The Coal Authority

Mine Water Hydrogeological Modelling

Scope Document

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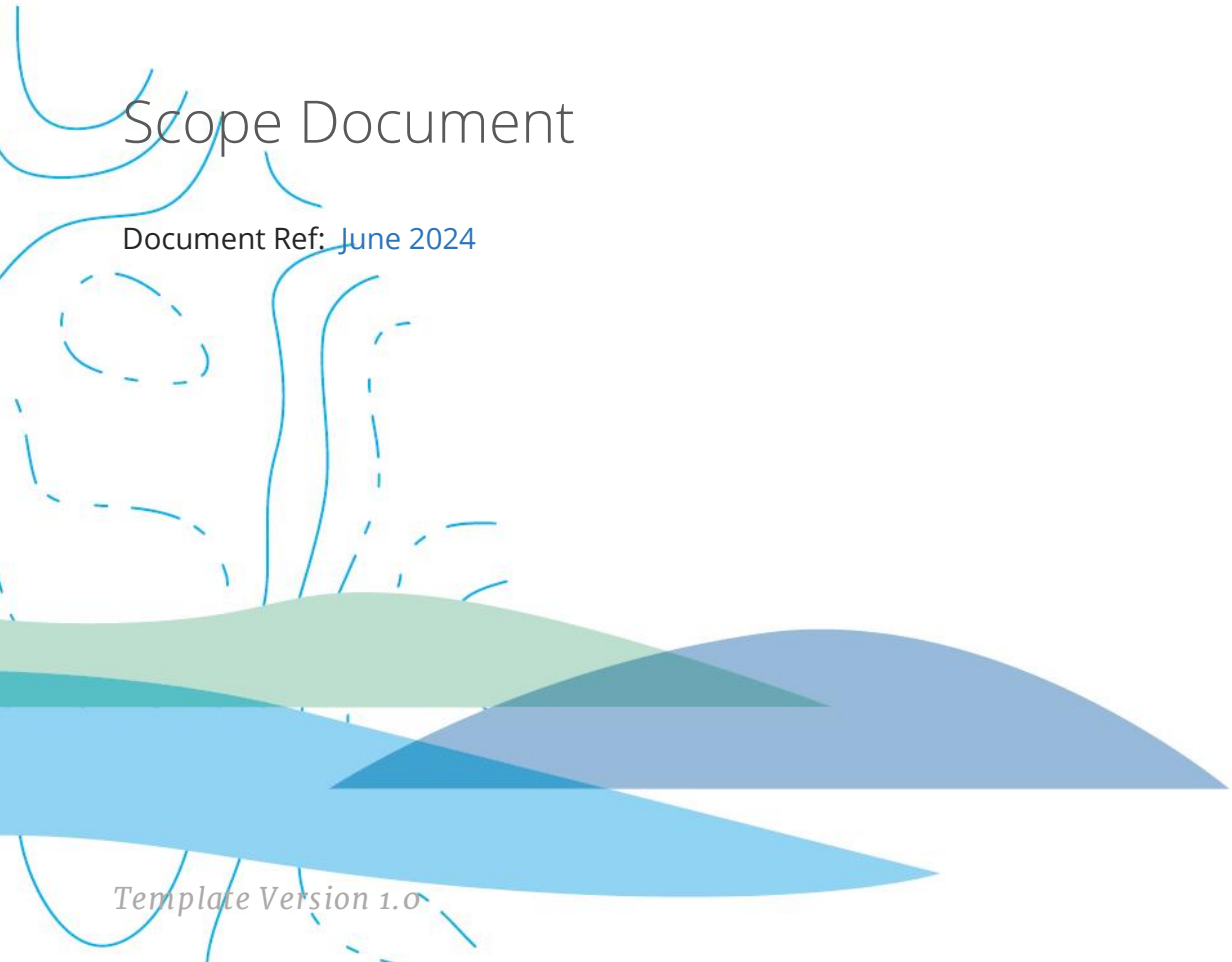

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Guide to Document Issue Status

Status	Description
Draft	Document is still working or for information or comment only. The document should not be priced.
Preliminary / Tender	Document is for information or pricing only
Final	Document included in the Contract

Contents

1. Introduction

The Coal Authority (CA) requires specialist technical support to scope, design, build and report the outputs from a predictive hydrogeological and geochemical model. The model is required to assess the potential impacts of poor quality rising mine water on surface water and groundwater receptors and to provide the technical basis for selecting the optimum mine water management strategy. The study area is in the English East Midlands and comprises a delineated area of abandoned coal workings which are partially flooded and rising.

Specialist modellers and consultants are invited to tender for the work which will include the design, creation and running of the model as well as producing model outputs, risk assessments and technical reporting.

Background

Flooding of abandoned coal mines in the UK presents a risk to the environment. As mine waters rise they may discharge into surface water and groundwater systems and cause pollution. In areas where deep mining has taken place, highly mineralised (saline) mine water is present which is challenging to treat and dispose of. Rising saline mine waters may pose a risk to aquifers and surface water systems through the creation of hydraulic gradients, outbreaks at surface and through deterioration of discharge chemistry from mine water control schemes.

One such risk area is the former collieries of Hartington, Creswell and Langwith, known as the 'HCL mine water block' (see Appendix A), in the English East Midlands where deep mining operations ceased in 2015. The area contains sensitive river systems and large parts of the worked coalfield are overlain by principal aquifers which provide drinking water to large populations. CA are currently pumping the mine workings as part of a hydrogeological test pumping exercise which began in 2020. Pumped mine water does not currently require treatment and is discharged to a watercourse under an environmental permit. Preliminary interpretations suggest that this discharge will become unsustainable in the future as the deeper coalfield rebounds and saline mine waters are drawn in from depth. If significant deterioration in pumped water quality occurs and/or pumping from the deeper coalfield is required to mitigate the risks of rising mine water; desalination and mine water/brine disposal is likely to be required. CA is currently investigating desalination and disposal options which would require a large financial investment and extensive strategic planning.

CA requires hydrogeological and geochemical modelling and associated technical work to quantify the risk from rising mine waters to surface and groundwater receptors and to assess the technical feasibility of management interventions including pumping scenarios and passive (allow discharge to occur) mine water control. The work will be used to develop the management strategy to mitigate mine water risks and to provide a robust technical justification for the chosen intervention. If the

work is successful the modelling approach may be rolled out to other areas which face similar mine water issues.

Significant technical work has been carried out on the study area to date including: conceptualisation of the mine water system and mining connections; identification of critical mine water control levels, recovery dates, hydraulic gradients and potential surface breakout zones; a Leapfrog geological ground model for part of the study area; a high level assessment of pumping scenarios and a simplified preliminary numerical modelling exercise focussed on potential aquifer impacts. A technical information pack which includes a summary of the study area, previous work and the data available for modelling is presented as Appendix A.

2. Aims & Objectives

Aims

The aims of the modelling work are:

- To define the risk to groundwater and surface water receptors from rising mine water in the study area.
- To assess the viability of the pumping and discharge operation at Hartington as a long-term management strategy.
- To assess the viability of pumping and discharge operations at other locations in the shallow coalfield as a long-term management strategy.
- To establish the optimum mine water control scenario(s) to mitigate risks to receptors.
- To communicate the risks clearly to regulators, government and other stakeholders.

The modelling work will be used to shape the optimum management strategy and justify the required interventions to stakeholders within CA, government, regulators and the public based on the risks.

Objectives

The preliminary objectives for the modelling work are:

- Robust hydrogeological and geochemical conceptualisation of the mine water system and its potential interactions with groundwater and surface water. It is intended that the modelling work will verify, challenge and build upon existing interpretations and technical work.
- Quantitative definition of the risks to receptors from rising mine water.
- Predictive hydrogeological and geochemical modelling of mine water recovery considering pumped and non-pumped scenarios.
- Definition of critical mine water control levels (if applicable) to protect receptors.
- Modelling and assessment of a range of risk scenarios assuming no intervention (assume 4 scenarios)
- Modelling and assessment of a range of management scenarios including pumping and passive discharge (assume 4 scenarios).
- Prediction and assessment of the location, timing, likelihood, magnitude and duration of any impacts to groundwater receptors (particularly drinking water aquifers/abstractions) and surface waters for pumped and non-pumped scenarios.

- Modelling and assessment of the long-term viability of the current pumping operation at Hartington Colliery based on the evolution of pumped mine water chemistry over time and the receiving capacity of the watercourse.
- Production of reports, images, and visualisations which communicate the risks and potential management scenarios clearly to technical and non-technical stakeholders.

CA recognise that a staged approach and some iteration will be required to successfully deliver the modelling work. Work will be required to collate, review and assess data, conceptualise the mine water system, review and confirm the achievability of the objectives and define the optimum modelling method as the work progresses. It is also noted that the complex nature of the mine system, data uncertainty/gaps and the limitations of modelling may require changes in scope, objectives and modelling approach as the project progresses.

CA reserves the right to modify or end the modelling work at any time should it no longer adequately meet the project needs.

3. Scope

Required Services

The modelling strategy and technical methods used are to be defined by the supplier and will be reviewed against the aims and objectives by CA as part of the tender process.

The following general services are required:

- Collation, input, processing and analysis of existing data including occasional visits to CA's mining archive at Mansfield to view historical reports and mining plans.
- Liaison with regulators and third parties to acquire environmental data.
- Hydrogeological and geochemical conceptualisation work and gap analysis.
- Scoping, design and creation of a hydrogeological and geochemical model or models and hosting of this model for the duration of the project.
- Technical reporting and visual outputs for CA and other stakeholders.
- Site visits (if deemed required as part of the conceptualisation and modelling process).
- Progress update meetings/presentations via web and occasionally in person (assume 1 hour fortnightly progress update calls and a 3 hour in–person meeting at Mansfield every 2 months.
- Project management of the work including detailed schedules and regular cost and progress updates.
- Web based hosting of geospatial and model data allowing view access for CA and stakeholders during the project.
- Transfer of all model data and outputs to CA as required.
- Other technical services related to the above as required.

Statement of Work

The following applies to the work:

- **Completion of the work is required before 30th April 2025.**
- The work will be managed under the Coal Authority's terms and conditions which are included in Appendix B.

- Timescales and budgets will be agreed at the outset of the project and must be adhered to. Any changes to scope or costs must be agreed in writing with CA before additional work is carried out.
- Industry standard and/or widely compatible software must be used.
- Adherence to government data handling procedures and standards to protect data is required at all times.
- The modelling approach should be guided by the principles presented in the Australian Groundwater Modelling Guidelines (AGMG; Barnett et al., 2012).
- All technical and modelling work must be carried out in accordance with industry best practices and Environment Agency standards/guidance.
- All modelling outputs and intellectual property will be owned by CA and must not be retained or shared without prior written consent from CA.
- Suitable licences must be obtained from any third parties for data where required.
- Technical assurance and sign off of modelling methods and outputs by a Chartered Geologist or equivalent.
- Use of technical experts with suitable experience in the field of groundwater modelling, hydrogeology, geochemistry and mine water throughout the modelling process.
- A principal manager or project director (or equivalent) from the supplier is expected to attend each web meeting and in-person meeting.
- CA will retain ownership of modelling data related to the project
- The supplier will work under a time limited licence to access and use CA data, data must be handled in accordance with this licence.

Indicative Modelling Scope

Suppliers are required to provide a proposal for the work which includes a detailed scope and modelling approach designed to achieve the aims and objectives of the project. Indicative scope items are provided below as a guide for suppliers. It is intended that the modelling will build upon previous conceptualisation and technical work, verifying and challenging it where appropriate.

Based on early market engagement with suppliers held in 2023 it is expected the modelling approach should include the following or equivalent:

- Data and literature review - a guide to the data available from CA is provided in Appendix A.
- Gap analysis.
- Detailed conceptualisation building upon existing technical understanding. Verification (and challenge where appropriate) of previous technical work and existing conceptual understanding.

- A model scoping stage to assess the available data and develop the conceptual understanding before finalising the modelling approach.
- Digitisation and georeferencing of mine abandonment plans.
- Processing, interpretation and input of: water level data, chemistry data, geophysical survey data, mine abandonment plans, mining/surveyors reports, test pumping data, maps, topographic and geospatial data, survey data, literature.
- Production of a ground model. Expansion of the existing Leapfrog ground model should be possible but for scoping/pricing purposes suppliers should assume a new ground model will be required.
- Incorporation/expansion (where possible) of the simple preliminary numerical model which has been built to assess aquifer impacts at a high level. The lessons learnt from this work should also be included. This work is not yet complete and so for scoping/pricing purposes suppliers should assume a new and complete numerical groundwater model will be required.
- Liaison with third parties such as the Environment Agency and water companies to acquire external data.
- Risk analysis including Source-Pathway-Receptor screening to identify risk areas and sensitive receptors.
- Risk modelling to focus the numerical modelling approach on key areas/receptors and to meet objectives within required timescales.
- A numerical groundwater model using market leading and widely compatible software.
- Geochemical modelling including contaminant transport to assess impacts on aquifers, abstractions, surface waters and other potential receptors identified during risk analysis.
- Linking/incorporation of the existing Environment Agency regional groundwater (Modflow) model for the key Permo-Triassic aquifers.
- Definition of suitable mine water control levels to protect receptors (if control levels are required following the risk assessments).
- Modelling of surface water systems as required to define risk and impacts.
- Predictive uncertainty and sensitivity analysis using PEST or similar.
- Risk scenario analysis for a range of rising mine water recovery, management and pumping scenarios which consider levels, flow, water quality and risk to receptors. Suggested scenarios include:
    - Modelling and assessment of 4 risk scenarios assuming no intervention e.g. best case, middle case, worst case scenarios and their impacts on key receptors.
    - Modelling and assessment of 4 management scenarios e.g. continuation of long-term pumping and discharge to surface water at Hartington Colliery;

pumping and discharge to surface water from multiple shafts in the western shallow coalfield; pumping at deep eastern shafts with poor water quality; combined shallow and deep coalfield pumping.

- Modelling and assessment of the volume and long term water quality at potential mine water surface discharges and pumped discharges to allow CA to understand treatment needs and/or requirements for mine water disposal.
- Consideration of mine water density stratification in pumped and passive scenarios.
- A risk assessment process and reporting format acceptable to government and regulators.
- Quantitative risk assessment for key receptors in line with regulatory guidance and best practices for the protection of groundwater and surface water.
- Production of technical modelling reports which detail a full and robust process which can be reviewed and scrutinised. The reports must define all inputs and model parameters (justification for selection) as well as all assumptions and limitations.
- Production of technical reports/updates following key stages of the project including, data review and gap analysis, conceptualisation & modelling strategy, model design, model calibration, risk assessment and pumping scenarios, uncertainty analysis, management scenario analysis, final model reporting,.
- Production of maps, cross-sections, diagrams and animations to illustrate mine water risks and pumping scenarios to the key stakeholders in government, regulators, industry and the public.
- Hosting and maintenance of the model and facilitation of view access for CA staff and stakeholders as required via the web.
- Hosting of geospatial data on a suitable web based platform such as ArcGIS or model web viewers for CA and other stakeholders to view during and after the modelling process.
- Transfer of all modelling files, data, intellectual property and reporting to CA in a suitable format ensuring forward compatibility and future-proofing for additional modelling work at a later date.

Outputs and Milestones

The specific outputs and milestones should be defined by the supplier in their tender response based on their proposed modelling approach and following the principles set out in the Australian Groundwater Modelling Guidelines (AGMG; Barnett et al., 2012). The work must be delivered before the end of April 2025.

CA will require interim findings to be communicated/reported throughout the modelling process, this will inform the ongoing wider mine water assessment work in the HCL block and assist with

stakeholder engagement and assurance. The tender response should include the key stages at which interim findings on the objectives will be available and how they will be presented.

The following formal reporting stages are recommended as a minimum:

- Data review and gap analysis
- Conceptualisation & modelling strategy
- Model design
- Model calibration
- Risk assessment and pumping scenarios
- Uncertainty analysis
- Management scenario analysis
- Final model reporting

Final reporting from the modelling process may be included in a business case to government to support the chosen interventions and management strategy and should be appropriate for this audience.

As set out in the Australian Groundwater Modelling Guidelines (AGMG; Barnett et al., 2012):

"Reporting should be tailored to its target audience, so a report should consist of an executive summary section for a non-technical audience and a detailed section for a technical audience. Model data and results should be presented using clear approaches to visualisation, with appropriate graphing, mapping and colour scheme. A model archive should be created that allows the model results to be reproduced exactly, while at the same time acts as a repository for data and knowledge of the system. It is recommended that GUI-independent standard file formats be used."

Service Levels and Key Performance Indicators (KPIs)

- Time targets are to be set and adhered to. These will be agreed at the outset of the contract and at updates during programme. To be assessed by progress review fortnightly.
- Cost target are to be set and adhered to. These will be agreed at the outset of the contract and at updates during programme. To be assessed by progress review fortnightly.
- Quality of service – production of a model, risk assessment and reporting output which meets the project objectives in line with industry best practice and relevant standards including quality assurance by competent professionals is required.

- Availability – attendance by key staff at update meetings and prompt response to email and telephone queries from CA throughout the works is required. A project manager or director should attend these meetings.
- Integrity – regular, open and honest communication throughout the modelling process to help CA to review the achievability of the objectives and the validity/uncertainty of the predictions is required.

Sustainability

Best practice measures should be taken to minimise the digital footprint of the work.

Cyber Risks

Secure storage of all data in line with government security classifications and handling instructions is required. All data included in the modelling work will be classified as OFFICIAL.

A data licence will be provided for use of CA coal mining data, this will be time limited and all data must be deleted from supplier's systems as required by the licence. Any third party data must be used in accordance with the terms under which it was provided. The supplier will be required to sign non-disclosure agreements with CA and third parties relating to the provision and use of their data as required.

4. Programme Requirements

A proposed programme (Gantt chart) is required to be submitted with the tender response showing the starting date and completion date as well as key steps/milestones (to be confirmed by supplier). The initial programme is to be submitted to the Client for acceptance within 7 days of the contract award and updated every 2 weeks from the starting date until completion. It is accepted that the form of the programme and milestones will require updates based on the findings of the key stages of the modelling process, changes should be agreed with CA in writing.

The work is to be completed before end of April 2025 and any findings, events, or activities which may put this completion date at risk must be communicated to CA at the earliest opportunity and efforts made to find suitable ways to mitigate these delays. Interim reporting will be required during the modelling process and should be accounted for in the programme.

5. Services Provided By the Client

The data to be made available by CA is presented in Appendix A. The supplier should provide access to a suitable file transfer method to ensure efficient delivery of this data.

6. Health and Safety

The activities of the work will largely be desk based. All works must comply with all relevant health and safety legislation for any workers involved in the project. Any site visits require RAMS to be approved by CA or a nominated subcontractor and must be conducted in line with CA risk assessments and industry best practice.

Accidents and incidents shall be reported to the Client within 5 working days from the date of their occurrence. Reportable incidents under RIDDOR are to be reported to the Client within 24hrs of them being known to be reportable. Please note that these requirements do not replace the supplier's legal obligations under health and safety law.

The terms and conditions will include the following reasons for termination:

- A prosecution for a breach of health and safety or environmental legislation
- Substantially or repeatedly broken a requirement of health and safety or environmental legislation.
- A material breach of its obligations under the Contract which is not capable of remedy.

7. Form of Tender

Suppliers must provide a response which includes a technical strategy, methodology, scope of works and schedule for the modelling works which will meet the aims and objectives and considers the indicative modelling scope.

Pricing should be broken down into appropriate project stages with an explanation of the expected labour and resources underpinning the prices for each stage and highlighting the key review/decision points in the modelling process. A total price for the proposed work should also be presented and any differences, exclusions or changes as compared to this scope document should be clearly explained and justified. A schedule of rates is also required from suppliers and may be considered to allow price comparison where required.

The successful tender response will be determined based on the technical merit of the proposed scope to achieve the project aims and objectives as well as price and schedule. Responses will be scored on a price per quality point system. The technical assessment will be made through review of the proposed modelling strategy and scope and other scored technical questions. Questions will be scored in the professional opinion of CA technical staff, considering this scope document and the project aims and objectives.

Suppliers may contact CA for clarifications and technical queries as part of the tender process.