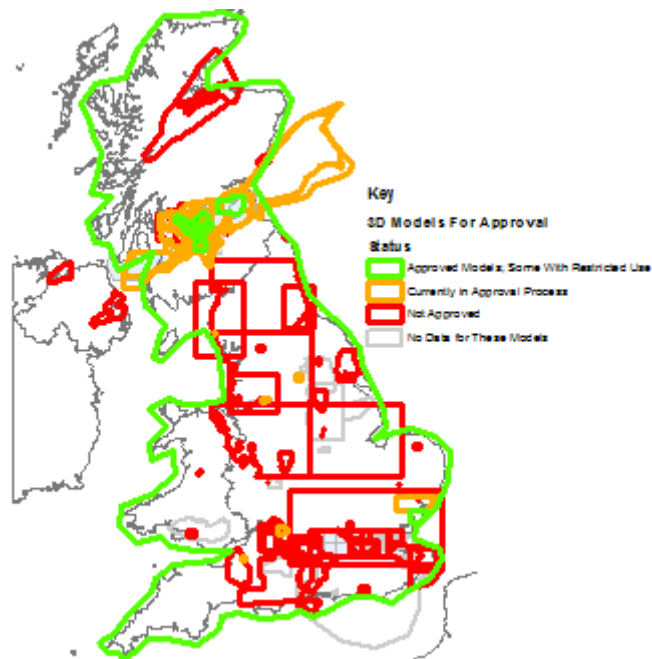




British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Model Approval Data Management - NGM

Geology and Regional Geophysics Programme
Open Report OR/13/035



BRITISH GEOLOGICAL SURVEY

NATIONAL GEOLOGICAL MODEL PROGRAMME

OPEN REPORT OR/13/035

Model Approval Data Management - NGM

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Map of the UK showing 3D
model approval status in the
MAD (as at July 2013)

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use topography based on
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1 Background and Introduction

Over the past 25 years the BGS has constructed many 3D geological models across the UK for various purposes and at varied resolutions. As the number of models increases it is important to capture information about the spatial extent of the 3D model coverage (including details about each model) so that these models can be used by all staff at BGS. In 2006, a 3D geological models GIS layer was created in ArcGIS by collating information about each 3D model built by BGS. The GIS layer was updated periodically to include more recent models but this has not always been consistent due to resources and the reliance of colleagues to pass on information about modelling projects they have worked on. The 3D Models Layer was only available internally to BGS staff through the Geological Data Index (GDI) but has been used to by the Digital Products and Business Development teams and others to generate external income from the models and exports derived from them.

In 2011 BGS began the assembly of a National Geological Model (NGM) from existing and future models (Mathers & Kessler, 2013), this involved:

- Finding and storing in a corporate location all existing 3D geological models
- Designing QA and approval procedures for these and future models including provision of adequate metadata documentation
- Storing the completed models in a systematic way both as frozen native-format models and in the future in deconstructed form as part of a ‘Geological Object Store’ (GOS) store of individual geo-referenced and attributed geological objects (sections, surfaces, coverage’s, faults etc).

The NGM has established quality assurance (QA) approval procedures for the storage and management of model data. The NGM incorporates existing data and is continually updated with new models. This has required a new data management structure. To achieve the aims set out for the NGM, a model approval workflow (Figure 1) and consistent data management procedures were established to ensure consistency in managing the model data, tracking changes to it and ensuring at all stages the correct QA procedures were followed.

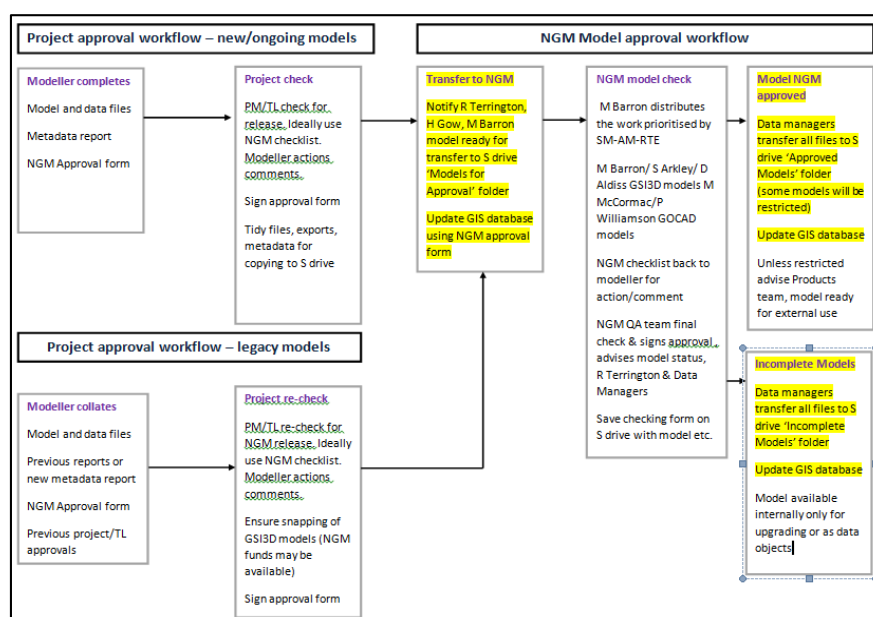


Figure 1 - NGM Model Approval Workflow (Data Management Tasks Highlighted in Yellow)

2 Overview of Model Approval Workflow

The BGS model approval process consists of a number of steps (Figure 1) for which there are a number of forms and templates. To submit a model the model builder or project leader performs geological and technical checks to the model and then submits the model files documented by:

- Model approval form (containing discovery metadata) and a
- Model metadata report (a BGS Open or Internal Report depending on confidentiality)

Note: Checklists for checking GSI3D or GOCAD® models are also available to the modeller and these are used routinely by the NGM QA staff in checking the model.

These can be accessed via the intranet pages

<http://bgsintranet/projects/mapmodelProcedures.html> or via the links given below. There are also links to software manuals and guidance on model standards. Modellers are advised to consult these documents prior to modelling as they give useful guidance on the standards expected and the checking of completed models.

2.1 MODEL COMPLETION

On completion of modelling, the modeller completes the one page model approval form (W:\Teams\NGM\Models\Documents\QA&ApprovalDocs\Model Submission\model_approval_form_version7.pdf current August 2013). The form describes the key information on model location, type and stage in the approval procedure (discovery metadata). It requires digital signatures as the model completion and project-based checking procedure is completed.

The modeller also completes a model metadata report the standardised template is (S:\Lithoframe\Data\MODEL_STORE\Documents\Modelmetadatareport_BGSreportformat_v1_3.doc current version August 2013). The structure of sections and examples in this report cover the main areas required for model users to document in a BGS report format, it is signed off in the usual way using the BGS Publication Worksheet for Open or Internal reports as appropriate. The aim is to keep the document as succinct as possible. Wherever possible the model metadata report should be published as a BGS Open Report and placed on the NORA archive. For external income models the model metadata report format may need to be adapted to meet the differing requirements of the study. In some cases a report supplied to the client about such a model can be accepted *in lieu* of the standard report so long as all the key aspects of the model and its construction are documented.

2.2 PROJECT CHECKS

This refers to the project approval workflow checks in Figure 1 for new, ongoing and legacy models in all formats.

Once the model, model approval form and model metadata report are complete the dataset should **undergo a project level geological and technical check**. This may be done by the project/team leader or delegated to suitably skilled and knowledgeable persons. For example, the geological check should be done by someone with knowledge of the geology of the area. The technical check should be done with someone with technical expertise and experience in the software. Specific guidelines are provided for GSI3D models (Terrington, 2011).

If possible the project checks should be done using the same checklists as the NGM QA team checklists (S:\Lithoframe\Data\MODEL_STORE\Documents\GSI3D_model_corp_check_8-3-13_TEMPLATE.docx or '[GOCAD Model corporate check v1 2.doc](#)'). This ensures that models meet a common set of standards. There may be additional checks required depending on the particular project scope.

Once any required edits have been made and the model has been approved at project level the model and documentation files should be submitted to the NGM data management team so they can keep the model approval database up to date. They then notify the NGM QA manager who will assign the model to an NGM QA checker.

2.3 NGM CHECK

This refers to the NGM model approval workflow check in Figure 1.

The NGM QA checker uses the NGM checklists ([S:\Lithoframe\Data\MODEL_STORE\Documents\GSI3D_model_corp_check_8-3-13_TEMPLATE.docx](#) and [GOCAD Model corporate check v1 2.doc](#)) as a basis to check the model. Using the same checklist as the project level check ensures consistency between checking and saves time. Comments should be given back to the modeller and the NGM model approval data management team, such that on completion of any required edits, and updating of the model approval form, the model can be moved to the ‘approved models’ folder on the BGS internal store drive and the metadata report can be released and published on NORA.

3 Model Approval Database (MAD)

As part of the NGM project a Geodatabase was created in Microsoft Access to store the model information. This allows the spatial data to be viewed in a GIS but still allows rapid data input and manipulation of the data via a database front end. The Model Approval Database (MAD) shows the models metadata in a form view (Figure 1) and allows easy input and viewing of the information held on each model. The MAD geodatabase feeds directly into a GIS layer that can show not just the spatial extent of each model, but also all the metadata held in the MAD as attributes.

Figure 2 - Model Approval Database (MAD) User Interface

The database has a series of dropdown, tick, date and free text entry boxes to allow the user to simply add in required details about each 3D model. A search box allows the user to filter

models by the model name, number or report for quick and easy access. The database contains two main sections that hold information on each model; Model Details and QA details.

3.1 MODEL DETAILS RECORDED IN GEODATABASE

Note - Drop down menu options are shown in red

Model No – Each model is assigned a unique model number that will stay with the model throughout the approval process. This makes it easier to identify a model in the MAD, GDI 3D models layer and storage folders as model names may differ between users and amended over time.

Model name – Name of model given by the project.

Modeller – Name of person(s) who constructed the model.

Project Manager – Name of project manager.

Data Type – Type of entity modelled:

- Volume
- Surface
- Cross –sections

Original Software –Software used to originally create the model (this can include two different software packages if used at the time of creating the model. It does not take into account any software that has been used prior to migration of the model into current software packages):

- GSI3D
- GSI3D v2011
- GSI3D v2012 Beta
- GOCAD®
- Earth Vision
- GSI3D- GOCAD®
- 2d/3d Move
- Earth Vision- GOCAD®

Scale – The ratio used to demonstrate a distance in the model and the corresponding distance on the ground. E.g. 50k is 1:50,000 scale. See Figure 3 below.

Type of Survey or Investigation	Overview	Systematic	Detailed
Section spacing	several km	0.5-1.5 km	< 500 m
Density of Coded Boreholes	Less than 1 per square kilometre	Commonly 5 - 20 per square kilometre	Often hundreds per square kilometre
Mapping Level	Major Groups and Formations only	Formations and Members, big lenses	Members and thin individual beds and lenses, Artificial Ground
Modelling speed (excluding data preparation)	Up to hundreds of square kilometres a day	2-10 square kilometres a day	< 2 square kilometres a day
Scale	Compatible with 1:250K and 50K geological linework	Compatible with 1:25K and 1:10K geological linework	Compatible with detailed site plans at scales around 1:1000
Modelling Output	Often just sections and an open fence diagram.	Computation of surfaces for export to GIS.	Computation of surfaces and lenses for export to GIS.
Uses	Useful for education, visualisation and overviews (eg catchment characterisation), first-pass assessments	Builds a 3-D model stack for interrogation in site selection, route planning, resource assessment, recharge and aquifer studies etc.	Detailed 3-D model for analysis of thickness, volumes, flow paths providing bed-by-bed stratigraphy for use in Urban planning and site development.
Minimum Unit thickness	2 metres	1 metres	0.1 metres

Figure 3 - Scales of Reference (Mathers & Kessler, 2007)

Details – Background history and purpose of the model, information on the units modelled or geology type.

Report(s) – Internal or Open Report number (if available).

Model Path – Current location on the network where the model files and supporting documents are held.

In Confidence – Yes/No box depending on if the model is commercially sensitive:

- Yes
- No

EA (tick box) – If this box is ticked the model was built specifically for the Environment Agency.

Model Geology – The category of geology modelled:

- Faulted Bedrock
- Non-faulted Bedrock
- Superficial
- Artificial
- Combination – A combination of superficial, artificial and/or bedrock model

Version No – The file name for the most recent version of the model file.

Model Metadata supplied (tick boxes) – Does the modelling folder contain a Metadata Report, Technical Report and a Summary Metadata (Model approval form).

Other – Any other documentation of relevance.

Original Location – Location on the network of the original project workspace. This is not the model approval folder drives location.

3.2 QA DETAILS

QA Status – This is a dropdown box to describe the QA status of each model within the approval process. Definitions of terminology used for QA Status in MAD are:

- **Modelling on-going** – The modelling is currently in progress.
- **Tech checked** – The model has been checked technically and is currently awaiting a geological check **by the project team**.
- **Geol checked** – The model has been checked geologically and is currently awaiting a technical check **by the project team**
- **Ready for Approval Process** – The model is complete with geological and technical checks conducted and has been submitted by the project team, it is awaiting checking and final sign-off by the NGM QA team
- **Full sign-off complete** – The model has been checked by the NGM QA team. This model is now signed-off and fully approved for release and external use.
- **Full sign-off complete; restricted use** - The model has been checked and signed-off by the NGM QA team. This model is approved but only for internal BGS use. Please see comments box for any additional details.
- **Modelling incomplete** – The model is currently incomplete and work on this model has come to a hiatus. These models can be put through the approval process but once they have been approved they can be moved to the INCOMPLETE_MODELS folder with the status remaining incomplete unless work is resumed.

Project Check-Technical – Has the model had a technical check by the modeller or cartographer? If so, a date entry is added:

- Yes
- No

Project Check-Geological - Has the model had a geological check by the project leader, team leader or a member of the, modelling team? If so also enter the date this was performed. In Figure 1, this refers to the project approval workflow for new, ongoing and legacy models:

- Yes
- No

NGM Check – Has the Model had a final QA check by the member of the QA Team and been approved for NGM release. If so, a date entry is added. In Figure 1, this refers NGM Model approval workflow:

- Yes
- No

Comments – Any additional information that is useful for the approval process or is not contained anywhere else in the database.

3.3 3D MODELS LAYER

To show the models spatial extent and locations, the MAD geodatabase can be added directly into a GIS as a layer. The metadata held in the MAD can be seen as attributes in a table (figure 4) and also interrogated using the Identify tool. The symbology can be changed to show the models by information held in the attributes such as Status, Scale, and Modelled Geology etc.

OBJECTID *	Model Name	Tech Report	Data_Type	Status	Modeller
147	Airdrie Superficial Deposits Block Model	IR/12/031	Volume	Tech Checked; with Geol	J. Merritt, S. Loughlin, A. Finlayson, T. Kearsey, K. Whitbread, C. Vye, S. Arkley, R.
24	ALF Archaeology	<Null>	Surface	<Null>	J. Ford
560	Ardeer Superficial	<Null>	Volume	Modelling On-going	S. Arkley, T. Kearsey
125	Ayrshire DGS Model	IR/12/001	Surface	Geol and Tech Checked; with QA for final sign-off	A. Monaghan
547	Beaulieu-Inverness	<Null>	<Null>	Modelling On-going	<Null>
97	Belfast Gasworks	<Null>	Volume	Ready for Approval Process	S. Thorpe
93	Belfast Pilot Model	<Null>	Volume	Ready for Approval Process	D. Boon, P. Bouteloup
99	Belfast Urban Model	<Null>	Volume	Modelling On-going	S. Thorpe, L. Hughes, D. Morgan
105	Belshill, Glasgow	IR/09/068	Surface	Full sign-off complete	M. McCormac
28	Berkshire Downs	CR/02/298N	Surface	Ready for Approval Process	K. Royse
187	Black Down Cheddar	IR/13/006	Volume	Tech Checked; with Geol	S. Thorpe
55	Brackenhurst	IR/06/074	Volume	Ready for Approval Process	H. Kessler, A. Scheib
75	Brighton-Patcham	<Null>	Volume	Ready for Approval Process	H. Hadlow, H. Kessler
96	Buncefield, Hertfordshire	<Null>	Volume	Ready for Approval Process	J. Brayson
537	Carlisle Bedrock	IR/12/046	Surface	Full sign-off complete	M. McCormac
135	CASSEM Forth CR Model	CR/08/151 & IR/12/002	Surface	Geol and Tech Checked; with QA for final sign-off	A. Monaghan, B. Napier, A. Hulbert
17	CASSEM Permo-Trias	<Null>	Volume	<Null>	J. Ford
144	Central Glasgow Superficial Deposits Block Model	IR/12/032 & OR/13/002	Volume	Full sign-off complete	J. Merritt, S. Loughlin, A. Finlayson, T. Kearsey, K. Whitbread, C. Vye, S. Arkley, R.
14	Cheshire Basin	<Null>	Surface	Ready for Approval Process	P. Williamson
90	Chichester	<Null>	Volume	<Null>	D. Aldiss, R. Terrington
546	Cirencester-Cricklade	IR/13/021	Volume	Tech Checked; with Geol	Steve Thorpe, Dave Morgan
19	Cliffe at Hoo, Kent	<Null>	Surface	Ready for Approval Process	A. Hulbert
102	Clyde Bedrock Regional Model	IR/09/070; IR/12/005	Surface	Geol and Tech Checked; with QA for final sign-off	A. Monaghan, G. Pouliquen
175	Clyde Catchment Superficial Deposits Model	IR/11/058	Volume	Geol and Tech Checked; with QA for final sign-off	A. Finlayson
117	Clyde Gateway V2 Bedrock	IR/12/006	Surface	Full sign-off complete	A. Monaghan
555	Clyde Plateau Volcanic Model Kilpatrick	IR/11/052	Surface	Modelling On-going	D. Millward
556	Clyde Plateau Volcanic Model North	IR/11/052	Surface	Modelling On-going	D. Millward
557	Clyde Plateau Volcanic Model South	IR/11/052	Surface	Modelling On-going	D. Millward
558	Clyde Plateau Volcanic Model West	IR/11/052	Surface	Modelling On-going	D. Millward

Figure 4 - GIS Attribute Table for the 3D Models Layer

The 3D Models Layer on the GDI is sourced from the MAD. It is symbolised in Figure 5 to show the current status of each model in the following classes: Approved Models; Some with Restricted Use (green), Currently in Approval Process (amber), Not Approved (red) and No Data (grey)

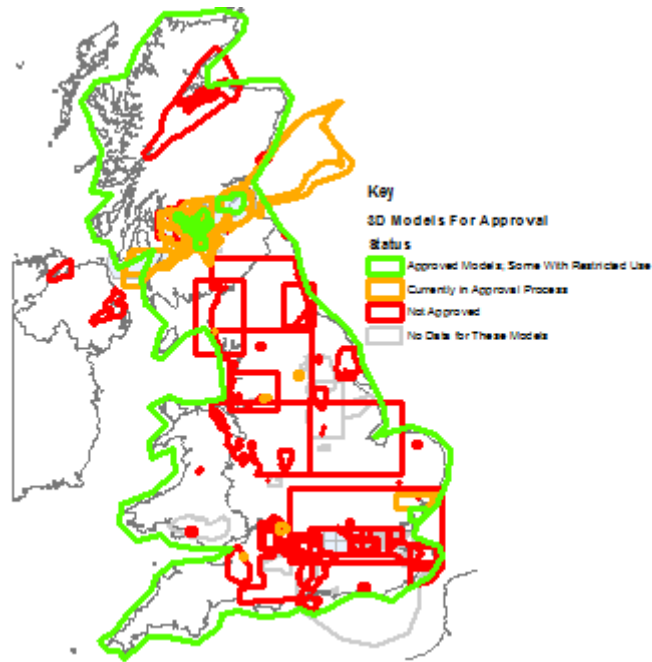


Figure 5 - 3D Models Layer in a GIS Showing Approval Status (as at July 2013)

4 Data Management Folder Structure

4.1 FOLDER AND FILE LOCATION

The data and model storage area for NGM are located on BGS internal servers:

S:\Lithoframe\Data\MODEL_STORE

Located within this folder are the Model Approval GIS, Models for Approval Database (MAD) and sub-folders that contain the model files and documents based on their approval status.

Please note; only data managers have write permissions to the MAD within this folder. If you notice a discrepancy or want to change any information held in the MAD please contact Hannah Gow, Steve Thorpe or Ricky Terrington.

4.2 SUB-FOLDER HEADINGS AND EXPLANATIONS

- **LEGACY MODELS**
Models that have been superseded, and as such, do not form part of the NGM.
- **MODELS FOR APPROVAL**
Contains the files of models that are waiting approval or are currently at some stage in the approval process. This folder may also contain the files for models that are currently on-going or incomplete.
- **INCOMPLETE MODELS**
Contains the files of approved models that have been signed off by the QA team but are currently incomplete (See QA status terminology above for definition of incomplete model) These models cannot be released for NGM but the data may be of use internally to other BGS modelling teams or projects.

Until they have had an NGM QA check they will remain inside the MODELS FOR APPROVAL folder, with the QA status as 'incomplete model' in the MAD. Once the model has had a partial NGM check by one of the QA managers and signed off it will be moved to the INCOMPLETE MODELS folder. QA status will remain as 'incomplete model' but the check boxes will be complete ("Yes"). These models may be reinstated in the future if time and funding allows by NGM or other modelling projects permits their completion.

- **APPROVED MODELS**

Contains the files of fully approved and signed off models, non-restricted and restricted, including the model files and supporting documents.

Individual model folders will be moved between these sub-folders according to their QA approval status, and the location paths in the MAD updated to reflect these changes when required.

4.3 EXTRA INFORMATION ON RESTRICTED/INTERNAL USE MODELS

Any models deemed to be unfit for external use can fall into this category. These models can be fully signed off for NGM but with the added caveat of being restricted to internal BGS use only. In the GIS database there is a status that reflects this 'Full sign-off complete; restricted use' For models still going through the approval process a note will be made in the comments if the model is known at that point to be of restricted use. Please contact the project manager or a member of the NGM team with regards to the use of these models as some of these may be strictly confidential.

Acronyms

<i>GDI</i>	Geological Data Index
<i>GIS</i>	Geographical Information System
<i>MAD</i>	Model Approval Database
<i>NGM</i>	National Geological Model
<i>QA</i>	Quality Assurance

References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: <http://geolib.bgs.ac.uk>.

MATHERS, S. J., KESSLER, H (2007) GSI3D. Version 2.6 user manual: *British Geological Survey Open Report OR/10/007*

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