



The Coal
Authority

Wrexham County Borough Council: Mine Water Heat Opportunities

July 2024



Making a **better future** for people
and the environment **in mining areas**

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Version	Produced by	Reviewed by	Approved by	Date
Final	Keith Parker Matthew Fox	Lee Wyatt	Gareth Farr	24/6/2024

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Executive summary

Coal mining has taken place in the Wrexham County Borough Council (CBC) area since at least the 16th Century with the last mine to close being Bersham in 1986. Much of the borough is underlain by coal mine workings, with multiple seams being worked in many localities. The presence of mine workings combined with knowledge (where available) of recovered mine water levels are used to provide a very high level assessment of the potential for exploring the development of open loop mine water heat projects in the borough. In addition to borehole opportunities and gravity-fed discharges have also been assessed for heat potential. Some discharges do not have sufficient data for assessment, hence are not included in this report.

The workings vary considerably in depth, being relatively shallow at the northern western part of the city of Wrexham. The strata and associated coal seams and workings dip to the east with the deepest seam workings in the Llay locality. The presence of numerous 'gravity fed discharges' in the Wrexham CBC administrative area together with the long period since the mines closed suggests that mine water has recovered.

The methodology for identifying the mine water heat opportunity areas is described in the overarching report. Mine water heat opportunities are based on mine workings information, with several 'good' and 'possible' opportunities in the Wrexham CBC area. This reports also includes surface details to provide opportunities to be progressed, these are also shown in the table below.

While there are no Coal Authority mine water treatment schemes in Wrexham, there are some gravity-fed discharges, where mine water is emitting at surface. This mine water may offer potential for mine water heat without the cost and risk of drilling and pumping, however currently there is no data to assess any of these discharges.

It is recommended that the opportunities listed are considered against surface heat demands to highlight those which may be served by mine water heat technologies. A subsequent, more detailed study of the mining and hydrogeology would add further information to firm up the case to take a number of mine water heat projects forward.

Summary of selected mine heat opportunity locations

No./ Area	Opportunity name	Opportunity type	Category	Potential MW _{th}
1	Brymbo	Borehole	Good	Subject to further testing
2	Brynteg	Borehole	Good	Subject to further testing
3	Rhosllannerchrugog	Borehole	Good	Subject to further testing
4	Pentre Bach	Borehole	Good	Subject to further testing
5	Stansty	Borehole	Good	Subject to further testing
6	Rhosymedre	Borehole	Good	Subject to further testing
7	Plas Madoc	Borehole	Good	Subject to further testing
8	Rhosrhedyn	Borehole	Good	Subject to further testing
9	Bersham	Borehole	Good	Subject to further testing

1 Introduction

The area covered in this section is the whole of the Wrexham CBC administrative boundary within which the presence of mine workings combined with knowledge (where available) of recovered mine water levels are used to provide a high level assessment of the potential for exploring the development of open loop mine water heat projects in the borough.

1.1 Geographic area

Wrexham CBC covers an area of approximately 500 km², and runs roughly north-south from just north of the A465 road, to just north of the M4. Urban areas within Wrexham CBC include: Wrexham; Rhostyllen and Bradley. Wrexham is within the North East Wales Coalfield.

2 Geological Summary

The solid and superficial geology, along with seam information has been ascertained by consultation of the available British Geological Survey records including:

- Online GeoIndex viewer ;
- Online geological memoirs;
- Online geology maps (Sheets 108, 109, 121 and 122); and
- Borehole and mine shaft scans across the area of interest.

2.1 Solid geology

The Wrexham CBC administrative area is almost entirely underlain by North East Wales Coalfield Strata. This comprises cyclic sequences of interbedded mudstones, siltstones, sandstones interspersed with coal seams, a generalised section of which is illustrated in **Figure 2-1** and **Figure 2-3**.

The Coal Measures strata outcrop in a broad belt that extends southward from the Llaneldian Fault in the north of the borough. The belt contracts in width between Minera and Wrexham but expands again around the vicinity of Rhosllan-churgog. Around the area of the Dee Valley, faulting has the effect of displacing the strata considerable distances to the west.

Figure 2.1: "Geological cross-section of units from west to east in Wrexham area."

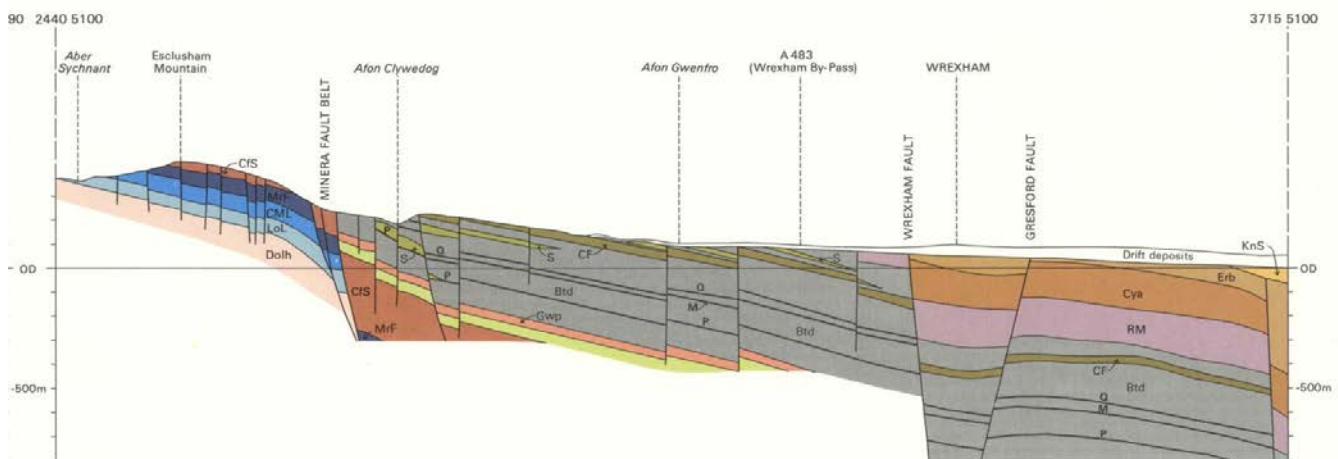


Figure 2-1. Regional geological cross section from West to East across Wrexham
[Source British Geological Survey Sheet 121 Wrexham](#)

Contains British Geological Survey materials © UKRI 2024

Regional solid geology and selected structural geology is shown in **Figure 2-2**. A representative stratigraphic sequence is shown in **Figure 2-3**.

2.2 Structural geology

The Coal Measures in Wrexham CBC outcrop to the west of Wrexham City and dip to the east with a series of N-S trending faults which form a graben around Wrexham City itself as illustrated on **Figure 2-1**. The deepest worked seams are present at depths of over 1000 m around the Llay area.

Main faults trends roughly north – south, with an additional series of southwest-northeast trend of faults and ‘disturbances’. The Glyn Fault around Pontllanfraith being a major geological disturbance, and has thrown the rocks up by approximately 100 m.

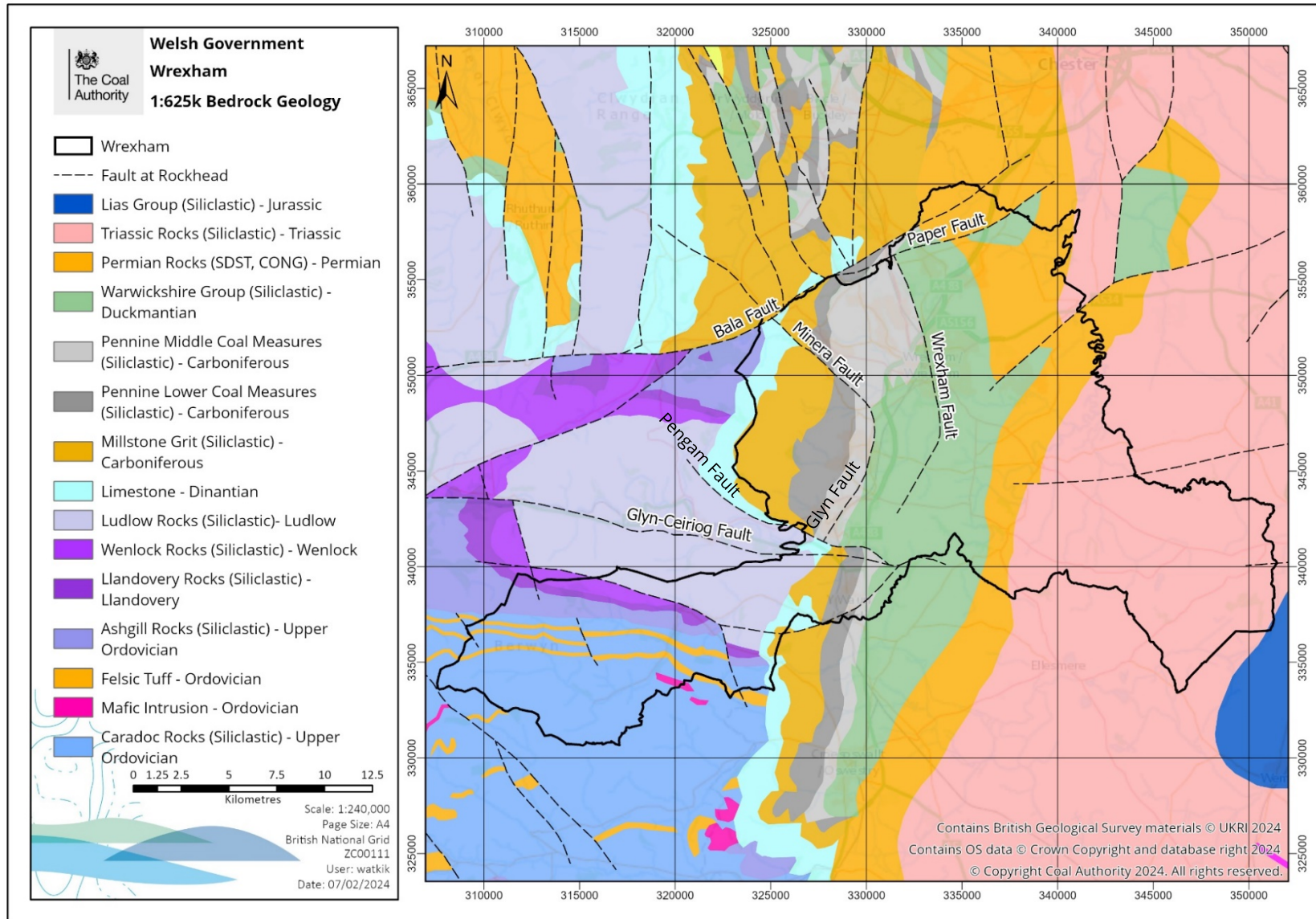


Figure 2-2. Bedrock geology in the Wrexham

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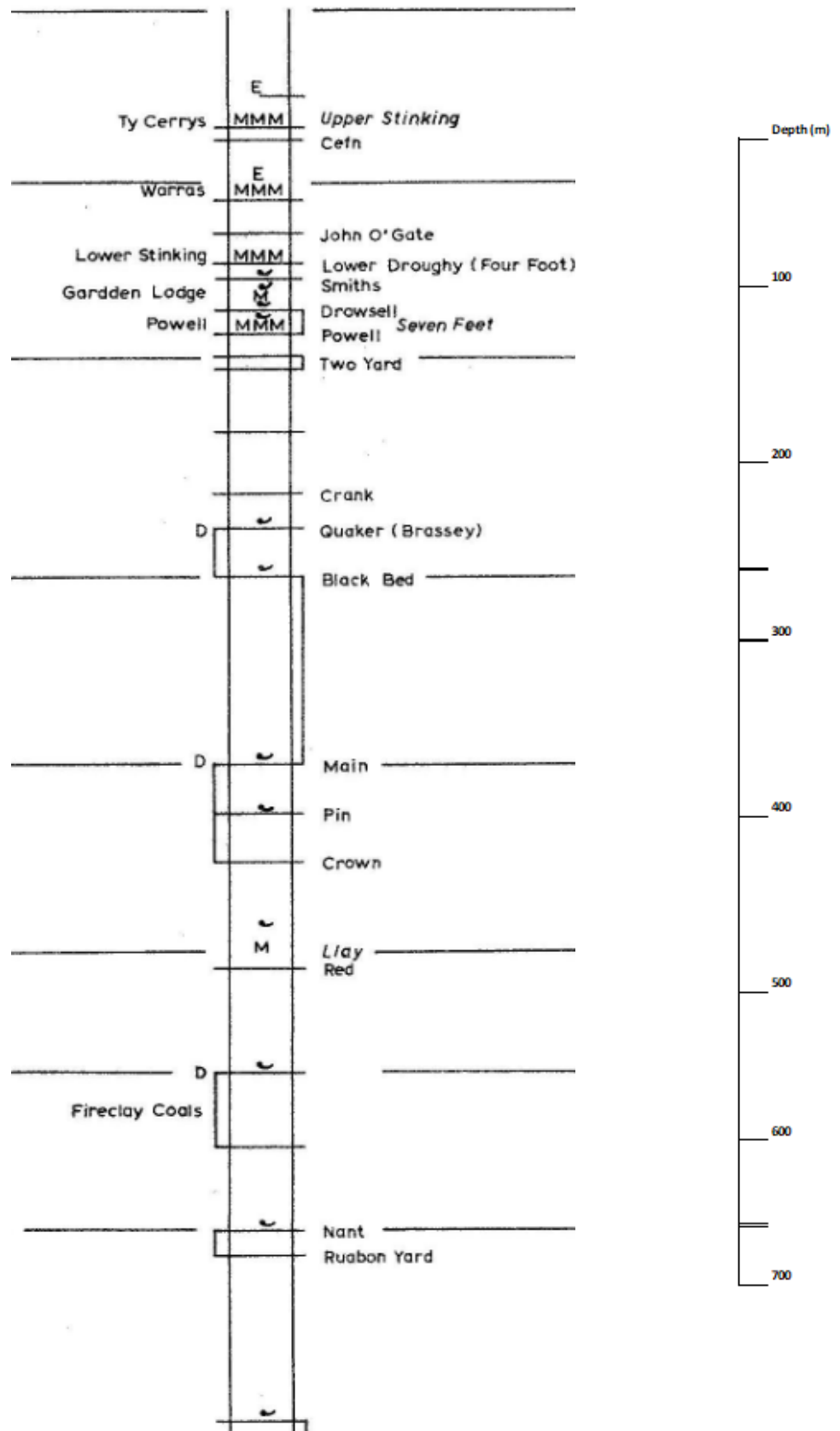


Figure 2-3 - Summary stratigraphy and geological sequence for the study area (from NCB Technical Document 1986)

3 Mining situation

Coal mining has taken place in Wales for several centuries with shallow seams being worked near to outcrop by means of roadways driven from the surface. These workings were often gravity drained by means of water levels, drainage adit or drainage soughs.

From the mid 1800's, the industrial revolution and concomitant increase in demand for coal led to the sinking of many collieries into the deeper seams.

Wrexham was an area where a number of large scale collieries were developed across much of the borough, to feed the demand for coal. In the 1970's and 1980's collieries were often connected together underground to form 'complexes' to improve efficiency by making use of common surface facilities such as coal preparation. These underground mining connections have a great bearing on the underground mine water regime by interconnecting considerable areas of mine workings.

Following colliery closures and end of mines in the 1980/90s, several mines were lost due to flooding. The final collieries to close, some of which had merged to become 'complexes' are set out in **Table 3.1** below:

Table 3.1: List of most recent colliery closures

Colliery	Closure date	Connected underground to
Bersham	1986	Not confirmed
Gresford	1973	Not confirmed
Llay Main	1966	Not confirmed

Note: a detailed assessment of underground mining connections is required to confirm the mining hydrogeological conceptual model(s)

Following these closures pumping ceased and the mines started to fill with mine water.

Up to 12 individual coal seams have been worked in the area with the northernmost extremity of working being those in the North East Wales Coal Measures, which outcrop to the west of Rhosllannerchrugog in an NNE-SSW orientation. The extreme eastern and western parts of the borough are devoid of any recorded mine workings.

4 Mine water regime

4.1 Description of mine water blocks

The Mine workings within the Wrexham CBC boundary are all located within the North Wales Denbighshire and North Shropshire mine water block as illustrated in **Figure 4-1**. The exact boundaries of these blocks will need confirmation by further investigation of mining connections and hydrogeological data.

The mine water levels and status of these blocks, along with the interconnectivity between blocks needs confirming by further study. Information from the very limited number of monitoring points, and known gravity discharges suggests mine water recovery is complete, or largely complete.

4.2 Monitoring data

4.2.1 Mine water levels

There is no mine water data for Wrexham. The time elapsed (>30 years) since colliery closures in this region suggests that mine water recovery is likely to be complete or at least well advanced. The presence of numerous gravity discharges (**Figure 4-2**), from workings in the North East Wales Coal Measures or from shafts into North East Wales Coal Measures adds further to this view.

A study into mine water temperatures at various depths around the UK coalfields was published in 2020 ([Farr et al, 2020](#)). This study used historic underground water and strata temperatures along with data from mine water temperature data where available.

Temperature typically increases with depth and data published in the study suggests the following may be anticipated for the Wrexham area:

Table 4.1: Anticipated mine water temperatures in North Wales Denbighshire and North Shropshire

Depth (m BGL)	Mean(°C)
100	12.5
200	14.9
300	17.5
400	19.8
500	22.3
600	24.7
700	27.1
800	29.6

4.2.2 Mine water chemistry

Mine water chemistry can be highly variable depending on specific location and would not normally form part of any initial high level opportunity scoping considerations guided by this study. Mine water chemistry assessment would be included in any more detailed, site specific studies, which may be commissioned in future.

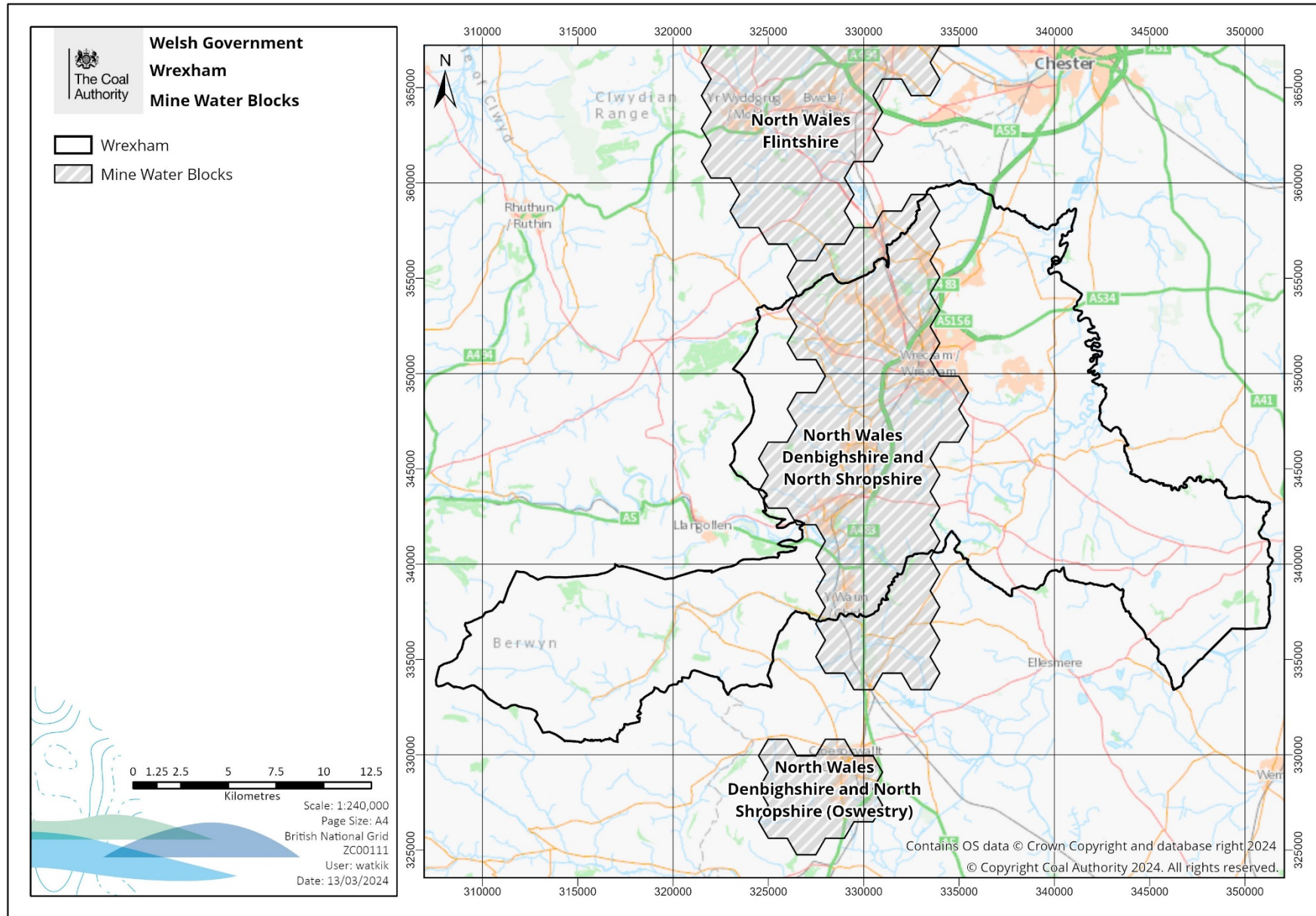


Figure 4-1: Mine water blocks in Wrexham

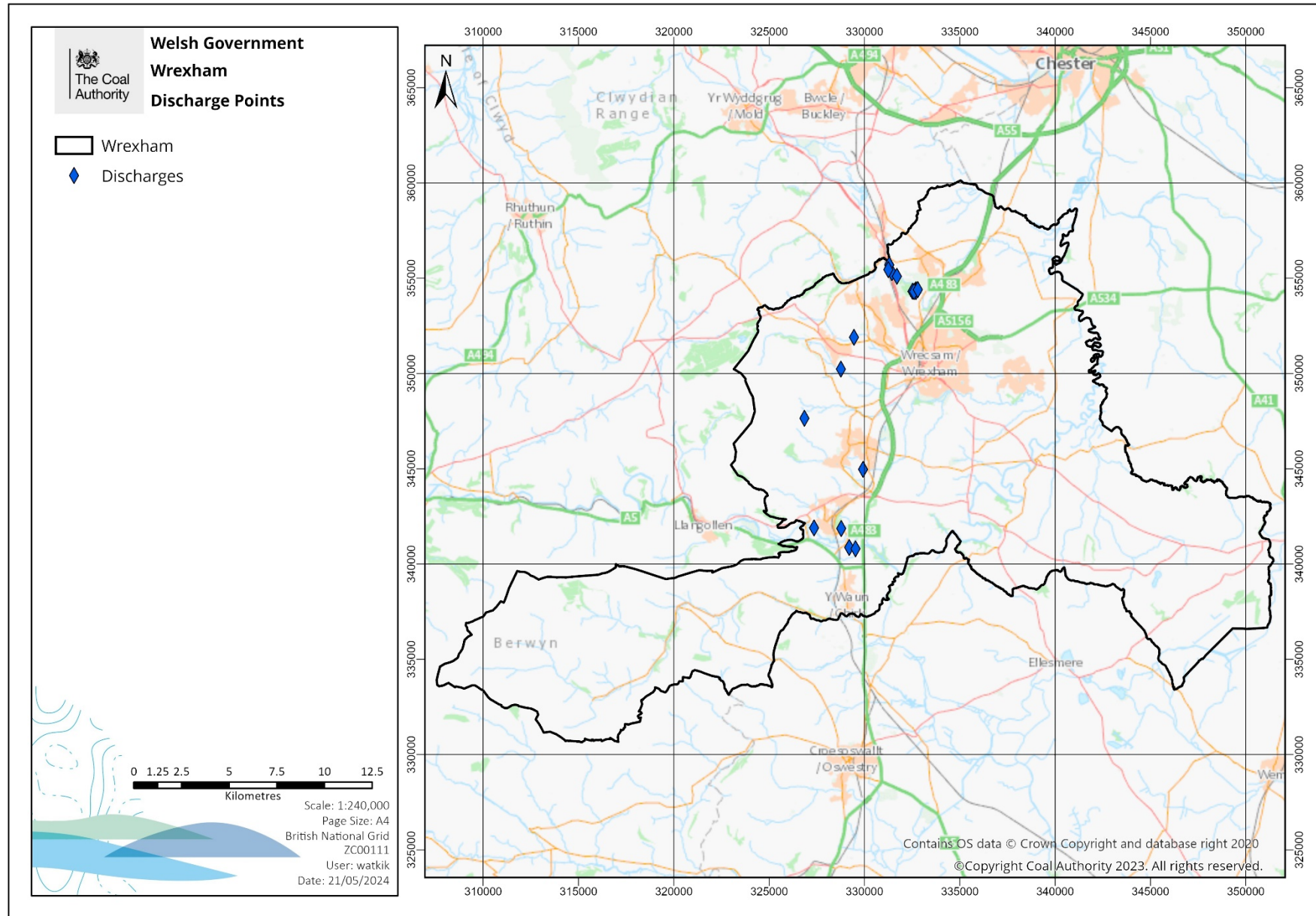


Figure 4-2. Gravity-fed coal water discharges in in Wrexham

4.3 Borehole schemes

The prospects for progressing a mine water heat scheme based on drilling boreholes to abstract and re-inject the mine water are assessed on a 'tier' basis. Three tiers have been adopted for the purposes of this study, the methodology and assessment criteria being set out in the over-arching report for Welsh Government

The classification of borehole based opportunities are:

Good opportunities – shown coloured dark orange

Possible opportunities – shown coloured medium orange

Challenging opportunities – shown coloured light orange

The opportunity areas within Wrexham CBC boundary are outlined below and are illustrated on the maps at **Figure 4-3**.

4.3.1 Good borehole scheme opportunities

Generally, the area to the west of Wrexham reaching following the A483 road offer "Good opportunities" and the most favourable for developing a mine water heat borehole based scheme. In this area mine workings in multiple seams at depths of less than 300m are present over wide areas, these workings being shallower than elsewhere in the south of the borough, thus likely to incur less expense and difficulties with drilling.

The largest settlement area in this area is the city of Wrexham, however the topography and geometry of the mining is such that coal mine workings are not recorded to be present under the central part of the town and only the western part is considered to have "Good opportunities". This area does, however, include some significant sites, which may present significant heat loads, the Wrexham Maelor Hospital lies in this area. This area is located north west of the A483 road and includes the main settlement areas of **Brymbo, Brynteg, Bersham, Rhosrhedyn, Pentre Bach and Stansty**.

Further smaller areas of good potential exist to the south west of Wrexham these include areas around **Rhosllannerchrugog, Plas Madoc and Rhosymedre**.

4.3.2 Possible borehole scheme opportunities

The main area of possible opportunities is to the south west of Wrexham in a mainly rural area following the route of the A483, specifically where it intersects with the B5426. However this is a mainly rural areas with limited development potential.

4.3.3 Challenging borehole scheme opportunities

The area to the north east of Wrexham includes a number of areas which, while offering potential for mine water heat, are over 500 m deep. Drilling costs (e.g. due to depth of workings) along with the single seam workings are potentially prohibitive with **Llay, Pandy, Gresford, Little Acton Borrass and Rhosnesni** presenting 'challenging opportunities' with workings approaching depths of close to 1000 m.

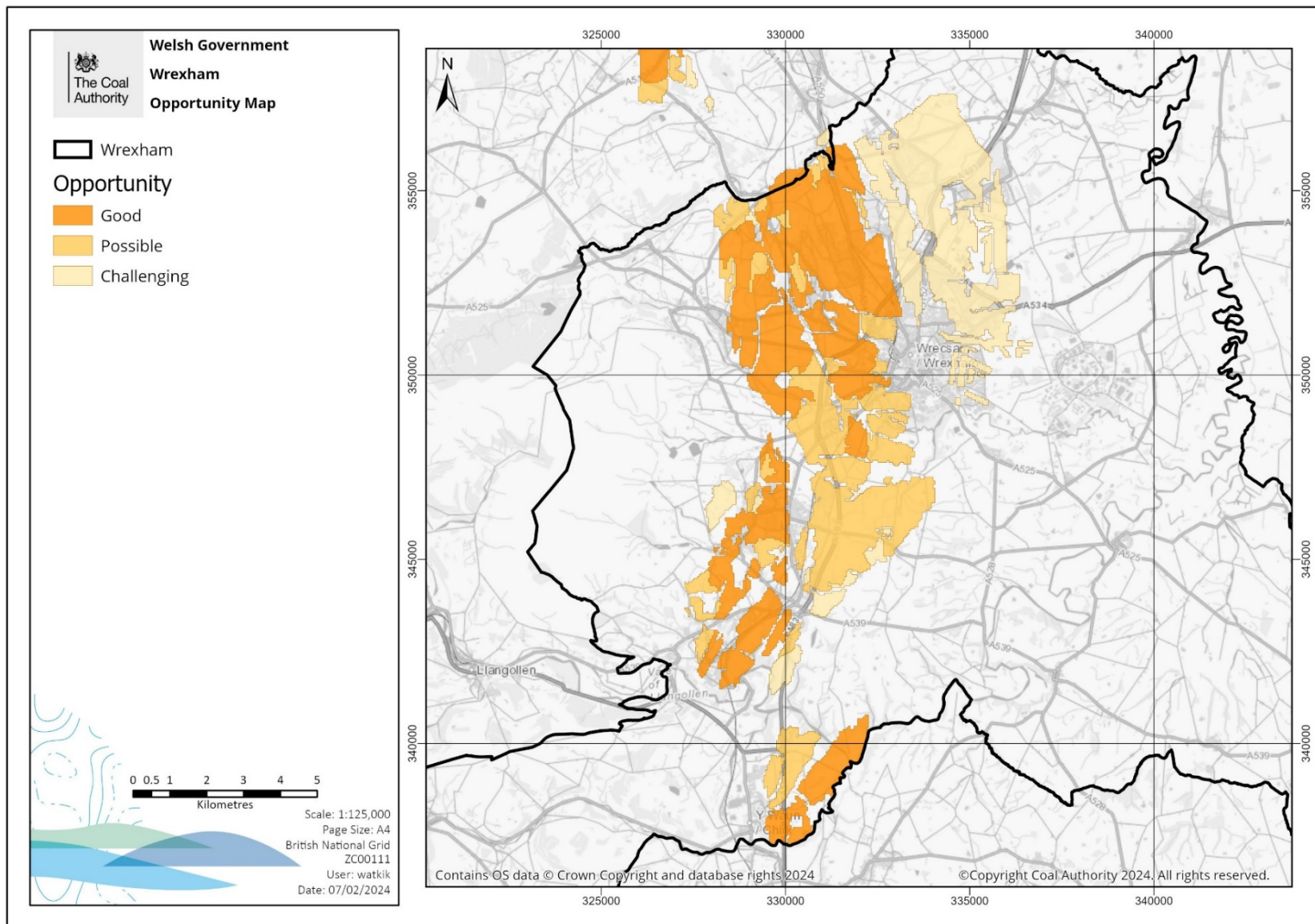


Figure 4-3 Mine water heat opportunities – borehole schemes

4.4 Mine water treatment schemes

Existing Coal Authority mine water treatment schemes, where mine water is already either pumped or flowing, may in some circumstances potentially offer a lower risk approach to developing mine water heat projects as new drilling and testing of boreholes would not be required.

However, there are currently no mine water treatment schemes in the Wrexham CBC area.

4.5 Gravity-fed discharges

Numerous gravity-fed mine water discharges exist in the Wrexham CBC area (**Figure 4-2**). However none of the sites are monitored for flow rate, water quality or temperature and thus are not presented within this report.

The nature of gravity-fed discharges (flow, temperature and quality) will be dependent upon a number of factors including mining type and geometry, the hydrogeological system of the mine workings and rainfall.

Some discharges are likely to be more variable in flow rate and temperature than others but as many of the discharges are not currently monitored for flow rate, water quality or temperature and so it is difficult to evaluate with any degree of confidence.

Should a potential heat demand be identified close to one of these discharges or any other discharge in the area, then a more detailed study would be required. Additional investigation and data gathering will likely be required to establish its potential.

5 Summary

Considerable areas of the Wrexham CBC administrative area are underlain by abandoned coal mine workings. The earlier sections of this report consider the mining and mine water parameters across the whole borough to rank areas by reference to an opportunity classification system. This summary section overlays the opportunities on populated settlement areas to provide a steer on localities where mining aspects and surface development may present the most likely places to further investigate and potentially deploy mine water heat.

The opportunity areas are set out in **Table 5.1** and their locations illustrated in **Figure 5-1**.

Table 5.1: Mine water heat opportunities within Wrexham

No./ Area	Opportunity name	Opportunity type	Category	Potential MW _{th}
1	Brymbo	Borehole	Good	Subject to further testing
2	Brynteg	Borehole	Good	Subject to further testing
3	Rhosllannerchrugog	Borehole	Good	Subject to further testing
4	Pentre Bach	Borehole	Good	Subject to further testing
5	Stansty	Borehole	Good	Subject to further testing
6	Rhosymedre	Borehole	Good	Subject to further testing
7	Plas Madoc	Borehole	Good	Subject to further testing
8	Rhosrhedyn	Borehole	Good	Subject to further testing
9	Bersham	Borehole	Good	Subject to further testing

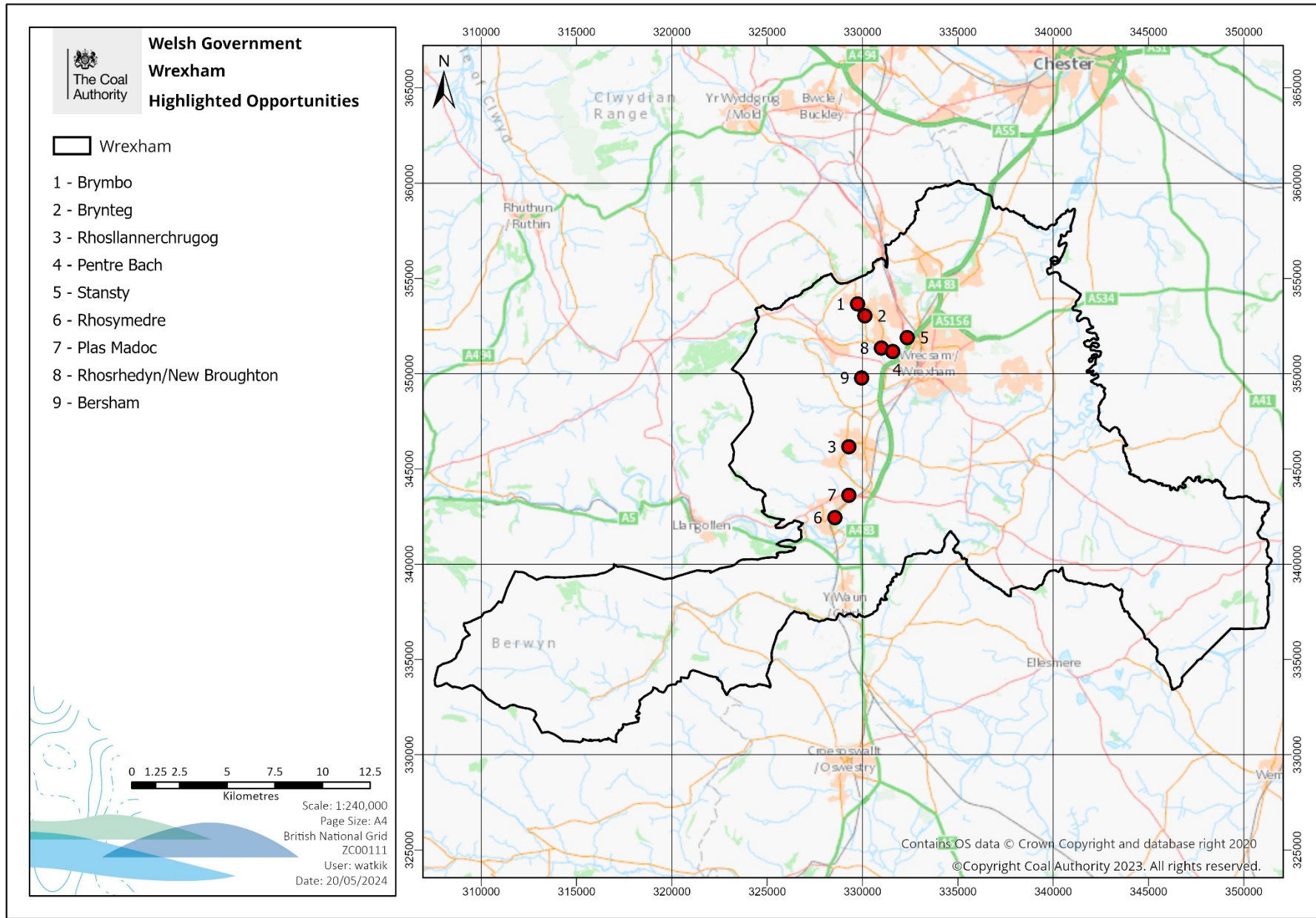


Figure 5-1. Highlighted good opportunities

5.1 Borehole schemes

5.1.1 Good opportunities

In broad terms, good opportunities are expected to exist in central part of the borough to the west of Wrexham City. These are found between where the coal outcrops around the B5102 and B5097 roads over to the area to the west of the A483. This area aligns well with the main settlement areas of **Brymbo, Brynteg, Bersham, Rhosrhedyn, Pentre Bach** and **Stansty** with further opportunities at **Rhosllannerchrugog, Plas Madoc** and **Rhosymedre (Figure 5-1)**.

5.1.2 Possible opportunities

The main are of possible opportunities in Wrexham is the area the south-west of the city, following the route of the A483 where it intersects with the B5426. However this area is mostly rural making current opportunities unlikely. If any future developments are proposes in this area, it would be worthwhile discussing with the Coal Authority to see what potential is present at that particular time.

5.1.3 Challenging opportunities

Workings do exist under large parts of **Llay and Bersham** and other areas to the north east of the city centre at depths of over 500m. While a mine water heat schemes may be technically possible here, it is unlikely to be commercially viable due to the high drilling costs/risk.

5.2 Mine water treatment schemes

There are currently no Coal Authority mine water treatment schemes within the Wrexham CBC area.

5.3 Mine water discharges

Many mine water discharges are known to exist in the area, however none of them have been monitored for flow rate, chemistry, or temperature data. Without further information, mine heat potential for mine water discharges in Wrexham is unknown.

5.4 Next steps

A number of good, possible and challenging mine water heat opportunity areas have been identified across the Wrexham CBC region as illustrated in . However, a significant part of the Wrexham CBC area is rural with little or no surface development, and potential users in those areas will be limited compared to urban areas. The opportunity areas have been considered against the major developed areas (which may have a significant heat demand) in the borough to seek to identify places where good heat supply opportunities may coincide with significant heat demand. It is suggested that the opportunities covered in this section

and listed in **Table 5.1** and shown in **Figure 5-1** are further considered for more detailed study.

The heat potential of the borehole schemes cannot be estimated to any degree of certainty until more detailed and localised study is undertaken. Localised studies or more in-depth studies for boreholes are required to confirm available flow rates and other factors that are used to determine heat potential. This may involve exploratory drilling. However, within this report, there are borehole opportunity areas marked as good on the basis that it is considered the workings in these areas are substantial and likely to have significant heat potential $>3 \text{ MW}_{\text{th}}$.

It is recommended that a survey of the main heat loads, particularly potential large 'anchor' loads such as hospitals or larger public buildings are undertaken in the opportunity areas in **Table 5.1** to establish synergies between potential heat supply and heat demand. Potential cooling demands should also be considered. This may identify good opportunities to further investigate pilot mine water heat projects through more detailed feasibility work, initially involving desktop studies and subsequent investigative drilling should the potential be attractive.

6 References

Farr, G., Busby, J., Wyatt, L., Crooks, J., Schofield, D.I., Holden, A. 2020. The temperature of Britain's coalfields. *Quarterly Journal of Engineering Geology and Hydrogeology* (2021); **54**(3). pp.1-14. <http://dx.doi.org/10.1144/qjegh2020-109>