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Geological information informing mine water heating, cooling and underground thermal storage



Natural
Environment
Research Council



British
Geological
Survey

Introduction

British Geological Survey = national geoscience organisation

- Data, information, products
- Research
- Monitoring and analysis

Recognises huge potential of subsurface for decarbonising heat

For mine water heating, cooling and thermal storage

Geothermal team

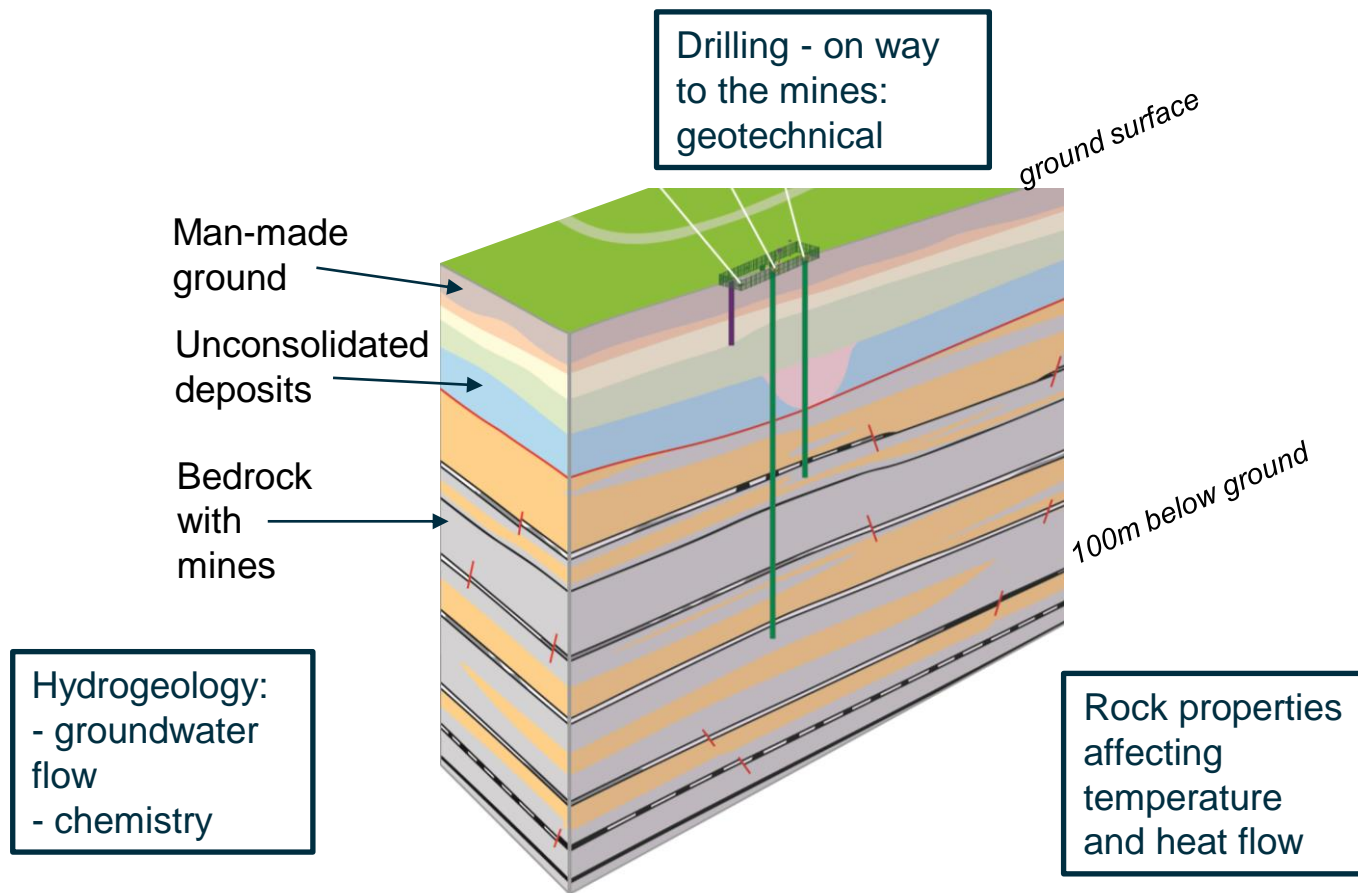
At-scale research & innovation facility

Energy storage team

- Resource maps, models
- Monitoring – geothermal boreholes and environmental
- Regulation and policy, public engagement
- Work with the Coal Authority

Identified need in NELEP mine heat white paper for geotechnical and hydrogeological information

Accessing mine water heat in the subsurface



Geothermal workflow – when is geological information needed?



Pre-feasibility Opportunity	Project definition Site selection Desk study + design	Exploration permissions permits borehole drilling testing	Appraisal Resource development	Construction	Operations	Decommissioning
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Regional products

Site specific:
borehole
prognosis,
models,
georeports

Environmental
products

Heat-flow
modelling
parameters

Products and
tools developed
at R&D facility



The subsurface is not uniform - but we have data



Blindwells
opencast, former
stoop and room
workings P220021
BGS©UKRI



Borehole
drilling and
construction =
significant
capital cost

Photo BGS©UKRI

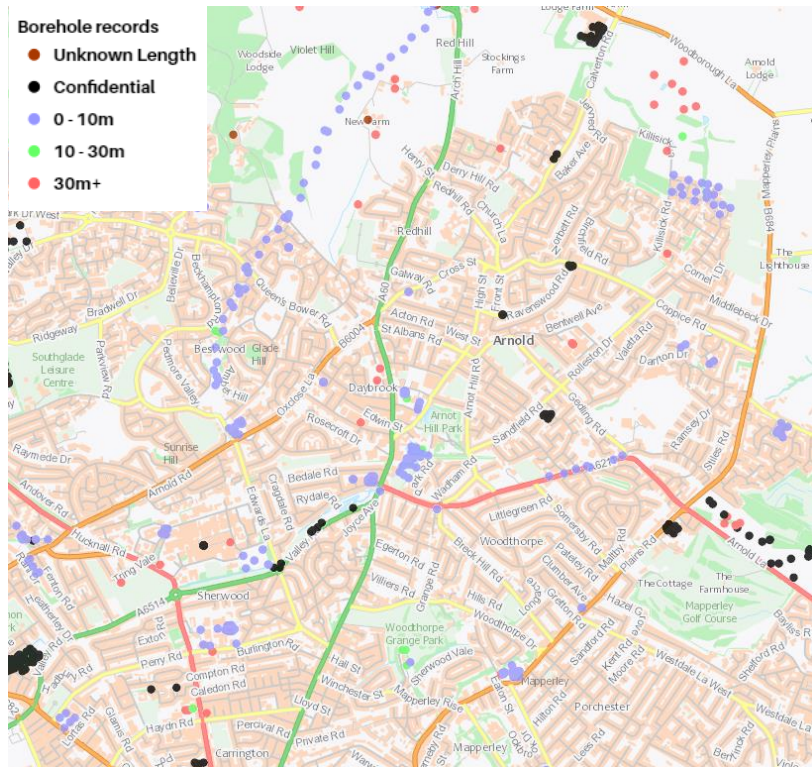


Coal-bearing rock
sequences
BGS©UKRI

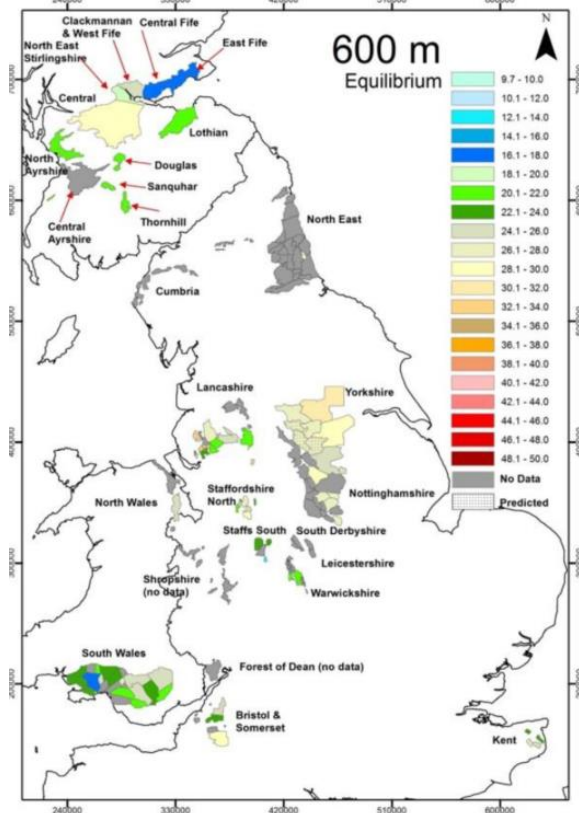
Geological information to reduce risk

Pre-feasibility: national datasets and information


Onshore GeoIndex – boreholes, engineering geology maps etc.



National mine water temperature maps (BGS and Coal Authority, Farr et al. 2020)

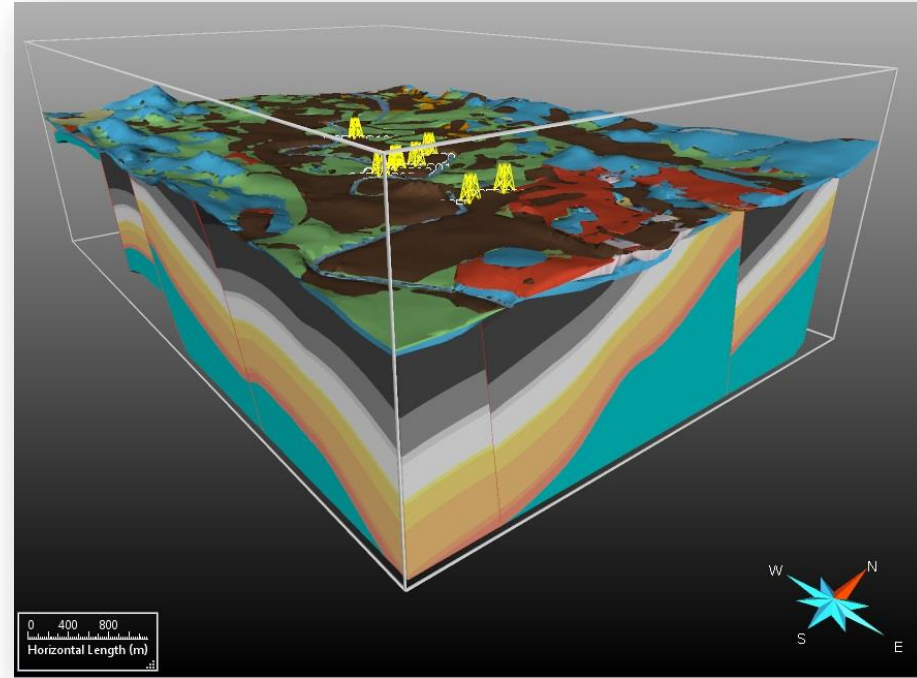


Project definition: Site specific georeports, geological models



GeoReports

GeoReports provides cost-effective access to unique sources of published and unpublished geological data, combined with expert advice from BGS scientists who know about your local area.



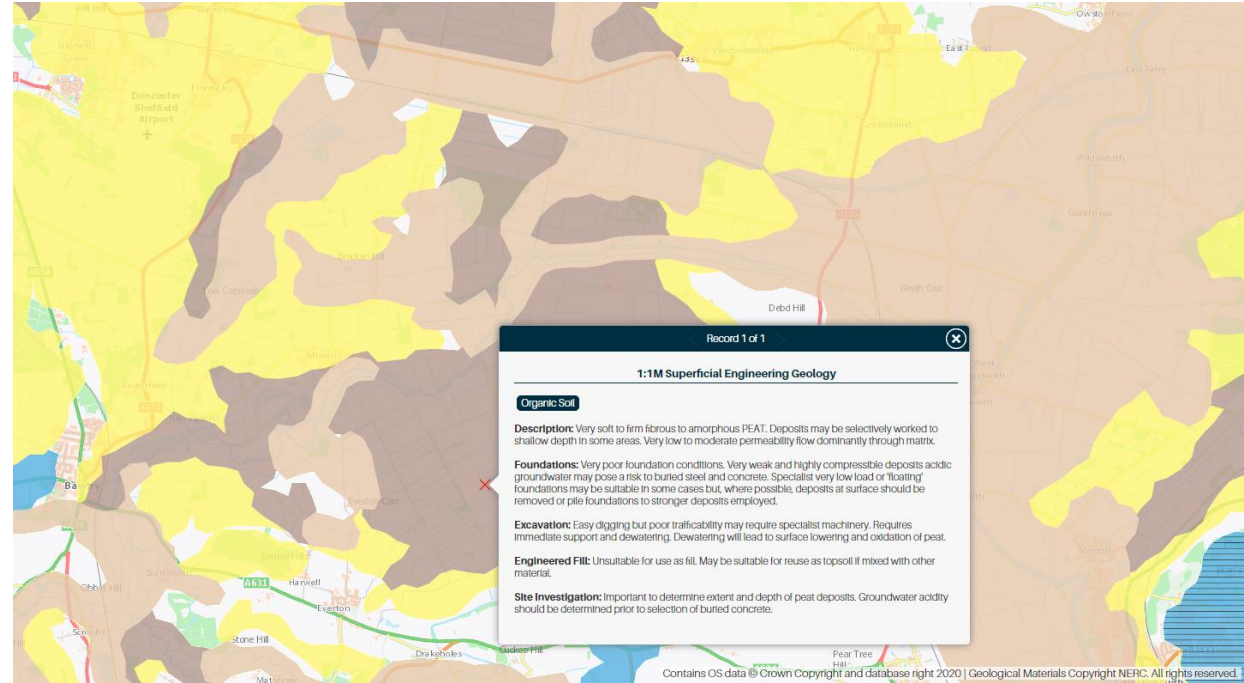
Geological model used to predict what boreholes would encounter

Future: decision support tools for de-risking?

- Pre-feasibility geological considerations – regional geospatial screening
- Initially, using existing national datasets

Influence on drilling costs

- Thickness of superficial deposits (e.g. buried valleys)
- Potential for difficult drilling: compressible ground (e.g. peat), running sand, landslides
- Faults

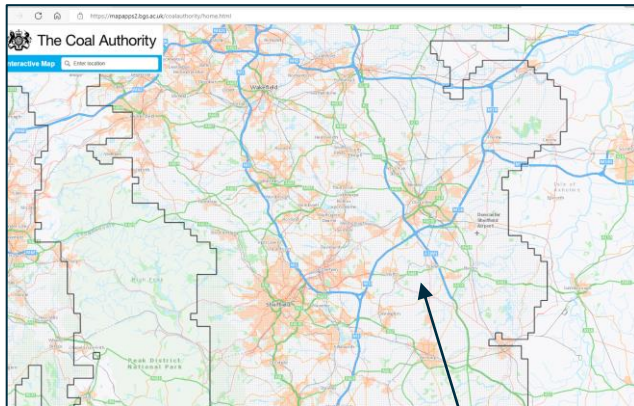


Environmental impact considerations

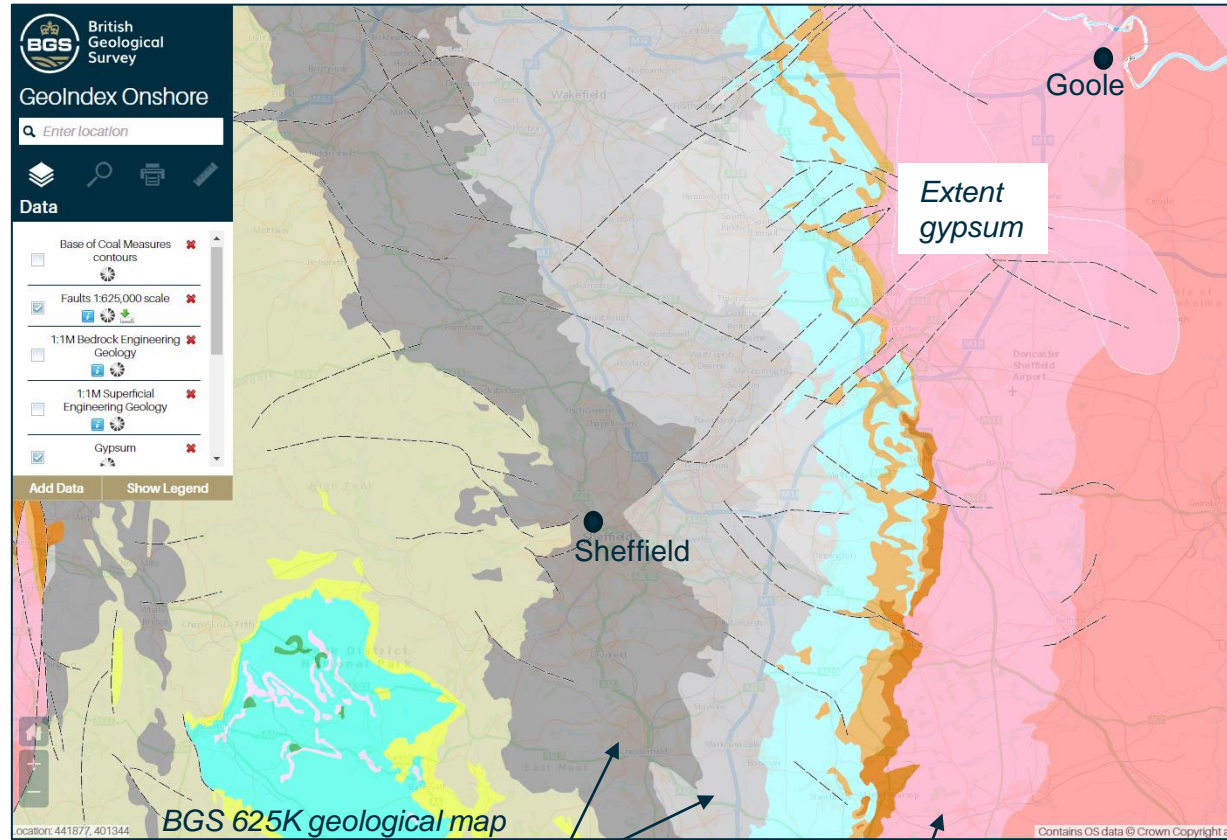
Shallow mining

Overlying aquifer, and separation

Overlying units: soluble rocks



Coalfield consultation area between Sheffield and the Humber



Within Coal Measures (grey) there are some areas of shallow mining

Aquifer overlying coalfield

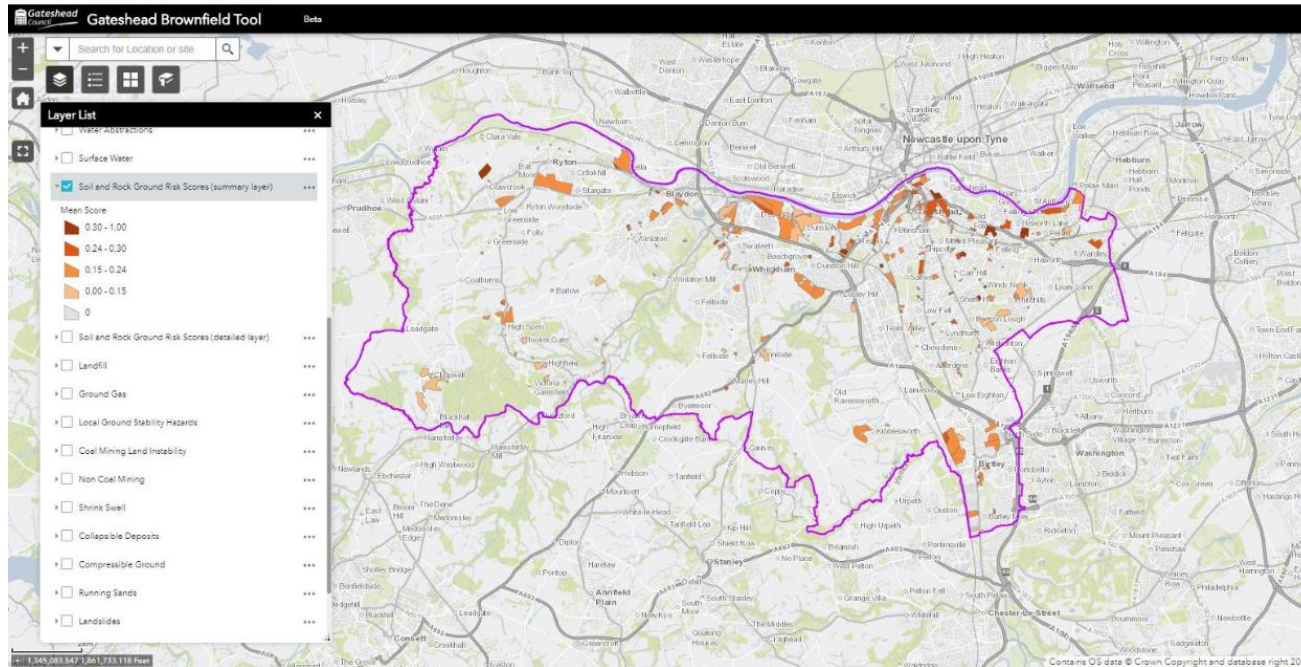
Future: decision support tools for de-risking?

Feedback welcome on your user need

Tools to synthesise more complex geological considerations that influence cost/risk?

Or access to the underlying datasets for use by geotechnical experts

Or ...?



Example of a decision support system developed by BGS, the Brownfield Ground Risk Calculator (example from Gateshead Council) BGS © UKRI

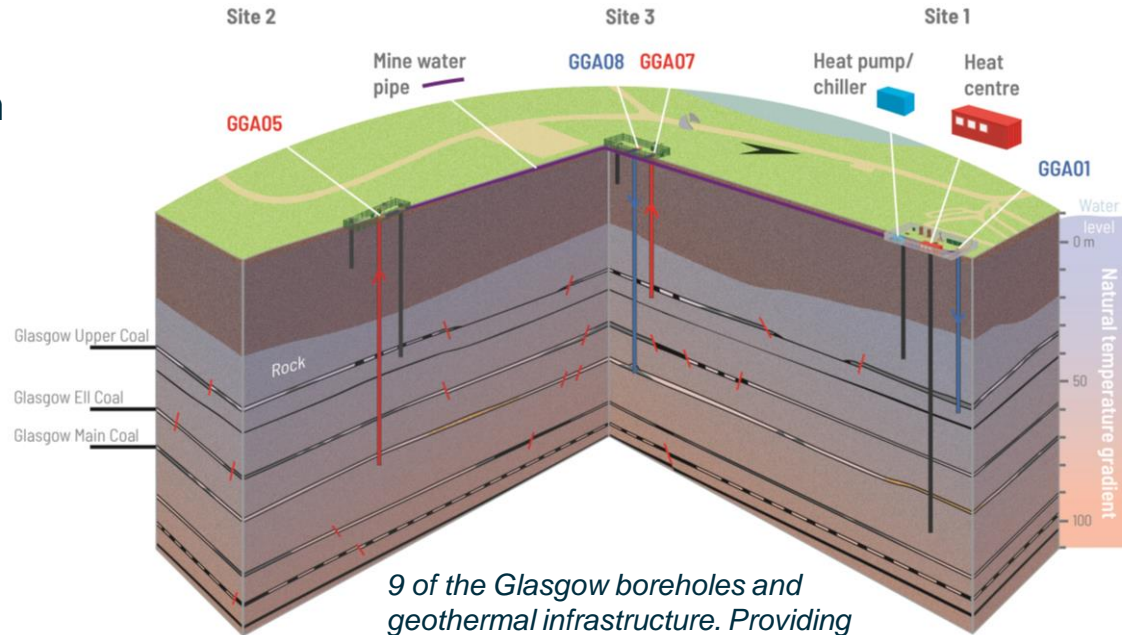
Geological information: investment in research and innovation

UK Geoenery Observatory in Glasgow

Research and innovation facility for mine water geothermal

- £9m UK Government investment
- 12 instrumented boreholes 16-199 m deep. 4 surface compounds
- At-scale, flexible, geothermal infrastructure
- Range of environmental monitoring
- Open data
- For industry and academic users investigating resources, sustainability, operations, new technologies etc.

www.ukgeos.ac.uk



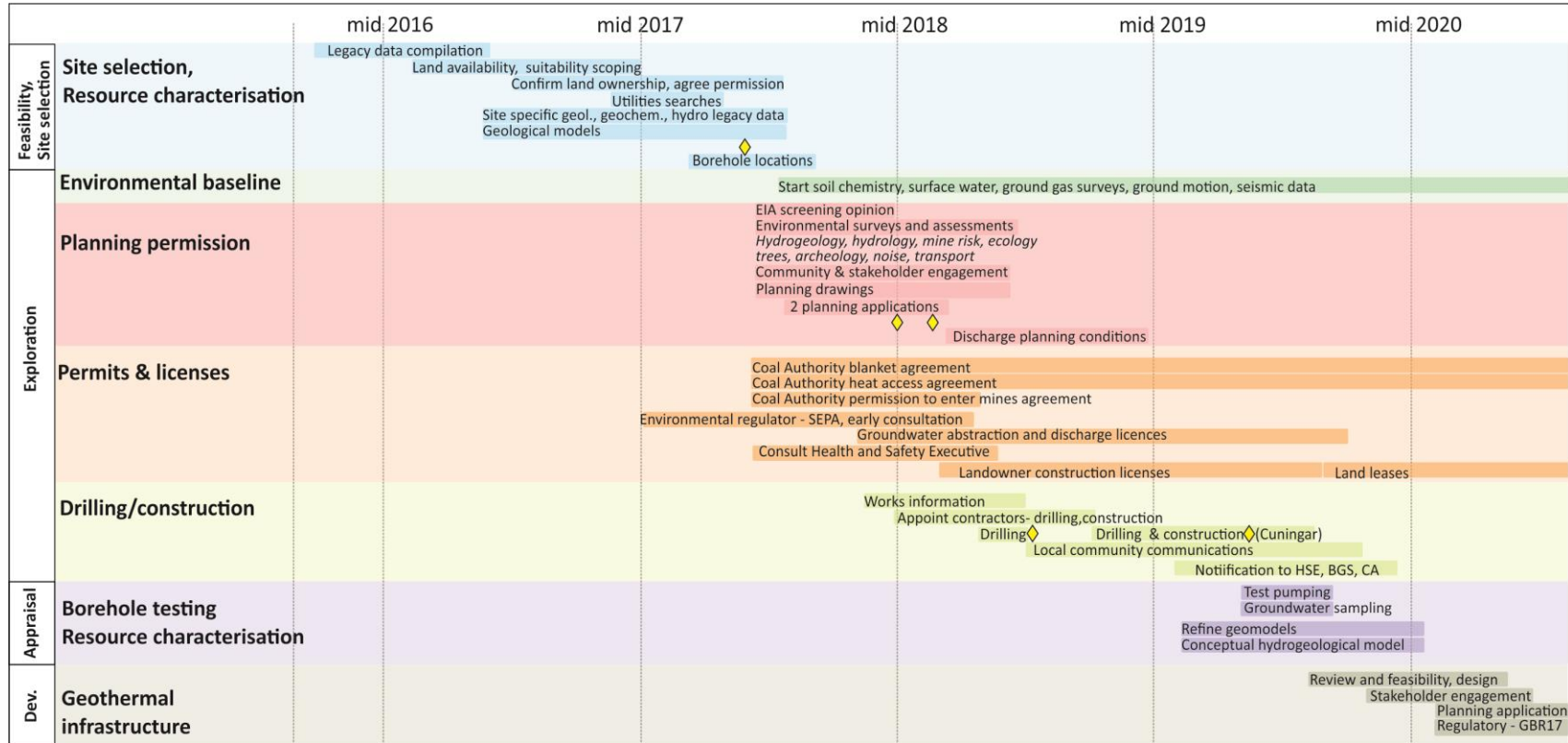
9 of the Glasgow boreholes and geothermal infrastructure. Providing flexible abstraction and thermal storage capability (200 kW, 3-12 L/s, sealed open loop, 2 abstraction, 2 re-injection boreholes) BGS©UKRI



Open data <https://ukgeos.ac.uk/data-downloads>

Includes a report on construction - provides a documented example

<https://nora.nerc.ac.uk/id/eprint/530822/>



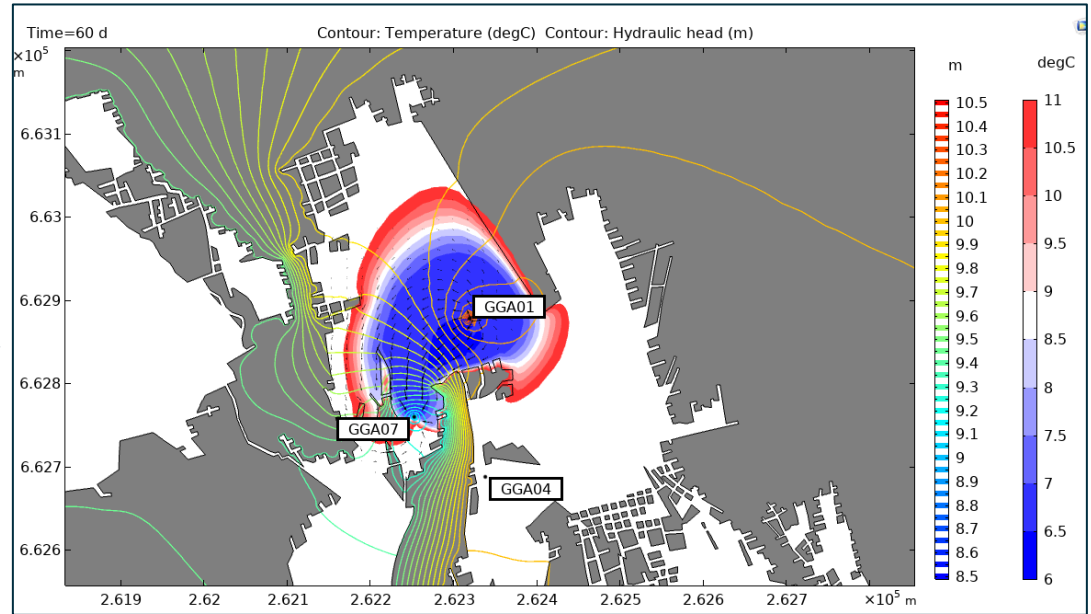
Sustainability of the resource

Active research and innovation

Add certainty to business case

Example: heat and flow modelling

Example: processes and efficiency of inter-seasonal thermal storage. Applicable to 5th generation district heating and cooling networks (5GDHC)



Modelled geothermal abstraction-re-injection in the same coal seam, after 60 days. Work in progress. BGS©UKRI

Environmental impacts

Active area of research and innovation e.g. in monitoring, sensing

- Reduction in CO₂ emissions
- Decentralised energy, energy security
- Integration into 5th generation heat networks

- Responses of
- groundwater
 - surface water
 - subsurface gas
 - ground motion

Multiple users



*Mine water borehole, groundwater sampling
BGS© UKRI*

Key area for public acceptance

Key area for new policies on economic case (value=cost compared to gas + CO₂ saved + social value)

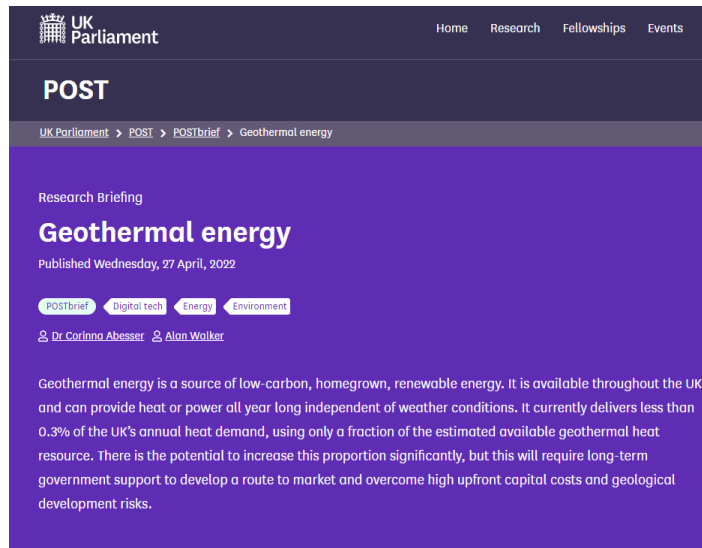
Raising awareness, policy, public engagement

Recognising that summary information can be hard to find:

- IEA geothermal mine water energy expert group – case studies, data listings (ongoing work)

BGS engaging with policy makers on geothermal in decarbonisation of heat

BGS involved in public engagement work and social science studies around mine water heat

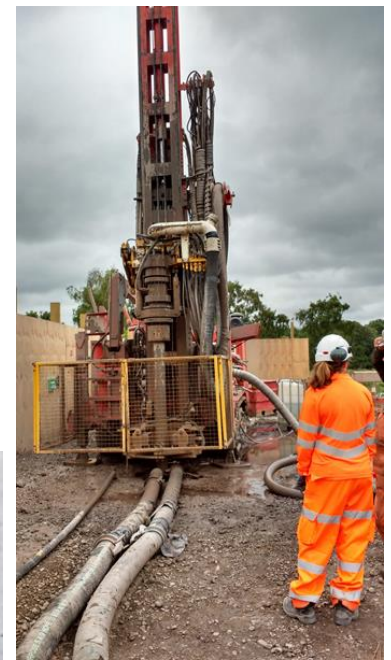


Summary

- Range of geological information available to de-risk future mine water heat projects
- Input very welcome of development of tools and products to meet user needs
- UK Government through UKRI and BGS have invested in a mine water geothermal facility for research and innovation.



Geothermal wellhead with mine water pipe, in construction. BGS© UKRI



Drilling a mine water borehole BGS© UKRI