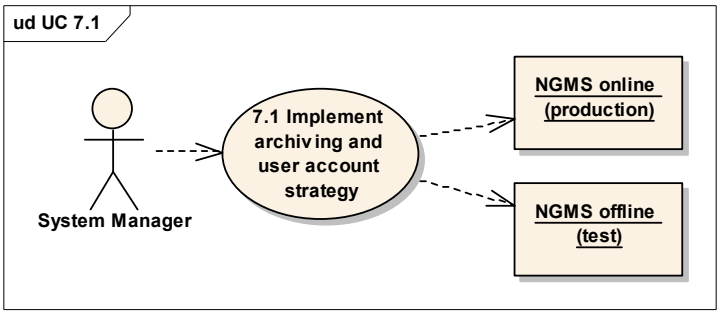
7 Use Cases: System Manager

The following use cases are presented for a system manager:

1. Install modules
2. Install software updates (system software and application)
3. Create and manage user accounts
4. Maintain system
5. Monitor system

Given the generic nature of the tasks no use cases have been made for the user requirements of the System Manager for use case 1, 2, 4 and 5.

For use case 3 the following use case has defined:

Use Case	**Implementing archiving and user accounting strategy**
Description	The system manager must be able to manipulate user accounts, adjust disk resources etc.
Actor / system setting	
Assumptions	• This strategy is defined on paper and handed over to the system manager to be implemented
Steps	1. Log into system (access level defined on the basis of the EA password) 2. View user accounts, edit where required
Variations	
Non-functional	These functionalities may be done directly on the database server underlying the NGMS
Issues	•

In the framework of this feasibility study this not felt to be essential because of the generic nature of the tasks.

Service levels

The following requirements with respect to service levels have been identified:

- Availability: no high availability required
- Resilience: no requirement for dual sites
- Recovery needs: within 72 hours
- Reboot: no reboot for every new abstraction location to be tested

Appendices

A Groundwater Modelling – Statement of Requirement

The following information has been taken from the Assignment Brief prepared by Mark Whiteman & Nigel Hoad.

A.1 Groundwater Modelling – Statement of Requirement

User Requirements - IT Needs

Background and Need

Groundwater resource assessment and modelling currently accounts for £3 million per annum of Water Resources capital and revenue investment. Modelling programmes underpin core work areas contributing to a number of themes within the Agency's vision. They are crucial to successful delivery of the EU Habitats Directive, National Environment Programme (contributing to 5-year Water Company Asset Management Plans AMP), Catchment *Abstraction* Management Strategies (CAMS), water resource abstraction licensing and support to Source Protection Zones (SPZ) and groundwater quality and contaminated land work. In future models are likely to be required to enable the Agency to implement River Basin Management Plans and Programmes of Measures under the EU Water Framework Directive (WFD). This will require models that are capable of being operated across Area and regional boundaries at the scale of WFD River Basins.

Groundwater modelling has been undertaken by the Agency for many years using both in house and consultants to develop models. Irrespective of their origin the models are delivered to the Agency. There has been no national consistency for hardware, there being currently a range from free standing PCs, to partially networked to fully networked PCs.
To enable the Agency to fulfil its duties and allow models to be used effectively whilst using best science and technology, the Agency must have access to appropriate IS tools. This covers both hardware and software.

It is important that the size and complexity of modern groundwater models be recognised, that "standard issue" PCs are wholly inadequate to run today's models. These models are becoming increasingly complex and create large files.

Groundwater science is advancing at a pace, which is mirrored by software developments. Technical Specialists within the Agency who use groundwater models, as a community, should have the freedom to be able to select the best tools for them to do the job. A means of updating software is needed to be able to keep up with current practise. In its current form, modelling involves a range of different software packages that are interlinked that deliver the final modelled product.

The supply of IT facilities for specialist applications such as hydrogeological modelling must be resolved at a national level through development of an IT Strategy for groundwater modelling, since it must be possible to develop an agreed national standard for the equipment and software. It is dependent on the Head Office Water Resources Hydrogeology Policy/Process Team to determine this.

This paper is intended to facilitate discussion and inform the following:

1. The Head Office team
2. Science Team (Air, Land and Water)
3. The groundwater modelling community

Initailly a scoping brief will be prepared (FY 2004/ 5), followed by a period of actual implementation, measured in years. The final product is intended to provide a flexible vehicle upon which modelling can take place for the foreseeable future.

Procedure

The approach that is anticipated to be followed is formed of two units:

- Functional Design: this represents the functional requirement of the task and answers the question "what must the system be able to do?"
- Logical Design: this represents the technical design and answers the question "how does the system fulfil functional requirements?"

Benefits of an IT Strategy for Groundwater Modelling

A summary of the advantages of the proposed IT strategy are as follows:

1. Delivery to Operational Requirements

The list of business drivers are:

- CAMS
- RSA (Including Habitats Directive, NEP, BAP, Local)
- Water Framework Directive
- Licencing
- Water resource operational management e.g. drought
- Strategic water resource planning/management (e.g. WR Strategies, Sect. 20 Agreements etc.)
- SPZ/groundwater quality/contaminated land

There will be a need to consult with the Area teams during our feasibility/design work over the next year so that each driver can be populated with answers to the following bullet points

- What does the model need to do?
- How should the model be used? and
- Who should be using the model?

2. Advantages to CIS

- national system accessibility to all appropriate users
- central repository for all models
- national application focus, allows for cross Regional and/or model application particularly when looking at delivery inside the Agency drivers
- links to live databases
- Receives CIS support

Such a system has to be consistent with the Water Resources Hydrogeology Head Office Policy and Process Team (HPPT) Business Plan and to slot in with all the other CIS requirements. e.g. CIS IT Strategy etc. CIS would need to undertake a technical options appraisal as part of the feasibility/design work. To this end this has been clarified with Andrew Dixon who is actively assisting with the preparation of "Project Mandate". This document is a requirement by CIS before any works of this type are undertaken even if they are not paying for them. A technical person (such as Stephen Limb) in CIS needs to be involved in this work.

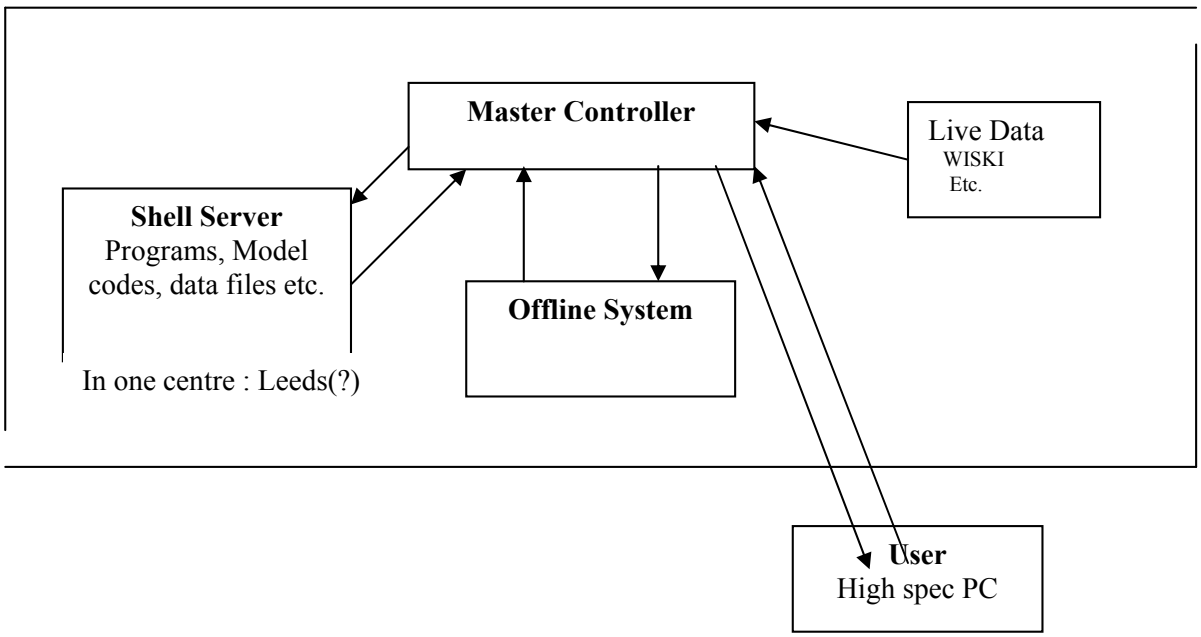
Summary of Options and Preferred Option

Options could include:

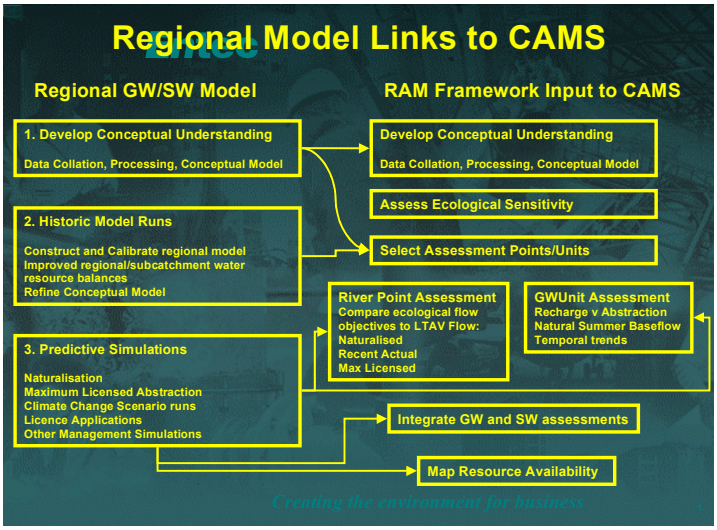
1. Continue as present, that is do nothing and would involve replacement of standalones and thus incur costs
2. Set up separate regional networks
3. Migrate to Agency's main network
4. Use of a (third party) consultant's network
5. Set up dedicated network
6. Make use of existing dedicated network (e.g. NFFS)

Outline of preferred option

(Based on Option 6) Broadly the anticipated system could follow the form of that approved and in use by the National Flood Forecasting Service (NFFS). This would take the form of a Master Controller with attached Shell Server. The models would reside in the server with user entering the system with appropriately powerful PCs through the controller. The data would enter through the controller. This system is illustrated below.



The user interface is also important, some of the scoping work will determine what sort of interface people want (e.g. in workshops with Areas). The results of this consultation form an element of functional requirements, in other words what does the system need to do.



Example from Anglian Region of CAMS with its requirement (Yare & North Norfolk).

Proposals for Feasibility Study to establish IT Strategy for Groundwater Modelling

Method Statement

Such a system as proposed has to be carefully thought out, with appropriate consultation with all customers who will impact upon the success of this. As the scope of these works involve a diverse group of experts, it is anticipated that the delivery of the works will be at some point in the future and not in the year 2004/5. There are likely to be parallels with works already established for the NFFS. It is inherent that there will be interaction to establish common ground and procedures with the NFFS.

As a start this User Requirement will be drawn up to form part of the Work inside the Form A, "Groundwater Resource Assessment and Modelling", item 6 that is "Feasibility Study for 5-year IT Strategy for groundwater resource assessment and modelling". To enable momentum to be maintained through the year 2004/ 5, the development of a project specifically on this subject has been entered in the Business Plan of the HPPT. Feasibility work should include:

- investigation of options
- development of functional requirement (with Areas)
- initial scoping for development of technical design (with external supplier)
- Technical Options Appraisal (by CIS)
- Obtaining approvals for main project (Form A, PID)
- Obtaining funding within business plans for main project during 2005/06 (contributions from Area budgets?)

Timescales

Summary of Proposed Project Stages and Timescales

The steps that should be gone through are:
- feasibility
- design stage which should include comment on money and hardware
- system implementation stage

It is anticipated that feasibility work and preliminary design work can be completed during FY2004/05, with main design work and system implementation (rollout to regions/Areas) during FY2005/06 and FY2006/07.

Recommendations

Groundwater modellers are asked to support in principle:

1. The establishment of a project to provide a national hardware and software system to support groundwater modelling activities within the Agency.

2. The preferred option to be based upon the use of an established dedicated network (NFFS) as far as possible.
3. Scoping work to be carried out during 2004/05 by Head Office Hydrogeology team to establish user requirement and technical requirement through contact with Area users.
4. Groundwater modellers are asked to consider the level of financial support which could be provided from Area budgets during 2005/06 and 2006/07 towards implementation of the new system.

A.2 Region Specific Hardware & Software Needs

A.2.1 Hardware and Software Needs of Southern Region.

Interview with Paul Shaw on the 6th April 2004.

Model Status

Question: Where are the models kept?

Answer: All models have been copied onto CD ROMs and they have been verified that they are there and accessible. These are then placed in a fire safe. There is only one copy of each. All runs have been kept.

Question: Any particular comments?

Answer: The models that have been made are:

- GPZ3 models
- East Kent (F2) Ken Rushton - not used but still needed
- ICMM models - Charing
  - Bourne Rivulet
  - Wallop Brook
  - Hamble/ Meon/ Wallington
  - Darent
  - Dour
- Chichester SLAY (Halcrow Model) this has been recently checked through by Bill Morgan Jones and improved a bit.
- Itchen (done)
- North Kent (nearly done)
- East Kent (starting)
- Test and Itchen (starting)
- IOW Central Downs, used for steering projects and Conceptualisation and a little numerical modelling.
- IOW Southern Downs, as for Central Downs.

Software

Question: What software have you used, and do you currently use?

Answer: Codes used are:

- ICMM (these are a collection of codes say recharge, gw flow, pre and post processors. Older models require special utilities, recent ones can use Excel.
- Textpad. A good editor is needed, ability to support ArcGIS.
- GWV. Useful to set things up.
- VKD and ADIT codes now often used to run models.
- Salford Compiler. Used on existing models to re-compile FORTRAN code, should a model be updated. Newer versions can use VBA or SURFER macros or ArcView.

Question: Any particular comments?

Answer: The importance of having the Salford Compiler should not be under estimated. It is needed when dealing with models coming from consultants for example when correcting or updating them. It has particular regard to say pre and post processors. The old Version 77 does not work in a DOS box, but the 95 version is OK.

DVF - Digital Visual Fortran is a compiler but not as good as Salford - in fact it does not do the job.

Hardware

Question: Have you access to hardware for all your models?

Answer: Yes

Question: What is the specificiation of your current hardware?

Answer: Current PC is a network 2.5GHz Pentium 4 with 512 MB memory and 40GB hard disk. It has an old CD burner (2X) which uses Nero software.

This networked machine can have CD Roms made on it. It is not viable to store all model runs on the server.

Question: Any particular comments?

Answer: At the moment the following hardware specification for modelling, in other words for say a laptop should be a minimum of:

HDD: 120Mb (fast drives, 7400rpm and serial ATA)
CPU: a 3 GHz P4
RAM: minimum 512Mb fast memory (DDR or better)
>2 USB2 ports (for file transfer, external devices like HDD or DVD burner and flash memory)

DVD/CD burner, preferably built in

Portables are preferred which could be linked, via a docking station/ KVM switch box, to existing desktop VDU, keyboard and mouse. This would allow us to take model results to other offices without the need for such lengthy preparation of presentations beforehand, and to work from any location.

VDUs must be of sufficient size to allow the modeller to see with out strain what is being done, thus 17" screens are a minimum, preferably 19".

A.2.2 Hardware and Software Needs of Thames Region.

Self Assessment of situation

Model Status

Question: Where are the models kept?

Answer: Recent transient models are kept on a stand alone PC (which does have a network card so data exchange can be undertaken). All models have been copied onto CD ROMs and they have been verified that they are there and accessible. There is only one copy of each.

Question: Model status?

Answer: The models that have been made are:

- GPZ3 models - not on PC, kept on CD Roms.
- SW Chilterns - poor model which although "operational" should be discarded and a new model built.
- Upper Colne - Gade - used for Low Flow studies
- Upper Lee - Mimram - used for Low Flow studies
- Kennet Groundwater Model - used for CAMS and HD
- Itchen (from Southern Region, but covers all of NE Hants of Thames Region)

There are a number of old and superceded models in the Region.

Software

Question: What software have you used, and do you currently use?

Answer: Codes used are:

- ICMM (these are a collection of codes say recharge, gw flow, pre and post processors. Older models require special utilities, recent ones can use Excel).
- Textpad. A good editor is needed.
- GWV. Useful to set things up.
- VKD codes now often used to run models.

- Salford Compiler. Used on existing models to re-compile FORTRAN code, should a model be updated.

Question: Any particular comments?

Answer: No

Hardware

Question: Have you access to hardware for all your models?

Answer: Yes

Question: What is the specification of your current hardware?

Answer: Current PC is a free standing PC **2.5MHz** Xeon with **512 MB** memory and **40GB** hard disk. It has an CD burner (2X) which uses Direct CD software. It also has a LS 150 drive (which has never to my knowledge been used).

It is not viable to store all model runs on the server.

Question: Any particular comments?

Answer: At the moment the following hardware specification for modelling, in other words for say a laptop should be a minimum of:

HDD: 120Mb (fast drives, 7400rpm and serial ATA)
CPU: a 3 GHz P4
RAM: minimum 512Mb fast memory (DDR or better)
>2 USB2 ports (for file transfer, external devices like HDD or DVD burner and flash memory)
DVD/CD burner, preferably built in

Portables are preferred which could be linked, via a docking station/ KVM switch box, to existing desktop VDU, keyboard and mouse. This would allow us to take model results to other offices without the need for such lengthy preparation of presentations beforehand, and to work from any location.

VDUs must be of sufficient size to allow the modeller to see with out strain what is being done, thus 17" screens are a minimum, preferably 19".

N Hoad

A.2.3 Hardware and Software Needs of North East Region.

Interview with Rolf Farrell on the 17th May 2004.

Model Status

Question: Where are the models kept?

Answer: All models have been copied onto CD ROMs, the GPZs are on floppy disks and they have been verified that they are there and accessible.

There is a free standing PC, currently with CIS for a rebuild. There was an issue that it used Win 95 as its operating system. RF not given an opportunity to determine its spec other than "what items should be moved to the rebuild". Not clear what will be done.

Question: Any particular comments?

Answer: The models that have been made are:

- GPZ3 models
- Corallian (Dales Area)
- Sandstone Aquifer (Ridings) (considered defunct)
- Yorkshire Chalk (Ridings)

The GPZs are mostly (?) done in Flowpath.

The Sandstone model is deemed not fit for purpose - this was a Southern Science Model.

The Chalk model is by ENTEC and is held in common with Yorkshire Water. These consultants have the current version.

Work in Hand:

- Selby / Doncaster. Just starting year 2 of 2. Have completed the conceptualisation, this is in a draft form. Works done by ESI by L. Brown. This model more or less covers the "old" sandstone model area.
- ENTEC are updating the Chalk model. Mostly looking at the confined bit. It possibly needs a look at the recharge model. There is active collaboration with Yorkshire Water on this model. Other than rolf no other EA person involved.

Software

Question: What software have you used, and do you currently use?

Answer: Codes used are:

- Have no good editor - this is needed, and also no ArcView. GWV. Useful to set things up.
- VKD and ADIT codes are considered not relevant.

The models use:

- Corallian - Modflow - Vistas (no VKD)
- Chalk - Birmingham code (should be on the stand alone when it comes back?)
- "new" Sandstone model - Modflow - Vistas

Hardware

Question: Have you access to hardware for all your models?

Answer: Yes, Vistas is on all PCs which could be used for modelling.

Question: What is the specificiation of your current hardware?

Answer: Nothing special about the stand alone (not modified). Possibly a P850 MHz.

There is a need that the spec below be used an interim measure (and there is nothing fancy about it either):

HDD: 120Mb (fast drives, 7400rpm and serial ATA)
CPU: a 3 GHz P4
RAM: minimum 512Mb fast memory (DDR or better)
>2 USB2 ports (for file transfer, external devices like HDD or DVD burner and flash memory)
DVD/CD burner, preferably built in

The VDUs must be of sufficient size to allow the modeller to see with out strain what is being done, thus 17" screens are a minimum, preferably 19".

It is not viable to store all model runs on the server. RF cannot comment on the use of the models being run on the networked PCs as they are not run in this Region in that way. The GPZs using Flowpath are likely to run on these networked machines. Existing concern about the grainy VDUs.

The Future
Use of Models:-

At the moment model usage is RF in Ridings on the Chalk and Sandstone Models and Neil Wotton in Dales on the Corallian Model. No other possible people other than Mike Lesson (ML) in Ridings (who may have

other interests). Northumbria have no models, no potential aquifers to be modelled (?) and no huge drive on it either.

The Dales team with one or two exceptions has changed entirely in the last 18 months.

Usage of models by other Water Resource type staff is limited, not really much technical knowledge (of hydrogeology let alone modelling). These people may not realise the potential application of modelling in their work. It relies on them to contact RF for advice.

The Selby / Doncaster Model has the following drivers:

- CAMS
- HD
- Renewal of licences
- (WFD)

It would be run by RF, but there is no one behind him other than ML. Management understanding of modelling appears weak and at AEM level there is no knowledge.

N Hoad

19 May, 2004

A.2.4 Hardware and Software Needs of North West Region.

Interview with Simon Gebbett on the 18th May 2004.

Model Status

Question: Where are the models kept?

Answer: All models have been copied onto CD ROMs, the GPZs are on floppy disks and it is considered that it is unlikely that these will be re-examined. The ICMM model is deemed to be an application in its own right and is on the server.

The existing server is sufficient to run these models.

Question: Any particular comments?

Answer: The models that have been made are:

- GPZ3 models
- ICMM models - Fylde
- Manchester and East Cheshire
- Coastal Sand Aquifer - Southport to Liverpool
- Wirral*
- West Cheshire*

* In house with support, conceptualisation done. WMC and Dave Johnson have assisted. Some investigative modelling undertaken.

Work in Hand:

- The Manchester and East Cheshire model has been finalised in early 2004, the Trafford Park is due to start mid 2004.

Software

Question: What software have you used, and do you currently use?

Answer: Codes used are:

- GPZs are mostly Flowpath, with some MODFLOW
- ICMM model

- MODFLOW
- Have no good editor - **this is needed**.
- GWV. Useful to set things up.
- VKD and ADIT codes are considered not relevant.

The models use:

- Fylde - ICMM. Last update three years ago. The application has all anciliary software it requires, but will it function correctly with the current Windows 2000 operating system.
- Manchester and East Cheshire - GWV
- Wirral and East Cheshire - Modflow - Vistas
- Coastal Sand - Modflow
- ZOOM
- ArcView

Hardware

Question: Have you access to hardware for all your models?

Answer: Yes, Vistas is on all PCs which could be used for modelling.

Question: What is the specificiation of your current hardware?

Answer: Nothing special.
128 Mb, P3, 800MHz, 10Gb, PC. This machine has a CD burner on it.

This machine is sufficient for the job, but due to be replaced the result of the Agency's rolling replacement procedure.

Maybe CIS should be asked for the following kind of PC:

HDD: 120Mb (fast drives, 7400rpm and serial ATA)
CPU: a 3 GHz P4
RAM: minimum 512Mb fast memory (DDR or better)
>2 USB2 ports (for file transfer, external devices like HDD or DVD burner and flash memory)
DVD/CD burner, preferably built in

The VDUs must be of sufficient size to allow the modeller to see with out strain what is being done, thus 17" screens are a minimum, preferably 19".

The Future
Use of Models:-

The groundwater modelling activity is focussed in Simon Gebbett. Support for his activities is given by Keith Seymour. Indeed for hydrogeological advise for the whole of the Region Simon and Keith are the established and known experts.

Usage of models by other Water Resource type staff is limited, not really much technical knowledge, but these officers (CAMS Co-ordinators, licence abstraction officers, HD officers etc.) do realize the potential application of modelling in their work. In terms of maangement buy in, the AEM of Central Area has knowledge of modelling, the others are not known. Team Leaders are generally aware of modelling.

The officers who would benefit from this model know of its existence and to whom they should talk when requiring output from it. Due the considerations mentioned above the system is robust enough for the end users, who are not hydrogeologists, to approach Simon and Keith for all the necessary technical support.

The link with Area Business Plans is good, the Regional Modelling Strategy is mentioned in all Business Plans.

The Wirral and West Cheshire Model (South Area) has the following drivers:
- CAMS
- Licensing
- Habs Dir

The Coastal Sand (Central Area) aquifer has the following primary driver
- Habs Dir

The Manchester and East Cheshire model (South Area) has the following primary drivers:
- CAMS
- Licensing

The Fylde Model (Central Area) has the following drivers:
- CAMS
- Habs Dir
- WFD

Plans for future models:

- Trafford Park - Third Phase Manchester and East Cheshire Model - WQ issue (South Area).
- Lower Mersey Basin - CAMS (South Area).

N Hoad

21 May, 2004

A.2.5 Hardware and Software Needs of Midlands Region.

Interview with Martin Shepley on the 10th June 2004.

Model Status

Question: Where are the models kept?

Answer: All models are kept upon a stand alone local server with one PC on it. One is P2 400MHz, and is about 5 years old, the server is a P3 750Mhz with a 60Gb hard disk drive and is about 3 years old. Both need replacement. In addition the models are backed up (weekly, sometimes daily) onto 90 Gb tapes for one year rolling basis.

Question: Any particular comments?

Answer: On the F: drive of the free standing PC there is a lot of GIS data, the intention is to have this migrated to the "i" drive and delete the files on this to free up disk space.

The files have been arranged on F: drive:

- EP models (all GPZ models)
- Sotfware –folder with source and executables compiled with Compaq Visual Fortran compiler (better than Lahey)
    - Recharge (D Johnson's code)
    - Modflow (Modlfow88, 96 and Modflow4R)
    - MT3D
    - Radial Flow
    - Unix Scripts
    - Fortran Utilities
- Groundwater models (listed below)

The Groundwater Model directory is entitled "WR_Modelling".

Models archived in 'project' folders

- Alberbury model (done in house with GWV - investigative model)
- Bromsgrove (Rushton code, but updated in house)

- Burton (done by WMC in GWV – investigative model)
- Birmingham CIRIA (old modflow model transferred in house to GWV and updated)
- East Shropshire Groundwater Model (ESI - recharge uses Dave Johson's code) - only final model runs are kept

(Series of Notts Doncaster sub-directories)

- Notts Doncaster (Rushton's code and still is, but later works done by WMC and in - house. The final update will be for the period 1998 - 2003, before a new model will be built).
- Whittingham (investigative mode currently being done by WMC)
- West Midlands - Worfe Model (project delivery archived temporarily on the E: drive) it is an ENTEC model, the directory contains all the pre- and post-processors, so it has all the software needed to run it. It is a MODFLOW model, although this is adapted for use with 4R).

Work in Hand:

- East Shropshire model in the last stages of delivery
- Whittington model being built
- Work in hand (in-house) on existing models
  - CAMS West Mids Worfe, Notts-Doncaster
  - STW Nitrate strategy, Notts-Doncaster

Software

Question: What software have you used, and do you currently use?

Answer: Codes used are:

- Bespoke (Rushton's Birmingham code)
- MODFLOW
- (GWV)
- FLOWPATH (for GPZ models)

ArcView is not really used here, Surfer is considered a more useful option. A lot of data is held on "I" drive.

Model Usage

Stand alone PCS are not ideal, but will remain in the short term. The existing PCs are now too old, the proposed National system is too far away, so it is likely that new free standing PCs will be purchased as an interim measure.

It is important that consultants are taken on board with the new proposed system, and that appropriate standards are also created.

The Future
Use of Models:-

The groundwater modelling activity is focussed in Martin Shepley, supported by Caroline Bakewell. Martin has pivotal role in modelling and this is known for this whole of the Region.

Other Water Resource staff do not run models, as they do not really have much technical knowledge (in general, one or two do though in the gw & cl technical teams), but these officers (CAMS Co-ordinators, licence abstraction officers, HD officers etc.) do realize the potential application of modelling in their work. These people do use the output of models. In terms of management buy in, the AEMs have little knowledge of modelling, Team Leaders are generally aware of modelling.

It is important that models are not run by Area Officers who do not appreciate all the intracacies of the models. Martin says it is important that the models are run from one place (this could be a remote server) by a team with enough critical mass so that there is a core of people under one management structure who actually understand the models - important for the QA. This is not compatible with running the models from Area. Access to the full data sets of the models should be restricted to those who know how to operate them. Furthermore having tools available at area so that they can interrogate selected model outputs would be a way of maximising their benefits

Model works were planned in the future (as outlined in the Midlands Region Modelling Strategy) are:

- Notts Doncaster Model
- Coventry
- Bromsgrove

The last two however were planned in relation to proposals for AMP4. The schemes were not approved by DEFRA and it is unlikely these projects will go ahead. Neither have been allocated funding. The scoping study for Notts-Doncaster has got funding..

N Hoad

14 June 2004

B Replies to Information Request in Study Proposal

B.1 North East Region (Neil Wootton)

We currently have 2 working models in the region

a) covers the corallian limestone near Scarborough.

The model was originally produced for the Upper Derwent project, to assess the impact of groundwater sources on the river, and also for the delineation of GPZ's for the YWS sources in the Scarborough area. As far as I am aware it has never been used in anger since the production of the model, although it has been updated once in the 6 years I've been here. It is intended to use the model for the CAMS which will be produced for the River Derwent.

b) Chalk model in the East Riding

We are currently updating this model which is a University of Birmingham bespoke code. It is used by technical officers for resource purposes. The model wasn't used for SPZ purposes but it is expected to use the updated conceptualisation as a basis for refining the SPZ's on the chalk.

In addition we are developing a Sherwood Sandstone model for the area between York and halfway between Selby and Doncaster. The main drivers are CAMS (this will be the only groundwater CAMS in the country) and resource pressures from public water supplies. Although in addition it may well be used for SPZ purposes.

We have a number of small models (in a variety of codes) for SPZ purposes which have never been assessed since the zones were initially defined.

B.2 North West Region (Simon Gabbett)

Nigel also discussed current use with me with regards to North West region and so should have these notes. This will answer the first part of the Delft request i.e. modules in operation, model datasets, types of users, usage of groundwater models. With regards to running of models the model file types are typical for Vistas/Modflow whilst the size of these files vary from model to model . Our models are probably smaller than some other regions but as an example I found one output file that was about 200 MB.

Most of the time series datasets used are taken from other systems i.e. NALD (and precursors) and WISKI and managed by other people. Output for other would come in the form of a report including maps, graphs and tables. The maps would be put together using Arcview/Arcgis and graphs using Excel.

Model files from previously developed models are kept on CD. Nothing has been archived elsewhere. It would be useful for certain model runs (input and output files) to be archived on a server somewhere and I see this as a crucial in the future.

With regards to present hardware this was also discussed with Nigel. From my point of view my present desktop works okay for my purposes, although I realise with larger models the run time would be a lot more.

B.3 Anglian Region (David Seccombe)

Response to Appendix A of Delft Uni Proposal

I am sure the Anglian Senior Tech Specialist would have been able to wax lyrical about the general information, overview, data storage and hardware platforms - so I will not endeavour to repeat that response.

From an end-user point of view, the use of a model may be quite limited.

For example, the current regional scale modelling (Y&NN and Essex) are indicating to me that the heterogeneities of the flow mechanisms (from recharge to groundwater flow) limit the usefulness of the model. I doubt I would ever use the model for abstraction licensing issues as the grid is too coarse and the spatial representation has been simplified. As funding within the Agency is a challenge (especially at Area) it would be difficult to allocate funds to pay for a consultant to refine the current models to a smaller window so as to run options for a PWS abstraction application (especially as the applicant should be doing this within the context of licence determination).

I also believe the use of the large models for HDRoC issues is misleading as the spatial over-simplification means that the output of the model gives the average flow net within the area of the wetland. As such, the model will not be able to adequately predict the reduction in levels or flows within the wetland itself. Therefore, the current model will have to be used in conjunction with other "tools" (e.g. knowledge, another smaller model, analytical solutions etc)

However, the large scale model should and would be used to assist in more strategic water resource management issues, such as strategic development, CAMS and WFD. As such, it may not be the Technical Officer (Hydrogeology) who would run the model - could be CAMS or RSA Officers?.

Therefore, the areal extent of the model guides the usefulness of the model results. Small model would be good for local issues and poor for regional issues. Large models would be poor for local issues and good for regional issues.

With reference to the NFFS system. I understand that Flood Warning want to use this architecture to derive results in real time (as well as real time predictions). I do not see that as being a hydrogeological need within Eastern Area. We do not have groundwater flooding issues that would possible need such architecture.

I trust my ramblings are not too heretical.

B.4 Midlands Region (Martin Shepley)

Please see my response below for the Midlands Region. Note I have only really detailed information for what I would call the operational models. We have a number of other models that were project specific.

We have two Modflow models:

- one standard Modflow96 model which is run with the EA recharge programme
  - validation time-series from 1965 – 2002, monthly stress periods, with 5 time step calculations
  - multi-layered with 250m grid, of dimensions 35 × 35 km^2
  - total electronic data set of validation run is approx 1Gb
  - run time of ~ 1hour depending on machine
- one with tweaked Modflow96 to handle runoff input from Entec's 4Rs runoff routing model. Note there is an unresolved issue with the use of 4Rs
  - validation time-series from 1970 – 1998, monthly stress periods, with 5 time step calculations, but also includes an historic time-series for 1850 – 1970, to simulate the historic development of the aquifer
  - multi-layered with 500m grid, of dimensions 25 × 55 km^2
  - total electronic data set of validation run is approx 0.7Gb
  - run time of ~ 1hour depending on machine

We have one bespoke Fortran model, but this is likely to be replaced soon by something more up-to-date:

- validation time series from 1970 – 2002, monthly stress periods, with 4 time step calculations
- single layer with 1km^2 grid, of dimensions 20 × 35 km^2
- total electronic data set of validation run is approx 30 Mb
- run time of a few minutes

- Models are run generally through Unix scripts
- Post-processing of model output largely done through Fortran utilities. The types of output that is processed are:
  - time series hydrographs, both for groundwater heads and flows
  - time series water balance budgets
  - flow duration curves (for CAMS)
  - flow accretion plots
- Use currently limited to specialist modellers on standalone computers, although would like to see use expanded through network (particularly ability to interrogate model output), potentially with access granted to water companies. Currently each model is run in predictive mode between 0 and 20 times per year depending on business requirements.

- Digital data currently held is around 30Gb, would anticipate operational requirement given three large operational models (i.e. current bespoke model is updated) of around 60Gb.
- Models currently run on old P750, which will be upgraded imminently. Given current computer power available do not see run times as an issue.

B.5 Southern Region (Paul Shaw)

Groundwater modelling currently resides in the Lead Area Hydrogeology based at Guildbourne House in Worthing and is incorporated in the Kent Area GW&CL team managed by Andrew Ogden. The groundwater modelling programme is managed by Andrew Ogden and John Ellis. Myself, Maria Walford, Ian Molyneux (recently left the Agency) and Mike Cheetham (based in Kent) form the modellers in the Kent GWCL team. This includes hands on modelling and Kent project management. Project management in Hampshire has been done by Alison Rennie. There is currently little modelling type activity arising from Sussex Area but of course this may change. The Lead Area are responsible for taking delivery of models developed by consultants, setting them up, running and maintaining them.

We have yet to take on a 'new' groundwater model from the current programme (the first will be the Test/Itchen Chalk) but we have a collection of older models as described below. In order to run these models we have 'administrator rights' on our desktop PCs which are attached to the Agency's Windows 2000 LAN. The software we use is all run from the server except for a Salford Fortran compiler which is locally installed (ie on C: drive). We have found that a fortran compiler is still necessary because of the large amount of Fortran77 'legacy' code we have to occasionally examine in detail and perhaps modify slightly (usually this just amounts to formatting outputs). The adminstator rights allows us to create 'new' EXE files which would otherwise not be permitted by CIS. We also have a laptop on which is loaded GWV, Salford Fortran and ArcGIS but it is still necessary to log on to the LAN for all other software (Office, Groupwise, Textpad, Surfer etc). The 'old' models don't have GUI's as such. We rely on our own 'utilities' and those developed by consultants which amounts to collections of small fortran programs and macros in Excel. We are moving more towards VBA macros in Excel and Surfer (and lately ArcGIS). It is only lately that we have started to make better use of ArcGIS and in my view this should form the core of our modelling work. Another point is that MODFLOW models under development by consultants now are usually using the VKD modified version which is not included within the GWV GUI.

The frequency of use of our models is very variable because it depends on activity in Areas on CAMS and licensing but it is very intensive and prolonged once started. An example is the Dour Chalk model (East Kent) where Kent Lead Area Licensing are actively engaged in redistributing licensed abstractions to the lower catchment area. Our activity then involves re-setting up (from archives), perhaps some updating and then production of outputs for various 'scenarios'. The outputs will be all the components associated with models of this type - catchment recharge distributions, groundwater levels and hydrographs, river flow hydrographs and accretion profiles etc etc.

Strictly speaking the input time series data sets are used to 'history match' ('calibration' is not really correct!) the outputs from the model which itself comprises a large set of aquifer and river parameters. The historic data is usually about 25 years of rainfall, evaporation, flows and levels obtained from Agency and Water Company archives. We (mostly our consultants) have found that the QA on this data is very time consuming and so must add

significantly to the cost of these projects. Some improvement has been found with the new WISKI archives but basically the data (especially rainfall) cannot be relied upon. Even when corrected, there is much infilling to do becasue of the sparsity of collection networks.

Data storage is something of a problem at the moment. The model files are too large to start sending around the LAN and there is insufficient space on the servers (a typical model file collection might be around 400MB) so we have resorted to CD backups in a fire safe. A set of about 5 or 6 CDs is needed for a typical whole model backup with the current working directory being several Gb. Although it takes up more space I personally prefer to back up everything on each scenario run rather than selectively back up only those files which are thought to differ from previous runs. I think (?) consultants like Mott MacDonalds also do this - it avoids losing those small changes which get forgotten. A DVD backup system would be better (we currently have only 2X speed CD burners) but a completly 'off site' solution would be best.

Our current model collection is:

Old ICMM models (Mott MacDonalds in-house FD code) but still used..
- DOUR Chalk
- DARENT Chalk/LGS
- HAMBLE-MEON-WALLINGTON Chalk

Old SLAY model (University of Birmingham-Halcrow code) recently used..
- CHICHESTER Chalk

Old Birmingham University (Ken Rushton) FD model..
- EAST KENT Chalk (now being replaced by a MODFLOW model)

MODFLOW models being built..
- ITCHEN Chalk (now incorporated with the TEST Chalk)
- EAST KENT Chalk
- NORTH KENT Chalk
- EAST HAMPSHIRE-CHICHESTER Chalk (in very early stages)
- SEAFORD-EASTBOURNE Chalk (recently completed by PhD student)

For recharge we (mostly consultants again) have been using the Science Centre FAO code. ENTEC (Itchen and Test) have been using their 4R code which incorporates the FAO method. Finally, we have a large collection (about 20) of GPZIII MODFLOW/MODPATH and some FLOWPATH simple steady state models.

C Replies to shopping list regarding the use of modules

C.1 Information regarding modules – Northeast Region

Item	Details
Region	Northeast
Contact name	Neil Wootton
Agency Contact Tel No (Internal & External)	

Technical details

Item	Details	Northeast
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). (Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)	Modflow 96 Birmingham University bespoke code
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a	Modflow96… • Corallian limestone (Scarborough) • Sherwood sandstone (York, Selby/Doncaster) Birmingham University bespoke code • East Ridings chalk Can be run independently

Item	Details	Northeast
	file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 2* *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Corallian limestone • assess river aquifer interaction Sherword Sandstone • Assessment of current situation • Impact of abstractions • CAMS East Ridings chalk • ?
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	Modflow: USGS Birmingham bespoke code: Birmingham University Module datasets • Corallian limestone – Entec • Sherwood Sandstone – ESI • East Ridings Chalk – Entec? Birmingham bespoke code • ?
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)*	Modflow96 • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets (Modflow) – Should be owned by the EA(?) – They are a result of commissions to consultants. Birmingham bespoke code • IPR: ? • No license fees

Item	Details	Northeast
	Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	• Open code; copy of source code may be available ? • Dataset – – EA property – code is aquifer specific
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	Vista and Modflow – Windows
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	?
What is the overall "architecture" of the software solution. *(Page: 3* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	Run stand alone
Method of module execution:	Examples of possible execution: • Module executed via batch file or	?

Item	Details	Northeast
	script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	No user interaction. Can give you feedback if there are errors. Modflow96 • you don't have re-compile Birmingham code • may have to as it is so specific.
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 4* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	• Chalk model: 3 Mb • Sandstone model: 355 Mb • Corallian model: 31 Mb
Estimated execution time	Please list per module dataset	
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	• Chalk model: 4.5 Mb; run 0-10 times/yr • Sandstone model: 430 Mb; run ? times/yr • Corallian model: 42 Mb; not been run for 3 yrs
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?)	Vistas (handles pre and post processing)

Item	Details	Northeast
	- Other tasks?	
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Potentially Water Companies and Consultants

C.2 Information regarding modules – Midlands Region

Item	Details
Region	Midlands
Contact name	Martin Shepley
Agency Contact Tel No (Internal & External)	

Technical details

Item	Details	Midlands
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). (Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)	Recharge… • 4R • EA recharge module Groundwater flow • Modflow 96 • Modflow 4R • Birmingham bespoke code Modflow4R is the same as Modflow96 but tweaked to import output from the 4R recharge module. (Modflow88 and 96 use and produce the same input and output file formats. Different Modflow versions however will not give the same results.)
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type).	Modflow4R and 4R recharge module… • West Midlands Worfe Modflow96 & EA recharge module… • East Shropshire

Item	Details	Midlands
	Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 7* *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	Birmingham bespoke code (to be replaced)… • Nottingham/Doncaster No
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	West Midlands – Worfe… • CAMS • Abstraction licencing East Shropshire (conjunctive use scheme) • Abstraction licensing related to Shropshire Ground Water scheme (the EA is operating the scheme and therefore needs to be seen to monitor it's own license very carefully) Nottingham/Doncaster… • CAMS • Abstraction licencing
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module	Recharge… • 4R: Entec • EA recharge modele: EA (D Johnson) Groundwater… • Modflow96: USGS • Modlflow4R: Entec • Birmingham bespoke code: Birmingham University Module datasets

Item	Details	Midlands
	datasets?	• West Midlands – Worfe: Entec • East Shroppshire: Entec • Nottingham/Doncaster: Birmingham University
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	4R • IPR: Entec • License fees to be paid • No access to code • Datasets (Modflow) – Should be owned by the EA(?) – They are a result of commissions to consultants. EA recharge module • IPR: EA • No license fees • Code open and available • Datasets (Modflow) – Should be owned by the EA(?) – They are a result of commissions to consultants. Modflow96 • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets (Modflow) – Should be owned by the EA(?) – They are a result of commissions to consultants. Modflow4R • IPR: USGS/Entec • No license fees ?? • Open code; modifcations can be made to the code ?? • Datasets (Modflow) – Should be owned by the EA(?) – They are a result of commissions to consultants. Birmingham bespoke code • IPR: ?

Item	Details	Midlands
		• No license fees • Open code; copy of source code may be available ? • Dataset – – EA property – code is aquifer specific
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	All run under Windows
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	
What is the overall "architecture" of the software solution. *(Page: 9* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	Run stand alone
Method of module	Examples of possible execution:	Run via a script (ksh).

Item	Details	Midlands
execution:	• Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	No user interaction (apart from selecting the naming of the output files) Can give you feedback if there are errors. There is a log No recompilation required for all modules except the potententially the Birmingham code. The latter is aquifer specific.
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 10* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	10 or so files. Run length… • Historic (1880-1970) • Recent (from 1970 onwards) West Midlands – Worfe… • 150Mb in total (ascii format) • zips up to 17Mb. East Shropshire… • 201Mb input (unzipped)
Estimated execution time	Please list per module dataset	1 hour for Modflow (750Mhz machine)
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	**Results of module runs** Historic + Validation + baseline run = 1.9GB (all binary) (sample file was 400MB zipped it was 75% reduction down to 100MB) East Shropshire = 2GB **Post Processed output** Post Processed output = 45MB Zipped size = 13MB Output file sizes can be reduced.
Utilities used in	What utilities are used to:	Set of EA utilities

Item	Details	Midlands
association with the module.	- Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	Vistas (handles pre and post processing) Excel spreadsheets etc.
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	0 to 20
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Maybe the water Companies? They did the pre-processing and some of the post processing. In some cases the models have been developed in conjunction with the Water Companies. Some of the datasets (Met Office) have licence issues, and therefore cannot be given to third parties. Would like to provide access to external parties (consultancies, Water Companies etc.).

C.3 Information regarding modules – Southern Region

In this section, 4 information sheets are included:

- information sheet filled during site visit in Peterborough on 14 October 2004 (information given by Nigel Hoad)
- Information sheet provided directly by Southern Region regarding…
  - ICMM model for the Dour
  - 4R recharge model for the Itchen
  - Modflow VKD model for the Itchen

C.3.1 Overall information

Item	Details
Region	Southern
Contact name	Information given by Nigel Hoad
Agency Contact Tel No (Internal & External)	

Technical details

Item	Details	Southern
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). (Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)	Recharge… • Southern recharge code Groundwater flow • Modflow 96 • Modflow VKD • ICMM (intended to be replaced)
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	None
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type).	Modflow96… • Itchen (Entec) • Eastbourne (to be confirmed) ??

Item	Details	Southern
	Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 13* *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	Modflow VKD… • North Kent (Water Management Consultants) • East Kent (Mott McDonald) ICMM… • Hamble (Mott McDonald) • Darent (Mott McDonald) *(to be maintained?)* Bespoke Halcrow module… • Chichester SLAY Model (Halcrow) *(to be maintained?)*
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Itchen (Entec) • … Eastbourne (to be confirmed) ?? • … North Kent (Water Management Consultants) • … East Kent (Mott McDonald) • … Hamble (Mott McDonald) • … Darent (Mott McDonald) • … Chichester SLAY Model (Halcrow) • …
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	See above and below

Item	Details	Southern
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	Southern recharge code • IPR: EA • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. Modflow96 • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. Modflow VKD • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. ICMM • IPR: Mott McDonald ? • No license fees • Open code; modifcations can be made to the code ? • Datasets – Owned by EA – They are a result of commissions to consultants. Bespoke Halcrow model • IPR: Halcrow ? • No license fees • Open code; modifcations can be made to the code ? • Datasets – Owned by EA – They are a result of commissions to consultants.

Item	Details	Southern
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	Windows 2000 Fortran 77.
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	Standard PC See Feasibility report appendix.
What is the overall "architecture" of the software solution. *(Page: 15* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	Run them off the EA server
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user	Needs confirmation???

Item	Details	Southern
	interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 16* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	
Estimated execution time	Please list per module dataset	
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	Vistas (3.8) Bespoke utilities
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	10 runs
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to	..

Item	Details	Southern
	retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	

C.3.2 ICMM for Dour

Item	Details
Region	SOUTHERN
Contact name	MARIA WALFORD/PAUL SHAW
Agency Contact Tel No (Internal & External)	01903 832293/2186

Technical details

Item	Details	Response
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). *(Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)*	ICMMDOUR.EXE (version 3.0, Salford compilation)
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 18*	No shared resources (all kept on C:) PARAM.DAT GRIDPLOT.DAT GEOM.DAT GEOHYD.DAT BOUC.DAT PIEZOM.DAT PIESNNNN.DAT RECH.DAT DISCH.DAT HYGR.DAT FIXHD.DAT SPRING.DAT INTIV.DAT RIVABS.DAT STAGE.DAT

Item	Details	Response
	In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)	RIVERLVL.DAT RIVINIT.DAT WEIR.DAT AUGMENT.DAT TARGET.DAT LAKE.DAT LAKEEVAP.DAT SUB-REG.DAT BOUC-SUB.DAT
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Groundwater flow model of the Dour Chalk catchment in East Kent.
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	Mott MacDonald Ltd Demeter House Station Road Cambridge CB1 2RS Jan VanWonderen Jan.vanwonderen@mottmac.com MMD
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	MMD No Yes Yes
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2).	Windows 2000 Professional 5.00.2195 (EA2000 build version 1.6)

Item	Details	Response
	In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	Fortran 77 using the Salford FTN95 or FTN77 compilers
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	2.53GHz Pentium 4 PC with 512Mb RAM
What is the overall "architecture" of the software solution. *(Page: 20* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a "back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	The model is run on a networked PC by users with Windows administrator rights with the model and all its associated files on the local C: drive
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or*	The model is run from a DOS box by typing the model name. The model then refers to run specific control files.

Item	Details	Response
	Dialog). Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 21* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	There are about 71 input files. Amounting to about 8.4 Mb. Most of these are static and don't change (usually) from run to run. The run parameters file and the abstractions file are the usual dynamic input files (about 0.14Mb). All the input files are kept on the local C: drive. If water companies have a model they keep their own copy.
Estimated execution time	Please list per module dataset	Run time is about 2h
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	There are usually (depending on options) about 12 output files amounting to about 223 Mb. Our strategy is to keep ALL output files (archived) rather than regenerate them from input file sets.
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	MMD have supplied many Fortran pre and post-processors to accompany the ICMM groundwater flow model but there is no GUI. Further processing is carried out by text editor (TextPad), Surfer (v7), Excel (97) and ArcGIS (v8).
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	Very variable depending on requests from Area teams. This model has been used for about 20 runs this year.
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	No, Water companies usually will have their own copy of the model.

C.3.3 4R Recharge Model for Itchen

Item	Details
Region	SOUTHERN
Contact name	PAUL SHAW
Agency Contact Tel No (Internal & External)	01903 832186

Technical details

Item	Details	Response
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). *(Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)*	RRR034CC.EXE
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 23*	No shared resources (all kept on C:) Rainfall grids (.GRD) Daily PE (PE03.PRN) Spatial datasets: Raprun04.csv Rip01.csv Wat01.csv Cy-wod06.csv Cy-ag06.csv Cy-pa06.csv Cy-bar06.csv St-wod06.csv St-ag06.csv St-pa06.csv St-bar06.csv Geoli15.csv

Item	Details	Response
	In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)	Peid01b.csv Pefac02.csv Catchi02.csv Rdecay12.csv Lag20.csv Leak02.csv
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	ENTEC 4R recharge model for the Itchen Chalk catchment in Hampshire
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	ENTEC UK Ltd 17 Angel Gate City Road London EC1V 2SH Tim Power POWET@ENTECUK.CO.UK ENTEC
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	ENTEC No No Yes
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded?	Windows 2000 Professional 5.00.2195 (EA2000 build version 1.6) Fortran 77

Item	Details	Response
	If known. (Please give language or tool name & version).	
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	2.53GHz Pentium 4 PC with 512Mb RAM
What is the overall "architecture" of the software solution. *(Page: 25* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	The model is run on a networked PC by users with Windows administrator rights with the model and all its associated files on the local C: drive
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).*	The model is run from a DOS box by typing the model name. The model then asks for a run control file name.

Item	Details	Response
	Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 26* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	Complete file sets are kept for every simulation run 18 .CSV files (about 2Mb) 26,298 rainfall grid files (629Mb)
Estimated execution time	Please list per module dataset	Run time is about 4h
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	Run record (.REC), Input trace(.DET) and warning (.WAR) files (17.5k). .OUT results files (66k) Complete file sets are kept for every simulation run
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	No GUI , Excel and Surfer are used for pre and post processing.
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	This model is not yet in use.
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	No, Water companies usually will have their own copy of the model.

C.3.4 Modflow VKD for Itchen

Item	Details
Region	SOUTHERN
Contact name	PAUL SHAW
Agency Contact Tel No (Internal & External)	01903 832186

Technical details

Item	Details	Response
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). *(Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)*	MF-VKD1.EXE
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known.	No shared resources (all kept on C:) File names depend on run ID. .OC (MODFLOW output control) .PCG (MF solver) .BAS (MF basic file) .BCF (MF bcf file) .NAM (MF nam file) .WEL (MF wells file) .STR (MF streams file)

Item	Details	Response
	(Page: 28 *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Groundwater flow model of the Itchen Chalk catchment in Hampshire
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	ENTEC UK Ltd 17 Angel Gate City Road London EC1V 2SH Tim Power POWET@ENTECUK.CO.UK ENTEC
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	Environment Agency No Yes Yes
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded?	Windows 2000 Professional 5.00.2195 (EA2000 build version 1.6) Fortran 77 (VKD modified version of the USGS MODFLOW96 code)

Item	Details	Response
	If known. (Please give language or tool name & version).	
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	2.53GHz Pentium 4 PC with 512Mb RAM
What is the overall "architecture" of the software solution. *(Page: 29* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	The model is run on a networked PC by users with Windows administrator rights with the model and all its associated files on the local C: drive
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).*	The model is run from a DOS box by typing the model name. The model then asks for a run control file name.

Item	Details	Response
	Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 30* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	The standard MODFLOW file set as follows (incorporating modifications for VKD): .OC .BAS .BCF .RCH (recharge) .WEL .STR .PCG .NAM Complete file sets are kept for every simulation run
Estimated execution time	Please list per module dataset	Run time is about 2h
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	Heads output file (.HDS) 324 Mb Flows output file (CS1 or CBB) 648Mb Complete file sets are kept for every simulation run
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	No GUI but Groundwater Vistas can be used in some stages (initial file setup, displays of parameter distributions) and Excel, Surfer, ArcGIS and TextPad are used also. ENTEC utilities (Fortan utility and Excel Spreadsheets) are: heads time series – HEADTIM00 (XLS) head contours – HEDSURFX river flows -- STRTIM00 accretion profiles – ACCPROF river/GW interactions – SPLOMANY water balances – ZONBD250
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	This model is not yet in use.
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	No, Water companies usually will have their own copy of the model.

Item	Details	Response

C.4 Information regarding modules – Thames Region

Item	Details
Region	Thames
Contact name	Nigel Hoad
Agency Contact Tel No (Internal & External)	

Technical details

Item	Details	Thames
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). (Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)	Recharge… • CatchMod (bespoke Thames code). Each catchment has its own modified version (file formats are the same). Groundwater flow • Modflow 96 (2) • Modflow VKD (2) • ICMM (intended to be replaced)
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	None
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a	Modflow96… • Mimram (Entec) • Itchen (Entec) Modflow VKD… • Kennet (Atkins) • Upper Colne – Gade (ESI) ICMM… • London Basin (Mott McDonald) No

Item	Details	Thames
	file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 33* *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Upper Lee - Mimran (Entec) • Low flow studies Itchen (Entec) • …? Kennet (Atkins) • CAMS • Abstraction licencing Upper Colne - Gade (ESI) • Low flow studies London Basin (Mott McDonald) • …?
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	See above and below
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")?	Catchmod • IPR: EA • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants.

Item	Details	Thames
	(This information is important so that we can accurately cost the options for the project's business case.) Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	Modflow96 • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. Modflow VKD • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. ICMM • IPR: Mott McDonald ? • No license fees • Open code; modifcations can be made to the code ? • Datasets – Owned by EA – They are a result of commissions to consultants.
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	Windows 2000 Fortran 77.
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	Standard PC See Feasibility report appendix.
What is the overall	Examples are:-	Run stand alone with a network card.

Item	Details	Thames
"architecture" of the software solution. *(Page: 35* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	• Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	Scripts; DOS cmd line. No user interaction (apart from selecting the naming of the output files) Can give you feedback if there are errors. There is a log
Size and number of input files. How many versions of these input files will you keep per annum (typically)?	Static data files (module datasets) Dynamic data files (boundary conditions)	• Kennet: 300 Mb • London Basin model: 100 Mb • Mimram: 150 Mb • Colne: 300 Mb

Item	Details	Thames
(Page: 36 *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*		
Estimated execution time	Please list per module dataset	
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	• Kennet: 2 Gb (0-20 times/yr) • London Basin model: 1 Gb (0-5 times/yr) • Mimram: 1 Gb (0-10 times/yr) • Colne: 2 Gb (0-10 times/yr)
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	Full range of pre and post processors for each module. (Nigel Hoad will produce a national list of pre and post processing tasks)
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	10 runs
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Yes. (Cannot divulge data about abstractions less than 3 years old.)

C.5 Information regarding modules – Anglian Region

Item	Details
Region	Thames, Southern, Anglian
Contact name	Mark Grout David Seccombe
Agency Contact Tel No (Internal & External)	

Technical details

Item	Details	Anglian
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). (Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)	Recharge… • 4R Groundwater flow • Modflow VKD (6) • Birmingham University bespoke code (Lincoln Chalk) • Birmingham University bespoke code (Southern Limestone)
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	None
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known.	Modflow VKD… • 6 models (under development) • development of 2 additional models foreseen for replacement of models listed hereafter Bespoke Birmingham code… • Lincoln Chalk • Southern Limestone (to be replaced by Modflow models)

Item	Details	Anglian
	(Page: 38 *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Modflow models (6)… • CAMS • Abstraction licencing • …? Lincoln Chalk… • operational water resource management Southern Limestone… • …?
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	See above and below
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	4R • IPR: Entec • License fees applied • Modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants. Modflow VKD • IPR: USGS • No license fees • Open code; modifcations can be made to the code • Datasets – Owned by EA – They are a result of commissions to consultants.

Item	Details	Anglian
		Birmingham bespoke codes • IPR: Birmingham University • No license fees • Open code; modifcations can be made to the code ? • Datasets – Owned by EA – They are a result of commissions to consultants.
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	Windows 2000/XP
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	Modern desktop PCs
What is the overall "architecture" of the software solution. *(Page: 39* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as*	Runs on the desktop.

Item	Details	Anglian
	possible.)	
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	Batch files (via DOS)
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 40* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	Input files generated with the recharge modules are of a similar size as the the head files (3MB per timestep ?)
Estimated execution time	Please list per module dataset	Typical module runtime: 12-15 hours (44 year run)
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	*Example Norfolk model…* 1. Output file: 14GB unzipped (cell by cell flows for 44 years) 2. Head file 1.6 GB (matrix of heads per time step per layer) This is just for 1 out of 6 models. The intention is to link module datasets together in single datasets in the future.

Item	Details	Anglian
		You would normally extract a small subset from the Modflow output file.
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	Full range of pre and post processors for each module… • GroundWater Vistas • Access, Excel • ArcGIS • Bespoke Fortran utilities for extracting results, like… – timeseries – Grids – Water balances (zone budgets: specify an area, extracts all the flows)
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	Not known at present. Run standard set of runs twice per year. Maybe batch up runs every 3 months.
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Entec could run the system remotely (once the system is configured and calibrated). Results of module datasets may be communicated with parties outside EA, like Water Companies.

Secondary database (SQL Server) held by Entec and made available by it's Extranet. The database holds validated input data. EA wants to maintain this database within the own organisation in the future.

C.6 Information regarding modules – Northwest Region

Item	Details
Region	North West
Contact name	Simon Gebbett
Agency Contact Tel No (Internal & External)	7-21-2027, 01925 542027

Technical details

Item	Details	Response
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). *(Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)*	Modflow 98 (as part of GWV) – windows version. ICMM
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	NA
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 42*	Wirral – Modflow East Cheshire – Modflow Sefton – Modflow Fylde - ICMM

Item	Details	Response
	In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	Both groundwater flow. Wirral – GW resources / CAMS / salinity problems East Cheshire – GW resources / CAMS Sefton – Habitats Directive/Licensing Fylde – Low flows/Licensing/CAMS
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	Modflow98 – USGS? (with GV – ESI) ICMM – Mott Macdonald Various consultants/EA
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the EA? If not please list details.	? GV – yes ICMM – no NA I believe so.
Machine operating system and source code (Windows 2000, XP, Unix etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2).	Windows 2000 EA build ICMM is still on standalone Windows 95 machine. VDS part (visual display) does not work on Windows 2000.

Item	Details	Response
(FORTRAN, C++ etc.)	In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	800Mhz, 128 MB
What is the overall "architecture" of the software solution. *(Page: 44* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architetcure.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	Network (EA Network) although runs are done on hard drive of the PC.
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature of the script – e.g. "DOS Shell", VB Script, Unix shell script.)* • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line*	I believe first option as once model is set to run no user interaction is needed. ICMM is DOS shell. MODFLOW is windows based.

Item	Details	Response
	interaction, Windows Form or Dialog). Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	No
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 45* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	• Wirral (MODFLOW) input: 200 Mb • East Cheshire (MODFLOW) input: 70 Mb • Sefton (MODFLOW) input: 240 Mb • Fylde (ICMM) input: 2 Mb
Estimated execution time	Please list per module dataset	• Wirral: 2-3 minutes • East Cheshire: 10 mins. • Sefton: 20 mins • Fylde: 30 mins
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	Up to 5 output files per module dataset as raw output. Upto 200Mb in size. • Wirral (MODFLOW) output: 300 Mb; runs 0-5 times per year • East Cheshire (MODFLOW) output: 200 Mb; runs 0-5 times per year • Sefton (MODFLOW) output: 880 Mb; runs 0-4 times per year • Fylde (ICMM) output: 70 Mb; runs 0-2 times per year
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	Vistas At present for MODFLOW models output imported to Vistas then exported into Excel for viewing.

Item	Details	Response
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	Once operational models used between 0 and 5 times per year as an estimate but will be updated after x years.
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Probably not.

C.7 Information regarding modules – Environment Agency Wales *(to be completed)*

To be added.

C.8 Information regarding modules – Southwest Region

In the table below an overview is given of the modules run by Southwest Region and some characteristic data.

The following of the current module datasets will be kept operational in future and need to be migrated to a new system:

- Bourne & Nine Mile
- New Wylye
- Future Stour Frome and Piddle
- River Allen (subject to completion of the Stour Frome and Piddle model)

The River Allen model is assumed to be developed in Modflow and is apparently not listed in table yet.

Model	Type	Input File Size (current model with all files necessary to run it)	Historic Runs we need to archive	Current model file output size for new runs	Likely number of runs in future	Contact
		File Size Mb/Gb	File Size Mb/Gb	File Size Mb/Gb		
Wylye	Existing Slay					Karen
Otter Model	Slay?					Karen
Malmesbury	Slay?					Lynsay
Bourne & Nine Mile	Modflow	529 Mb or ~70Mb compressed	3.71Gb, already compressed	1.6Gb, uncompressed	10-20?	Phil
Wylye	Modflow	1.918Gb		637 Output: model_run.hds file is 552Mb (for gw contours). Final hydrograph files are 20Mb.		Tim Bartlett
Malmesbury	Modflow	93		1300 Output: model_run.out file is 1.1 Gb (due to large number of iterations) - could prob. be slimmed down a lot.		Tim Bartlett
Avon model	future Modflow	3Gb (assumed doubled test for two layers) 300Mb zipped		4.2 (assumed double test for 2 layers) Zips to 1.8Gb	30 or more, but not all that will need to be saved?	Tim Power
Stour Frome & Piddle	future Modflow	3Gb (assumed doubled test for two layers) 300Mb zipped		4.2 (assumed double test for 2 layers) Zips to 1.8Gb	30 or more, but not all that will need to be saved?	Giles
Wylye	Existing Slay	two directories occupy approx 2.8 Mb 11 input data files for recharge model occupy 152 Mb 17 input files to catchment model occupy Mb 211 Mb	Natural Historic 8 Chitterne runs	2 recharge output file 47 Kb are input to Catchment model 10 output files occupy 608 Mb (per model run) Max 143 Mb, average accretion 10Mb	? To be replaced by new Wylye model/all avon model	Karen
Otter Model	Slay?	200Mb?		200Mb?		Karen
Piddle	SLAY	two directories occupy 1.8 Mb Input models similar to Wylye, but smaller size	Natural Historic full Licence WW Full Licence Average Annual	Output files as Wylye model. Size less than Wylye (approx 117 Mb) Max 62 Mb, average accretion 861kB	?	Karen
UHA	SLAY	Directory occupies 1.96 Mb	Full Historic Full naturalised Historic Naturalised (not clear what difference is)	Output accretion files 430 Kb each x 5, river flow file 43Mb, gw head 29Mb	? Largely to be updated/replaced by Avon model	Karen
Allen	SLAY?	Basic directory occupies 46 Mb plus 5 sub directories of which Data directory 1.2 Mb Database directory 2.2 Mb	1992 1998 ??? Without the manuals to hand, it is not clear whether any natural/historic runs etc have been archived. I gather that John Ellis may have got model output directly from Mott MacDonald's, but it may be that we could re-run the model to generate them	Not clear which are the final output files without manual If assume OUT files in data directory, then 7 files occupy 66 Mb	poss 5 for testing some licensing scenarios	Karen

C.9 Information regarding modules – Science Group

Item	Details
Region	Water Cycle Group (Science, Head Office)
Contact name	Paul Hulme
Agency Contact Tel No (Internal & External)	722 4755 0121 708 4714

We currently use the modelling software given in the table below.

Program	Version	Network	Standalone	Comment
Compaq Visual Fortran standard Edition	v 6.5		✓	
FLOWPATH II	v 1.3.2	✓		
GW Vistas	v 3.38	✓	✓	
IGARF 1	v 3	✓	✓	
MODFLOW	96			Need source code
MODFLOW	VKD version			Need source code
MODPATH	v 3			Put on R&D standalone laptop
PEST				
SPIGARF	v 1.0 beta	✓	✓	
Surfer	v 7.02	✓	✓	
Text Pad	v 4.5.0	✓	✓	
ZOOMQ3D				

The applications that we envisage we would use immediately on the national server are: ArcView:

- Groundwater Vistas,
- MODFLOW 96,
- MODFLOW (VKD),
- MODPATH, PEST,
- Surfer,
- TextPad,
- ZOOMQ3D.

Since ArcView , Surfer and TextPad are standard Agency software I have not included them in the Technical Details table below.

We have started testing the most recent version of MIKE-SHE and the operational modellers have requested that we also then test MOD-HMS. We will do this testing on our Science standalone machines which are specifically for that purpose so I have not included them in Technical Details table below for the national server. However if after evaluation we recommend the use of new software that we have tested, it would then need to be added to the server for operational modellers to use.

In addition, there are two other picces of software being developed by the other Science fields within the Agency which GW modellers may need to run. I am not sure whether they would access these applications separately or via this proposed national server. The applications are:

- **Continuous Estimation of River Flows (CERF)** which is the successor to Low Flows 2000. Currently this uses enormous amounts of data, eg the rainfall dataset is 400Gb. But I imaging ethis will have to be reduced for operational use. Stuart Allen is the Agency contact for this project.
- **Decision Support Code** which is a collation of mainly water quality models from academia. The Agency contact is Neil Preedy.

Technical details

Item	Details	Response
Module (like Modflow88, ZOOMQ3D etc.)	Please give name and version number. If in any doubt then please list all the executable names that you use (e.g. prog1.exe, test2.exe). *(Manufacturer and Version number for Windows-based executables can be found by interrogating the properties dialog box and selecting the "Version" tab.)*	MODFLOW 96, MODFLOW (VKD), MODPATH, PEST,ZOOMQ3D. Agency recharge code, 4R Recharge code, BGS recharge code.
Do a username and password or other security measures restrict access to the "module"?	Give details of any method of user authentication. DO NOT list any passwords. Give the name and tel,. No of the Agency contact that knows the authentication details (i.e. the username & password).	No
Module datasets **required to be migrated into new architecture** (could be none…)	List names of module datasets (probably reference to area and application type). Indicate whether any of these datasets or interfaces require access to a shared resource. Please give details of any "shared resource" (e.g. is it a file on a file server, a database on a database	MODFLOW datasets from regions including Lee-Mimram (Thames), Itchen (Southern), Bourne (SW), Selby (NE), Leith (NW).

Item	Details	Response
	server?) What is the name of the server that hosts the shared resource and/or what is the "share" name, if known. *(Page: 52* *In this context a "shared resource" means a shared file server or database server. I.e. the module or model can NOT be run on a stand alone workstation.)*	
Description	Brief description of the purpose of the module and its module datasets. (Groundwater flow / recharge etc.)	• Groundwater flow models: MODFLOW 96 & MODFLOW (VKD), ZOOMQ3D • Particle tracking code: MODPATH • Parameter optimisation code: PEST • Recharge estimation code: Agency recharge code, 4R recharge code, BGS recharge code.
Manufacturer/Developer	Who is the producer of the module? Please give supplier name and contact address as well as telephone number and web site address, if known. If we have a contact name (e.g. an account manager) for the supplier please give details for this individual plus any technical or support contact information. Who is the producer of the module datasets?	• MODFLOW 96 – USGS • MODFLOW (VKD) – Environment Agency • ZOOMQ3D – BGS • MODPATH – USGS • PEST – Watermark • Agency recharge code – Environment Agency • 4R recharge code – Entec • Environment Agency or its consultants develops the module datasets.
Licence and IPR position	Who owns the copyright and/or Intellectual Property Rights (IPR) o the module? Do you have to pay a licence fee to use the module? If so, what is the "licence basis" - (Some examples are per seat, per use, per CPU, "enterprise")? *(This information is important so that we can accurately cost the options for the project's business case.)* Do we have a complete copy of, or own, the software (module) source code? Are module datasets all owned by the	• MODFLOW 96 – USGS, Public Domain – no license fee • MODFLOW (VKD) – Environment Agency, Open Source – no license fee • ZOOMQ3D – BGS – no license fee • MODPATH – USGS, Public Domain – no license fee • PEST – Watermark – no license fee • Agency recharge code – Environment Agency, Open Source - no license fee • 4R recharge code – Entec – no license fee. • Agency has source code for the following: MODFLOW 96, MODFLOW (VKD), ZOOMQ3D,

Item	Details	Response
	EA? If not please list details.	MODPATH, Agency recharge code.
Machine operating system and source code (Windows 2000, XP, Unix etc.) (FORTRAN, C++ etc.)	What is the operating system on the machine that executes the module? Please give precise version number plus any patch releases (e.g. Windows 2000 Professional, SP 2). In which computer language(s) (or with what tools,) the module is coded? If known. (Please give language or tool name & version).	All operate under Windows • MODFLOW 96 – Fortran • MODFLOW (VKD) – Fortran • ZOOMQ3D – C++ • MODPATH – Fortran • PEST – not known • Agency recharge code – Fortran • 4R recharge code – Fortran
Hardware specification (processor speed and memory) of machine	What is the processor speed and memory configuration for the machine that executes the module? If the hardware is multi-processor, please indicate number of processors and specification of each processor.	Don't know.
What is the overall "architecture" of the software solution. *(Page: 53* *If you don't know the answer to this question, then it's important you give all the details you have available about the supplier – see previously). The explanations given in the highlighted "comments" are for guidance only (there may be exceptions).*	Examples are:- • Stand alone *(A stand alone system can be run on an isolated PC (i.e. not connected to the network) and generally runs in a single execution thread or shell.)* • Client/Server *(A client server system generally runs as a multi-functional user interface that requires a connection to a"back-end" database server.)* • n-tier. *(An n-tier system uses a desktop "client" that provides limited functionality and both the application functionality tier and the data tier are hosted on separate servers. [It is unlikely that you will have any models that fit this architecture.])* • Any other *(If you don't think it fits any of the categories listed above then please give as many details as possible.)*	All are currently running standalone.
Method of module execution:	Examples of possible execution: • Module executed via batch file or script with no user interaction. *(Please give details of the nature*	All run from DOS box or batch file.

Item	Details	Response
	of the script – e.g. "DOS Shell", VB Script, Unix shell script.) • Module executed by user interaction (i.e. the user has to interact with the model whilst execution is taking place, entering parameters etc.) *(Please give details of the type of user interface - e.g. DOS command line interaction, Windows Form or Dialog).* Does the module have to be recompiled before running to apply changes to module datasets and/or boundary condition sets?	
Size and number of input files. How many versions of these input files will you keep per annum (typically)? *(Page: 54* *It doesn't matter how exactly it's done, but we need to distinguish between Agency use and "external party" use - e.g. Water Companies)*	Static data files (module datasets) Dynamic data files (boundary conditions)	~5Gb of input files
Estimated execution time	Please list per module dataset	2-10 hours
Size and number of output files.. How many versions of these output files will you keep per annum (typically)?	Please list per module dataset	~10Gb of output files
Utilities used in association with the module.	What utilities are used to: - Create input files (module datasets, boundary condition etc.) - Analyse or view the model output (i.e. what tools do you presently use to support your business processes?) - Other tasks?	ArcView, Compaq Visual Fortran standard Edition, Groundwater Vistas, Surfer, TextPad

Item	Details	Response
Approximate number of runs performed per year	Average number of times that the module datasets are executed each year. Please list per module datasets.	• MODFLOW 96 via DOS box – 5 • MODFLOW 96 via Groundwater Vistas – 20 • MODFLOW (VKD) – 3 • ZOOMQ3D – 50 • MODPATH – 5 • PEST – 10 • Agency recharge code – 50 • 4R recharge code – 1
Will external parties require access to models that use this module?	If "yes", then how frequently are external parties likely to want to use it per annum? Will the Agency want to retain any data they use or generate *(is there any "legal angle" on this?)* and if so how many versions of it?	Yes, consultants working for the Agency on our projects. Every year. But they will mainly work on their own standalone machines.

D Minutes of second workshop phase 2

Q3986/NGMS2-MoM2/pg

To : Nigel Hoad
From : Peter Gijsbers
Subject : NGMS Phase 2 - Minutes of design workshop 1 20-21 June 2005
Date : 22 June, 2005
Cc :
Action: FYI

1 suggestions Martin Shepley July 25, 2005

MINUTES OF MEETING

Project:	National Groundwater Modelling System (CCN 2005/03) Phase 2 Detailed Design
Meeting:	Design workshop 1
Location:	UK Water Office, Queen Anne's Gate, London
Date:	June 20-21, 2005

Participants

Nigel Hoad	EA National Groundwater Modelling Team
Mark Whiteman	EA National Groundwater Modelling Team
Neil Wootton	Hydro-geologist EA Northeast Region
Simon Gebbett	Hydro-geologist EA Northwest Region
Martin Shepley	Hydro-geologist EA Midlands Region
Paul Shaw	Hydro-geologist EA Southern Region
Ian Smith	EA CIS - Hardware
Simon Williams	EA CIS – Applications
Keith Phillipson	Hydro-geologist Entec (consultant, representing Anglian region)
John Godfree	IT expert Tessella
Toine Vergroesen	Geo-hydrologist Delft Hydraulics
Peter Gijsbers	Project manager Delft Hydraulics

Objectives

The objectives of the workshop are to obtain become practical by explicit:

- indication how combinations of codes are handled (e.g. recharge+ GW-flow + particle tracking + solute transport)
- definition of data involved;
- definition of data handling functions needed (slicing, manipulation, reporting)
- indication how data handling functions are pre-configured
- of non-pre-configured data handling functions, explicit indication how data handling functions are offered for user-definition
- definition of reporting formats (pre-configured and user defined)
- definition of archiving & downloading functionality (what, who, how long, how to operate)

At the end of the workshop it should be clear what data sets are involved, how they are categorized, named and represented, what and how data handling facilities need to be offered (i.e. pre-configured vs. user defined).

Based on the outcome, the Contractors will develop proposals for solutions. The second workshop will focus on the proposed solutions and their representation in the user interface.

Actual programme (adapted at meeting) Monday June 20, 2005

10:10	**Welcome**	Nigel Hoad
10:15	**Introducing to this workshop**	Peter Gijsbers

10:30	**Module data sets** (discussion)	all
12:00	**Introduction to module adapters and workflows** (presentation)	Peter Gijsbers
12:30	*Lunch*	
13:15	**Output** (discussion) • **Slicing and manipulation** • **Visualization & reporting**	all
14:30	*Break*	
14:45	Continued	all
16:15	*Break*	
16:30	**Archiving and downloading** (discussion)	all
18:00	**Closure for the day**	Peter Gijsbers

Actual programme (adapted at meeting) Tuesday June 21, 2005

10:00	**Introduction to day 2** (presentation)	Peter Gijsbers
10:15	**Modules** (discussion)	all
11:45	*Break*	
12:00	**Model run execution and checks** (discussion)	all
12:30	*Lunch*	
13:15	**Pilot application** (discussion)	all
14:00	**Webserver and external user access** (discussion)	all
14:30	*Break*	
15:00	**Other discussion items (from feasibility study)** (discussion)	all
15:15	**Next actions**	Peter Gijsbers
15:30	**Closure for the day**	Peter Gijsbers / Nigel Hoad

Decisions and action points

Below, the main issues are listed that were discussed. Where action is required at shorter notice, the responsibility is assigned in the last column.

Action

1 Context

1.1 No new information

2 Scenarios and boundary conditions

2.1a *User defined scenario variables:*
- abstraction (Q_abs) in Ml/d (Megaliters per day = 1000 m3/day)
- surface water levels (SWL) in maOD (meters above Ordenance Datum)

2.1b User defined variables have soft-limits to warn that a value is not very suitable for the situation to be assessed

2.1c User defined variables have hard limits for those variables that invalidate the model

2.1d Users can define new abstraction locations as follows:
- the topographical data of the abstraction (name, xy-coordinate) is specified in a form
- the system displays the abstraction location on the map
- the system assigns the abstraction to nearest calculation entity (model node/cell/element/grid point)
- The system allows the user to assign the abstraction to any other adjacent calculation entity that surrounds the abstraction's xy-coordinate
- The system must warn if the selected entity is a river element. It must allow choosing another location.
- for any calculation entity, the system can show the following calculation entity properties:
  - nr.aquifer layers
  - for each layer:
    - transmissivity
    - top-bottom elevation of layer (for unconfined aquifer the top is the groundwater level equilibrium)

2.1e In addition to the xy-coordinate, the user can define the following abstraction properties:
- z-coordinate
- time series of abstraction flow rate (Ml/d)

2.1f Users can only specify surface water levels at pre-defined locations (i.e. predefined by the custodian while uploading module data set)

2.1g While the NGMs should communicate with the user in the above mentioned units, the system should enable unit conversion such that data is passed to the models in the units of the model .

2.2 *User selected scenario variables:*

Action

- recharge (Q_rech) in m/d (meters per day)

NB data set is prepared by custodian by running recharge code on the system

2.3 Custodian can prepare recharge data set on the system by defining and running recharge scenario using the following variables:

- net rainfall

2.4 All other input variables can not be modified in the GUI of the NGMS

2.5 Remark:
some recharge codes contain business logic that deals with abstractions !

3 Identifying module data sets

3.1 *Primary identifiers (available via tooltip or direct in explorer)*:

- name of the model area
- model boundary display on map
- custodian: name, organisation/department

3.2 *Secondary identifiers (information window available via a hypertext link):*

3.2a Geology (chalk, Permo-Triassic sandstone, Magnesian Limestone, Lower Greensand …)

3.2b Module Data Set Statistics

- Number of aquifers
- Available module code (incl. code version)
- Modelling grid (size, density,..)
- typical run-time duration for a transient run (e.g. per year of data)
- Time series length

3.2c Module Data Set History

- Year of creation
- Module data Set version identifier
- Original purpose of module dataset
- History log
- References to model studies
- Link to quality audit log (e.g HarmoniQuA)

3.2d Spatial Coverage of Module Data Set

- Env.Agency Area(s)
- CAMS area(s)
- WFD river basin district(s)
- Local Authority areas (for contaminated land purposes)
- WFD groundwater body reference number(s)
- National Grid Reference

3.3 *Additional information:*

- all model shape files as overlay on Ordenance Survey base map

Action

4 In/Output – definition, slicing, manipulation, visualization

4.1 *Output variables*
4.1a groundwater head (maOD)
4.1b stream flows (Ml/d)
4.1c cell flows (Ml/d)
4.1d groundwater unit budgets

4.2 Input variables: model dependent! **to be defined**

4.3 *Data slicing*
4.3a *Variables*: single selection
4.3b *Temporal* slicing: time series selection: begin, end, end of all stress periods
4.3c Slicing in *horizontal plane* (cookie cutter):

- point (location/xy-coordinate in form, pointed by mouse)
- multi-point selection (location set in form + pointed by mouse)
- streamline (end node pointed by mouse)
- entire model area
- polygon sub-area (outer 3+ points pointed by mouse)
- circular sub-area (centre pointed by mouse, radius by form edit)
- upstream catchment area (downstream cell pointed by mouse, for top layer only)
- import slice boundaries overlay from shape file (custodian can limit nr. of polygon overlays, as well as size of data slice)

Low priority:

- straight line (begin + end pointed by mouse)

4.3d Slicing in *vertical plane* (for any horizontal selection):

- single layer
- multiple-layers

4.3e It should be able to save and retrieve slicing specifications in a slicing template
4.3f Except for basic output control, slicing functionality is concentrated in the NGMS-system and not in the module adapters

4.4 *Manipulation functions*
4.4a basic statistics:
for each spatially defined unit

- temporal mean./min./max./standard deviation/accumulation
- accumulation by distance (= accretion for streamlines)

for each time step

- spatial mean/min./max./standard deviation/accumulation

for each averaged time span/each time span minimum/each time span maximum

- spatial mean/min./max./standard deviation/accumulation (low priority)
- temporal threshold exceedance
- spatial threshold exceedance (contour lines)
- frequency (temporal)

Action

- classification

4.4b basic mathematics:
- difference
- proportion
- change over time

4.5 *Raw output visualizations*

4.5a
- map view for any horizontal area selection (animation → map stacks)

4.5b
- XY-time line (hydrograph) for any point/group of points

4.5c
- XY-profile for any line (time series animation)

4.5d
- vertical cross-section for any point(s) selection (→ column/bar chart) or line selection (stacked area chart)

4.5e Note: animations are middle priority

4.6 *Predefined/dedicated layout definitions*

4.6a Stream accretion:
XY-profile along river/streamline (cell 1,2,3…n) of flow accumulation, either at an instantaneous moment in time or as time averaged. Used to display the gain and loss of surface water along the open water body from and to the aquifer.
X-axis = cell/node ID's, Y-axis = accumulated flow rate

4.6b stream outflow hydrograph:
XY-time line of flow passing at cell x (i.e. accumulation of upstream outflows)
X-axis = (absolute) time, Y-axis = flow through cell x

4.6c Splodge plots
Map-view of locations where data set values are represented with proportional circles

4.6d Winterbourne signature:
Series of vertical lines, where each line represents a time step, and the vertical represents the river sections. For each time line is indicated when a certain threshold of the flow (e.g. zero flow) is passed. Colours may be used to indicate the flow value

4.6e Ground water unit budget – map overview for entire model area:
Map-view of ground water units with cumulative horizontal flows between the units. This can be either averaged flows, accumulated flows (i.e. volumes)

4.6f Groundwater unit budget - Vertical view for selected groundwater unit
Cross section of layers with inflows and outflows (both horizontal and vertical)

4.6g Duration curves

4.6h Frequency curves

4.6i Bar charts

4.6j Map view of isolines - Contour plots

4.6k Tables using format templates

4.6l Differentiation of flux per cell e.g. two rivers in one cell is deemed not relevant in UK (!)

4.7 *Output production control*

Action

- should accommodate control of output variables, output period, layer selection, layer-file relation
- can assume that output is desired at end of each stress period (NB stress period is period for which input remain stable)
- should facilitate reuse of control settings by way of templates

4.8 The system should preferably accommodate user/custodian-defined templates to manage the production of similar diagrams / graphs

4.9 *Downloading*
Data can be downloaded in Shape-format (+dbf), xls format and PI-format

5 Archiving

5.1 Critical model runs to be archived are:
Standard Scenarios
- Naturalised (zero abstraction)
- Historical
- Fully License (predictive)
- Recent Actual (baseline)

Other
- EA-approved Climate change scenarios
- Essential calibration runs (other than historical).

5.2 Non-critical model runs are all deviations from standard scenarios

5.3 Preferably, the NGMS should assist in naming consistency for archived model runs (e.g. archiving form contains individual fields for area, scenario etc. while full model name becomes concatenation)

5.4 Archiving decisions for non-Standard Scenarios are made by custodian in consultation with Nat.Super Users

5.5 Nat.Super User has overall responsibility for archiving strategy and disk allocation

5.6 Contents critical model run archive
- run-time log by executable of critical meta-data (no in/output)
- modeler's log book (see below)
- all module input files (recharge)
- all module object code (executable)
- all module output files

5.7 Minimum contents logbook critical model run
- Run name/Number
- Date of upload
- Date of last run
- Module (code) version
- Module data set version
- Comments: Purpose of run. Brief summary of change from previous critical run version
- Custodian
- Standard Scenario Name

Action

- Reference to associated documentation (PDF)
- Run start end date
- Link to input files (incl. date + time created and by whom)
- Link to output files (incl. date + time created)

Optional extensions

- Agency project number

5.8 Archiving duration/strategy critical model runs

- Last critical model run version should be completely available and quickly accessible and thus stored on hard disk (HD)
- Previous critical model run should be completely available; storage may be external to the system (e.g. tape or HD). To be decided by custodian and Nat.Sup.User
- Older critical model runs should contain sufficient info to repeat and check the run → logbook, run-time log, input files, object code and one module output file to enable check of rerun

5.9 Availability/Archiving strategy non-critical module runs

- Users receive a limited disk storage account which they have to manage.
- Default expiration period for a module run is two weeks
- After two weeks the user is send an email (cc. custodian) through which he can request for an extension up till 3 months
- After three months the custodian is end an email (cc.user) to handle accordingly.

If a user is sending out a computation batch which will result in an overflow of the allocated disk account, the user will be requested to do its housekeeping before the batch is started. Default policy will be that a computation job is executed only if disk space is available on the users account.

5.10 Archiving of stand-alone results is not allowed. Important runs should be done on the system to ensure QA traceability

6 Modules and workflows

6.1 The following order of priority has been identified for management support:

1. accommodate upload, management and visualization of data sets
2. develop module adapter(s) to run groundwater-flow modules (Modflow96 / Modflow VKD)
3. develop module adapters to run recharge modules (4R, EA)
4. develop module adapter to run particle tracking module (Modpath)
5. develop module adapter to run other codes (ICMM, ZOOMQ3D, MikeSHE)

6.2 Custodians will be able to run recharge codes, Users not.
Incorporating recharge codes in the NGMS is expected to improve the version management of these codes

6.3 No decision is made yet on the need for multiple module adapters in case various code versions of Modflow (or 4R) are used. An analysis will be conducted as part of the NGMS Phase 2 project. Reuse of code is highly preferable

6.4 The following workflows are identified:

- Modflow96
- Modflow VKD

Action

- Modflow VKD + 4R
- Modflow 96 + EA

6.5 Incorporation of ICMM and ZOOMQ3D will require the interface definition for an irregular grid. It is recommended to account for such interface definition in this Phase of the project

NB. Modflow is a finite difference model with regular grid
ICMM is a finite difference model with regular grid, where local refinements are 45° rotated. this might need to be dealt with as irregular grid
ZOOMQ3D is an irregular grid

7 Module execution and checks

7.1 To support the assessment of module run viability, the following parameters should be highlighted (e.g. by subtracting them from the log file or output data and transferring it into a times series)

- max.# iterations overflow in a time step
- water balance error
- map with nr.time steps that cells are dry
- runtime/duration needed for successful computation

7.2 Threshold values of these check parameters should be defined by custodians

7.3 The NGMS should accommodate manual interruption

7.4 The NGMS should have an automated interruption procedure that is activated based on unexpected run-time duration or unexpected output file size (both pre-defined by custodian as part of module data set)

7.5 While executing a model run, the NGMS should, on a regular discrete basis, perform an automated analysis of above mentioned module check parameters. (e.g. copy log file each five minutes and analyse errors). Upon request of the user, the analysis results (of the latest analysis) should be displayed.

7 Pilot application

7.1 The objective of the pilot application is to develop a running prototype that:

- can demonstrate the full work process for the user
- provides a feeling how the system facilities will work for the user, i.e. define an abstraction, run a workflow, show output, download data)
- covers all user-oriented functionalities (e.g. slicing, manipulation, visualization etc.) but not necessarily to the full extent.
- helps in the identification of the system load / impact on network
- provides an appropriate feeling on the additional investments needed (software & hardware)
- find out what the implications are for the interaction with the webserver

Note

- the prototype will not, or only to limited extend, focus on custodian facilities (uploading forms, configuration modification, archiving)

7.2 The prototype should be used and tested by users that are not involved in the current Phase of the project

7.3 In a sequential development process, module adapters will be developed for:

- Modflow VKD

Action

- Modflow 96
- and preferably 4R

This will generate knowledge in module development for different version of Modflow codes. In addition it will generate insight in the development costs of additional Module Adapters

7.4 Application areas will be Anglian (Modflow VKD) and West Midlands Worfe (modified Modflow 96)

8 Webserver and external users outside EA

8.1 *Internal viewer via intranet*

- The NGMS provides basic page content in web-compatible format
- The NGMS will provide maps with various variables
- the webserver content and upload will be managed off-line via standard EA protocols

8.2 *External Viewer via internet*

same methodology, but potentially less data content

8.3 *External user via NGMS shell…*

- to be sorted out with CIS

9 Other items

9.1 Only a custodian may be given access to download module data sets as module input files (i.e. not NGMS standardized format). Users will only have access to NGMS standardized formats

10 Next actions

10.1	Minutes: expected July 1, *feedback*: July 8	all
10.2	Detailed requirements + sketch of components: draft end of July, *feedback* begin August	DH/TS
10.3	Draft of components: end of August, *feedback* at next meeting	DH/TS
10.4	analyse difference module data sets VKD & MF96: (questions to Paul Shaw)	DH
10.5	Discussion with CIS to sort out hardware/software design after 3rd workshop	DH/TS/ CIS
10.6	Question regarding module adapter for ICMM-versions will be formulated for jan.vanwonderen@mottmac.com (low priority) • check module data sets on similarity • check if most recent version works with all data sets	DH