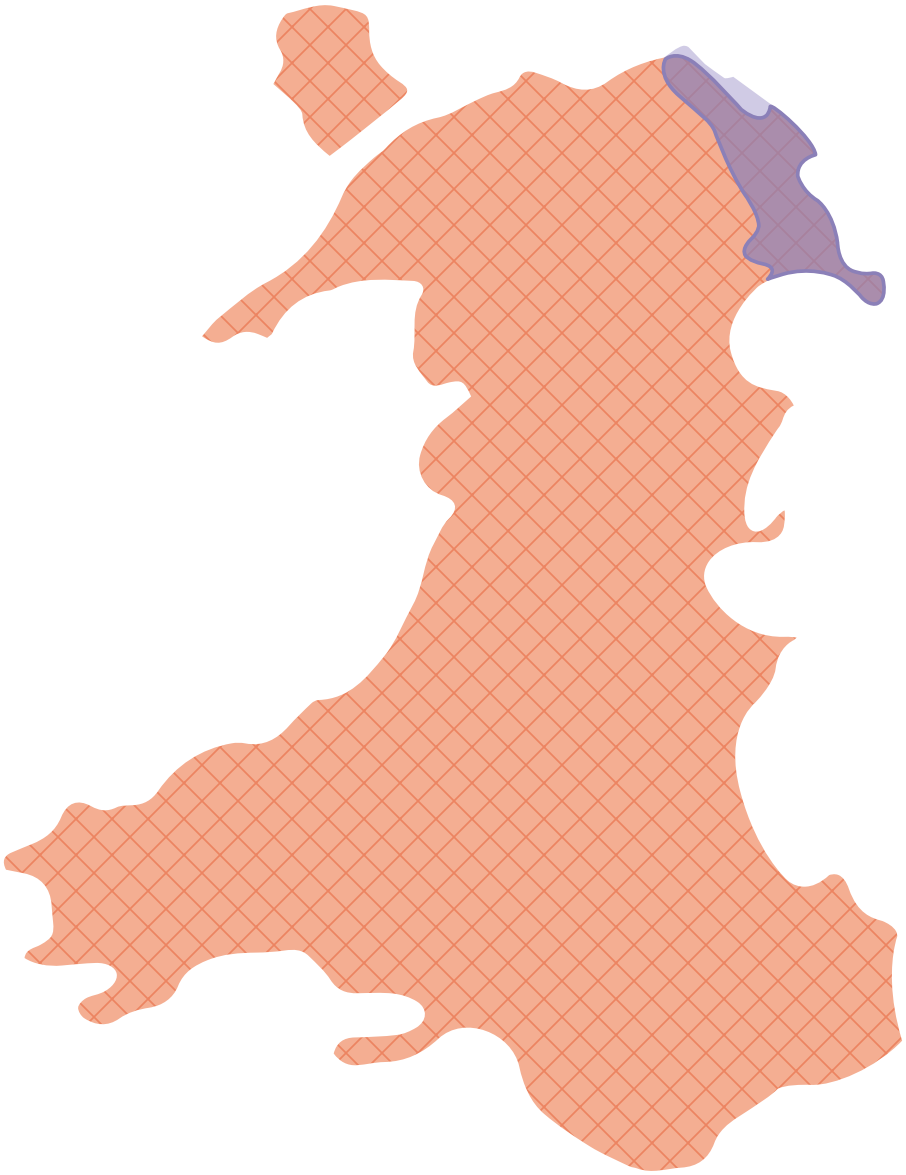
Radioactive Waste Management



Wales

SUBREGION 2

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Clicking on words in green, such as sedimentary or lava will take the reader to a brief non-technical explanation of that word in the Glossary section. By clicking on the highlighted word in the Glossary, the reader will be taken back to the page they were on.

Clicking on words in blue, such as Higher Strength Rock or groundwater will take the reader to a brief talking head video or animation providing a non-technical explanation.

For the purposes of this work the BGS only used data which was publicly available at the end of February 2016. The one exception to this was the extent of Oil and Gas Authority licensing which was updated to include data to the end of June 2018.

Our work shows that we may find a suitable geological setting for a GDF in a small part of this subregion, although the thickness and properties of the potential host rocks present may not be suitable.

Rock cannot generally be seen at the surface in this subregion, except in man-made excavations such as quarries or road cuttings. However, deep boreholes and geophysical investigations, largely associated with mining, give us an understanding of the rocks present and their distribution.

There are clay-rich rock layers to the east of Wrexham and rock salt layers to the west of Whitchurch in which we may be able to site a GDF. The available information suggests that they may be too thin and we would need to do more work to find out whether these rocks have suitable properties and thicknesses.

Even where individual clay-rich rock layers are found not to be thick enough to host a GDF they may support the siting of a GDF in deeper rocks as they could act as a barrier to groundwater flow from depth. This is important because movement of groundwater is one of the ways in which radioactive material could be carried back to the surface.

Some of the subregion has been mined to depths below 100m for coal resources, in the Flint and Denbighshire portions of the North Wales Coalfield, and lead and zinc, south of Holywell and west of Wrexham. In these areas the mining is likely to have affected the way in which water moves through the rock. Also possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility.

Parts of the east of the subregion have Petroleum Exploration & Development Licences to allow companies to explore for oil and gas. This exploration is currently at an early stage and it is not known whether oil or gas in these licence areas will be exploited. RWM will continue to monitor how this exploration programme progresses.

Parts of this area, in the Dee Estuary and south of Buckley, are Coal Authority Licence Areas allowing companies to explore for coal. It is not known whether coal in these licence areas will be exploited. RWM will also continue to monitor how this exploration programme progresses.

Introduction

This subregion comprises the area of the North Wales Coalfield around Wrexham north to Prestatyn on the coast including the eastern part of the Dee Estuary.

Rock type

Figures 1a to 1c show where in the subregion there are likely to be Rock Types of Interest for the development of a GDF within the depth range of interest. There are only 2 parts of the subregion with Rock Types of Interest:

- Near Wrexham the Warwickshire Group occurs below 200m. It comprises beds of mudstone, interlayered with sandstones and siltstones. The mudstones are interbedded with siltstones and sandstones on a metre scale and so are unlikely to form a sufficiently thick and uniform body to act as a Lower Strength Sedimentary Rock (LSSR) host rock.
- West of Whitchurch evaporites within the Mercia Mudstone Group are present in the top part of the depth range of interest. In this location they are at the very edge of the Cheshire Basin described in the Central England region. Rock salt (halite) layers may be present but may be too thin to act as an Evaporite host rock.

A summary of the geological attributes of Wales can be found here, including a simplified rock column showing the oldest and deepest rocks at the bottom, with progressively younger rock units towards the top.

Rock structure

There are many major faults in this subregion (Figure 2) but no major folding. These faults are mostly oriented north-south and are related to the same ancient rift basin that extends northward into the East Irish Sea basin. They largely control the overall structure of the North Wales coalfield. Faults may act as barriers to or pathways for groundwater movement, depending upon their characteristics, and they would need to be considered during the siting of a GDF [1].

Groundwater

There is very little information on groundwater in the depth range of interest for a GDF, 200 to 1,000m below NGS datum, although there is information on groundwater in aquifers above 200m. The Carboniferous Limestone aquifer is a principal aquifer in this subregion of Wales, especially around the margin of the coalfield. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK [2].

[1] Faults occur on a diverse range of scales, from centimetres to kilometres, and the subsurface is criss-crossed by networks of numerous individual faults. However our work includes only those faults identified by the BGS with throws (vertical offset) of 200m or more. This is because the data available to the BGS are not able to resolve all faults consistently, across all thirteen regions, with throws less than 200m. We recognize the potential importance of smaller scale faults to the integrity of a GDF and will need to survey them in detail as part of the site evaluation process.

[2] Water Framework Directive UK TAG. Defining and reporting on groundwater bodies, 2012.

Only near Wrexham are there LSSR layers which are likely to act as a barrier to vertical groundwater movement between different aquifers and deep and shallow groundwater, even where they are not thick enough to host a GDF. Mining is also likely to have changed the original patterns of water movement in the coalfield area and shallow groundwater may now circulate to greater depths within the depth range of interest than it did before mining. A 16 km adit was used to drain a series of mines between Mold and Holywell and has had a significant impact on the local groundwater.

Deep exploration boreholes may influence the connectivity between shallow and deep groundwater which would also need to be considered during the siting process (Figure 3). There are no thermal springs in this subregion to suggest rapid flow of deep groundwater to the surface.

Resources

Coal has been mined extensively below 100m in the Flint and Denbighshire portions of the North Wales Coalfield (Figure 4a) and lead and zinc were mined in the area south of Holywell and west of Wrexham, with mines up to 300m deep (Figure 4b). In these areas the mining is likely to have affected the way in which water moves through the rock. Possible exploration in the future in these areas means that it is more likely that future generations may disturb a facility. These known resources would be taken into account in the siting of a GDF.

There are Petroleum Exploration and Development Licences [3] related to coal bed methane in the coalfield region in the east of the subregion (Figure 4c). There is also a small Coal Authority Licence Area south of Buckley (Figure 4a). It is not known whether coal or gas in these licence areas will be exploited, but they would need to be considered during the siting process.

An area of historical iron ore mining is also shown in Figure 4d but is not relevant to the siting of a GDF as the mines are shallower than 100m.

Natural processes

Earthquakes and glaciations are unlikely to significantly affect the long-term safety of a GDF in the UK. Therefore, whilst a GDF would need to be sited and designed to take account of natural processes which may occur during its lifetime, they are not considered further as part of this screening exercise.

[3] This also includes other licences awarded by the Oil and Gas Authority to allow companies to explore for hydrocarbons.

Figure 1a The areas of Wales subregion 2 where any of the 3 Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

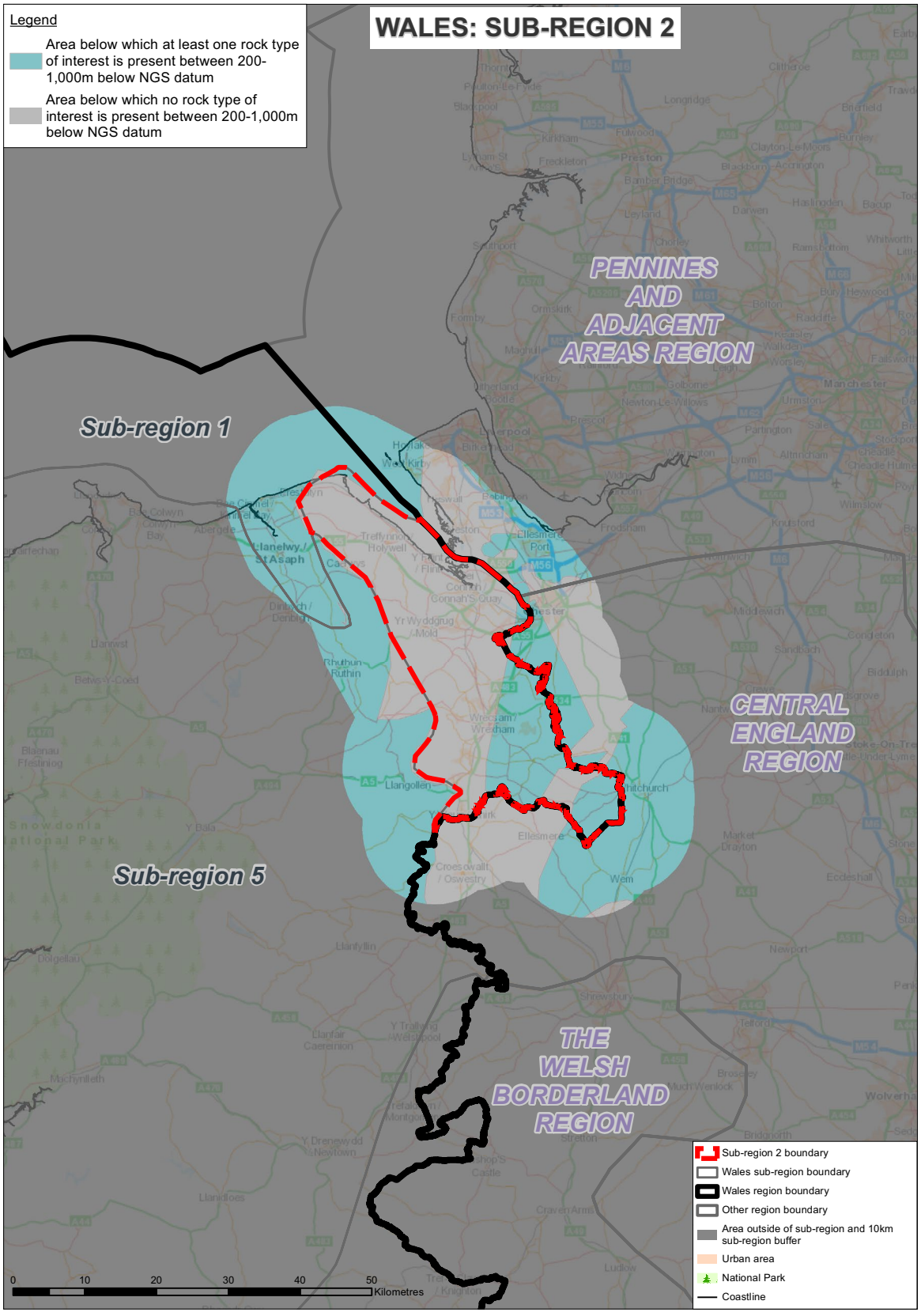


Figure 1b The areas of Wales subregion 2 where Lower Strength Sedimentary Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

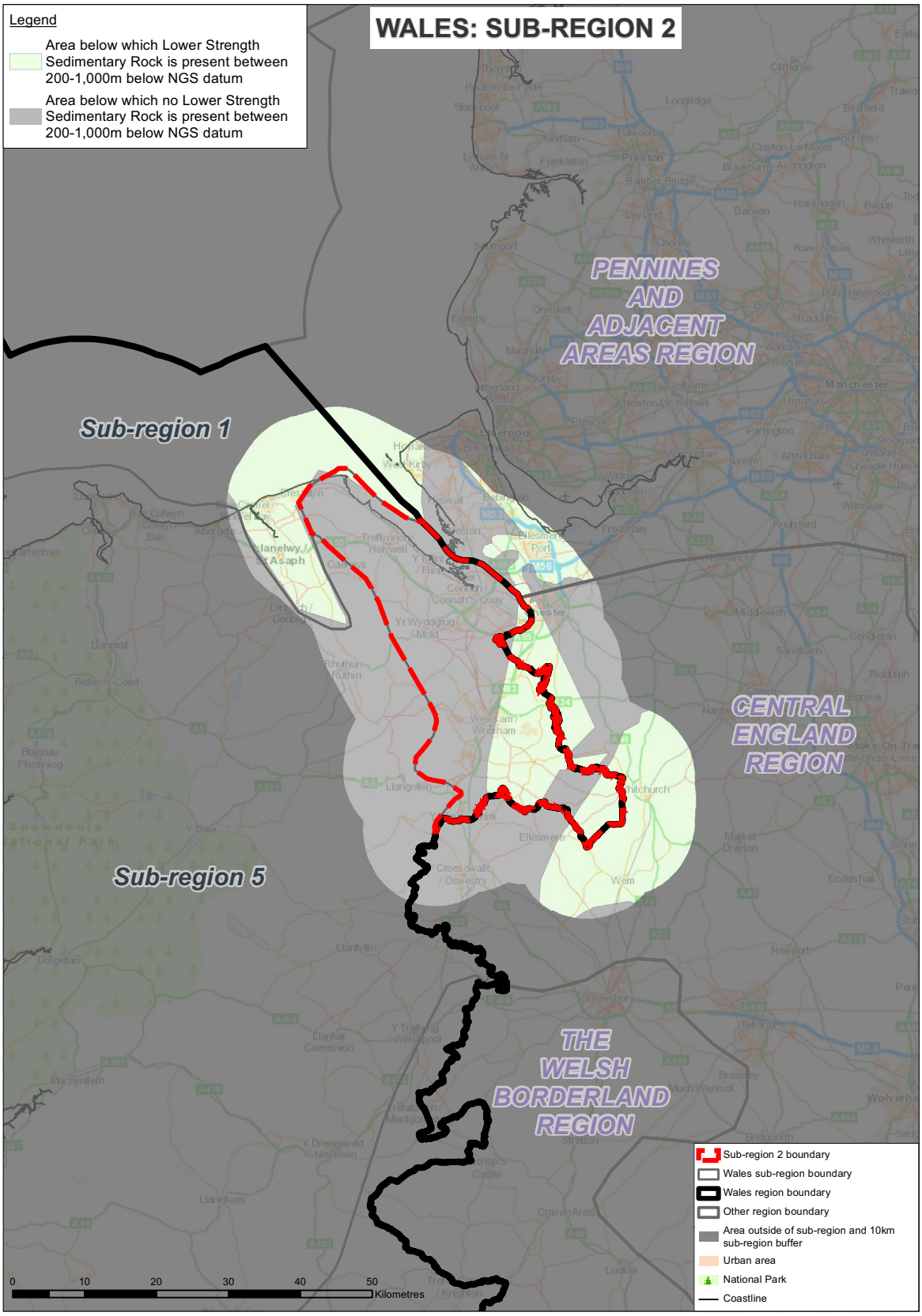


Figure 1c The areas of Wales subregion 2 where Evaporite Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

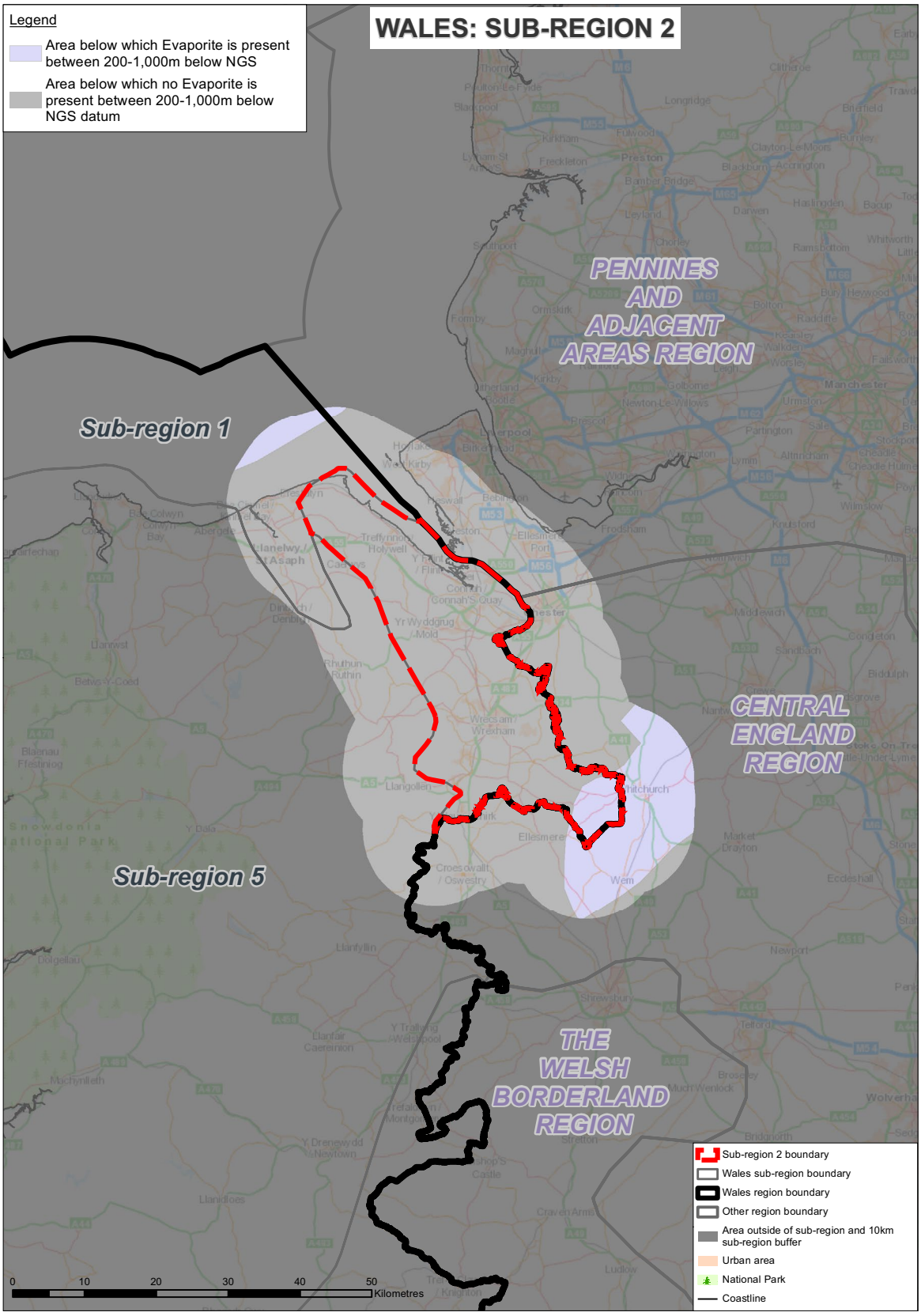


Figure 2 Major faults and areas of folding in Wales subregion 2.

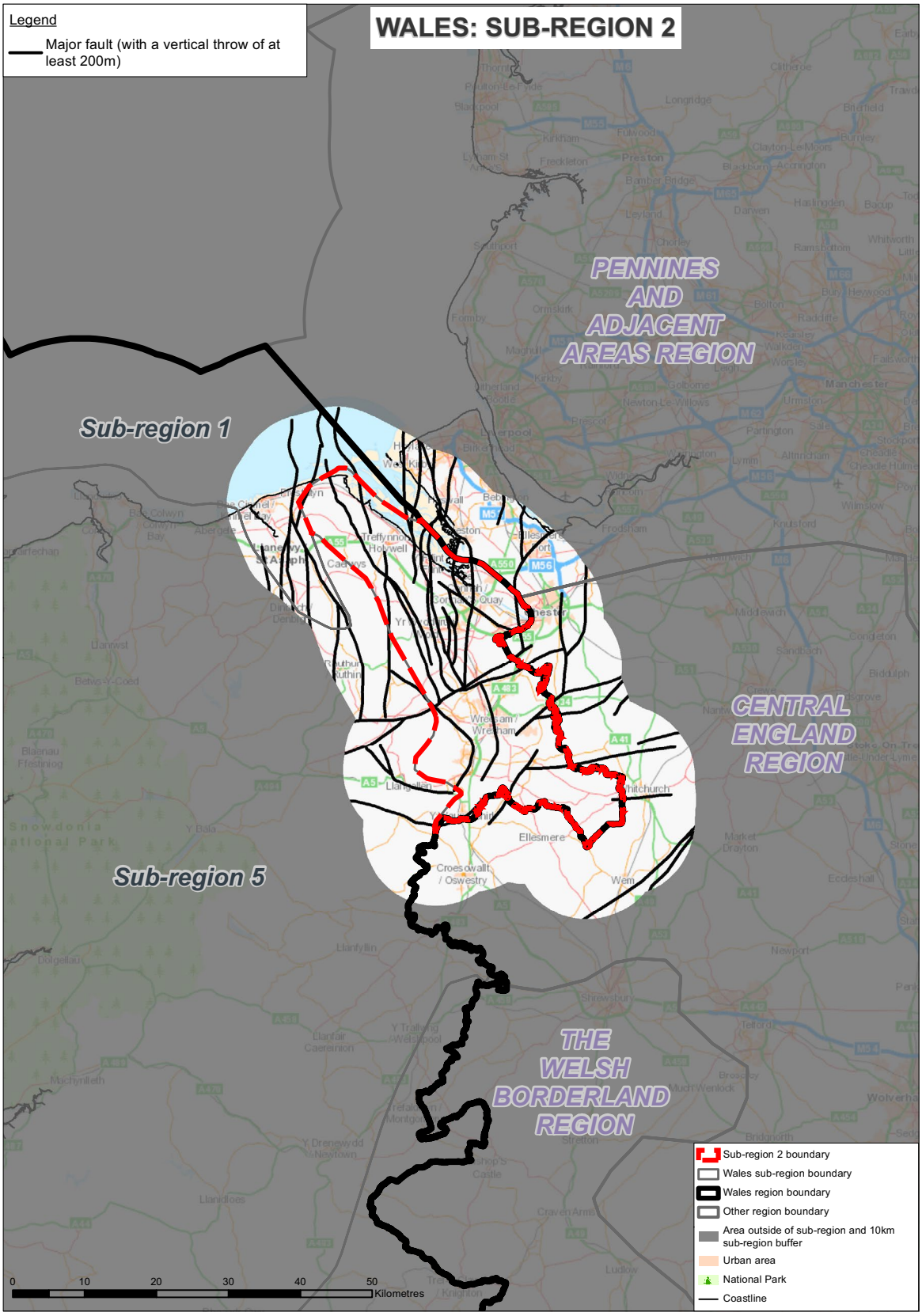


Figure 3 Areas in Wales subregion 2 with concentrations of deep exploration boreholes.

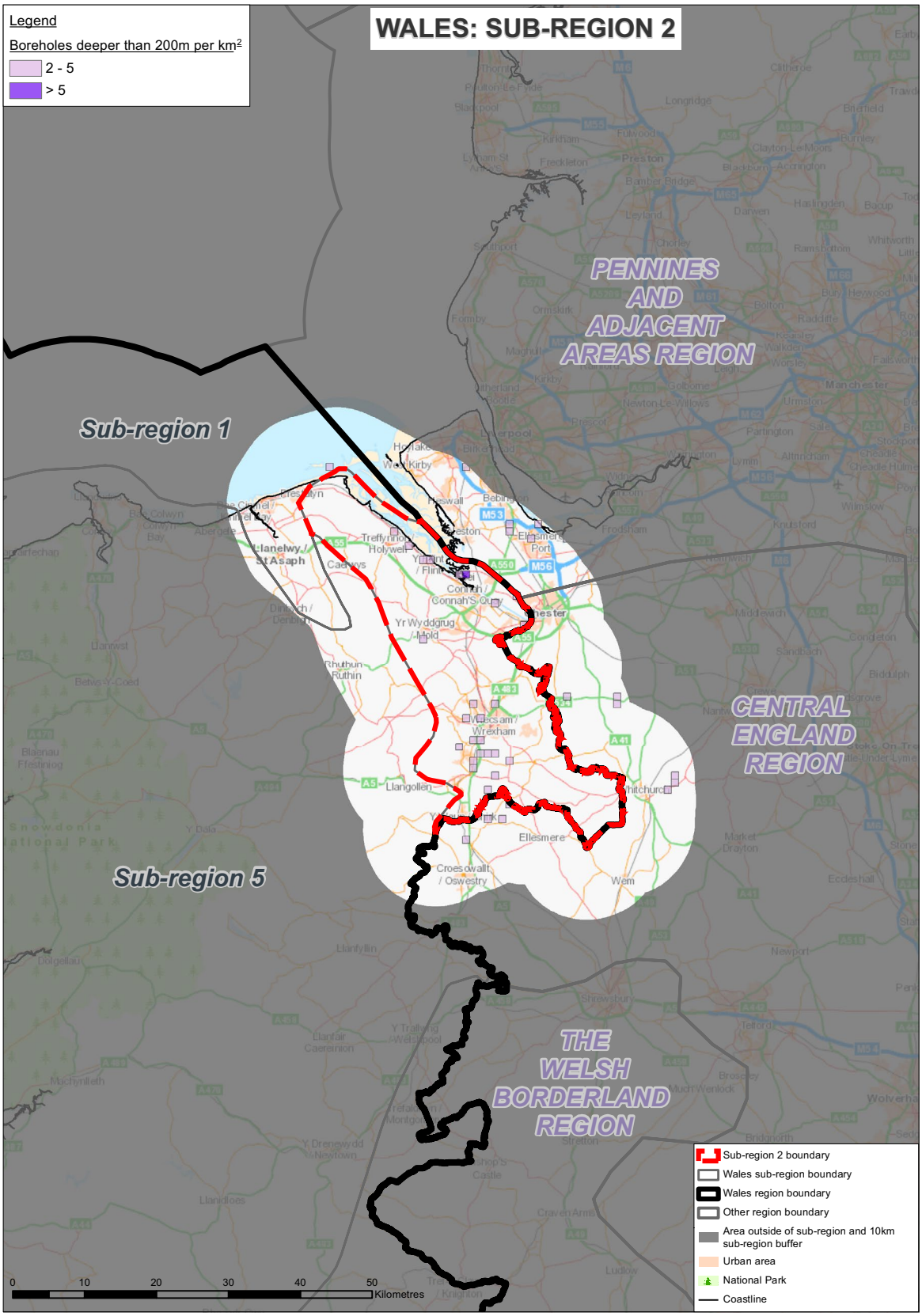


Figure 4a Areas of Wales subregion 2 with coal mines present below 100m and Coal Authority Licence Areas.

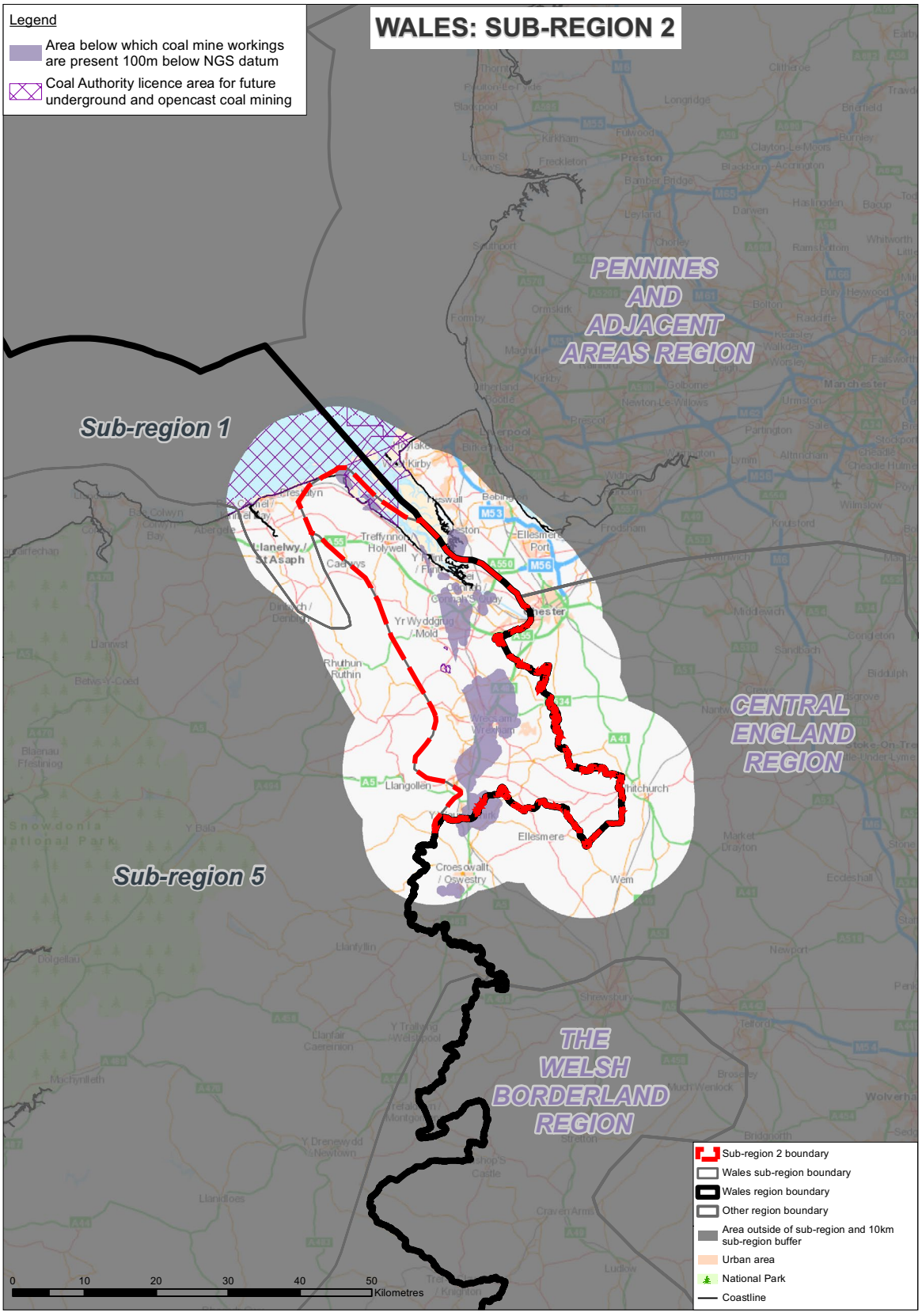


Figure 4b Areas of Wales subregion 2 with lead and zinc mines present below 100m.

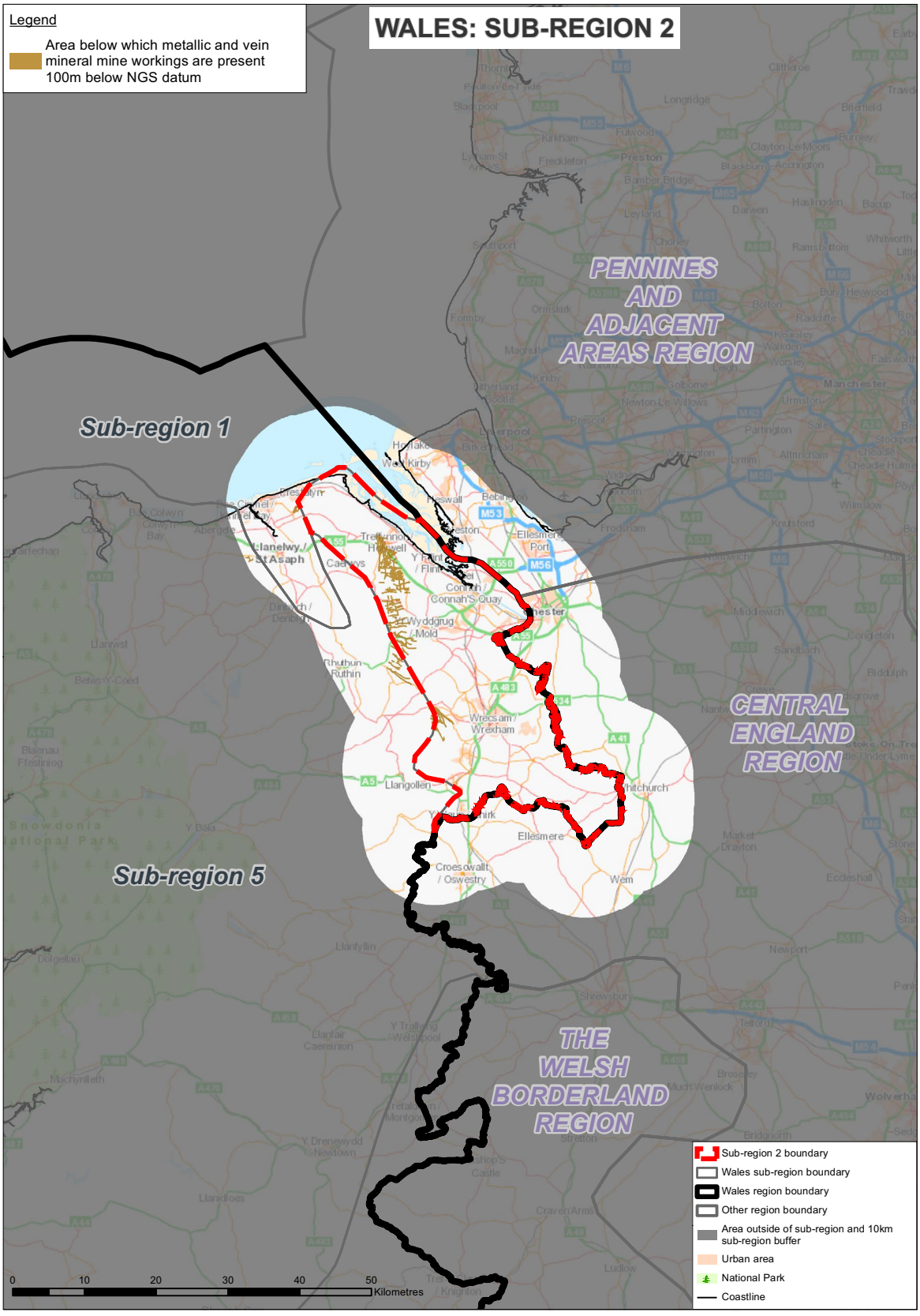


Figure 4c Areas of Wales subregion 2 with Petroleum Exploration and Development Licences.

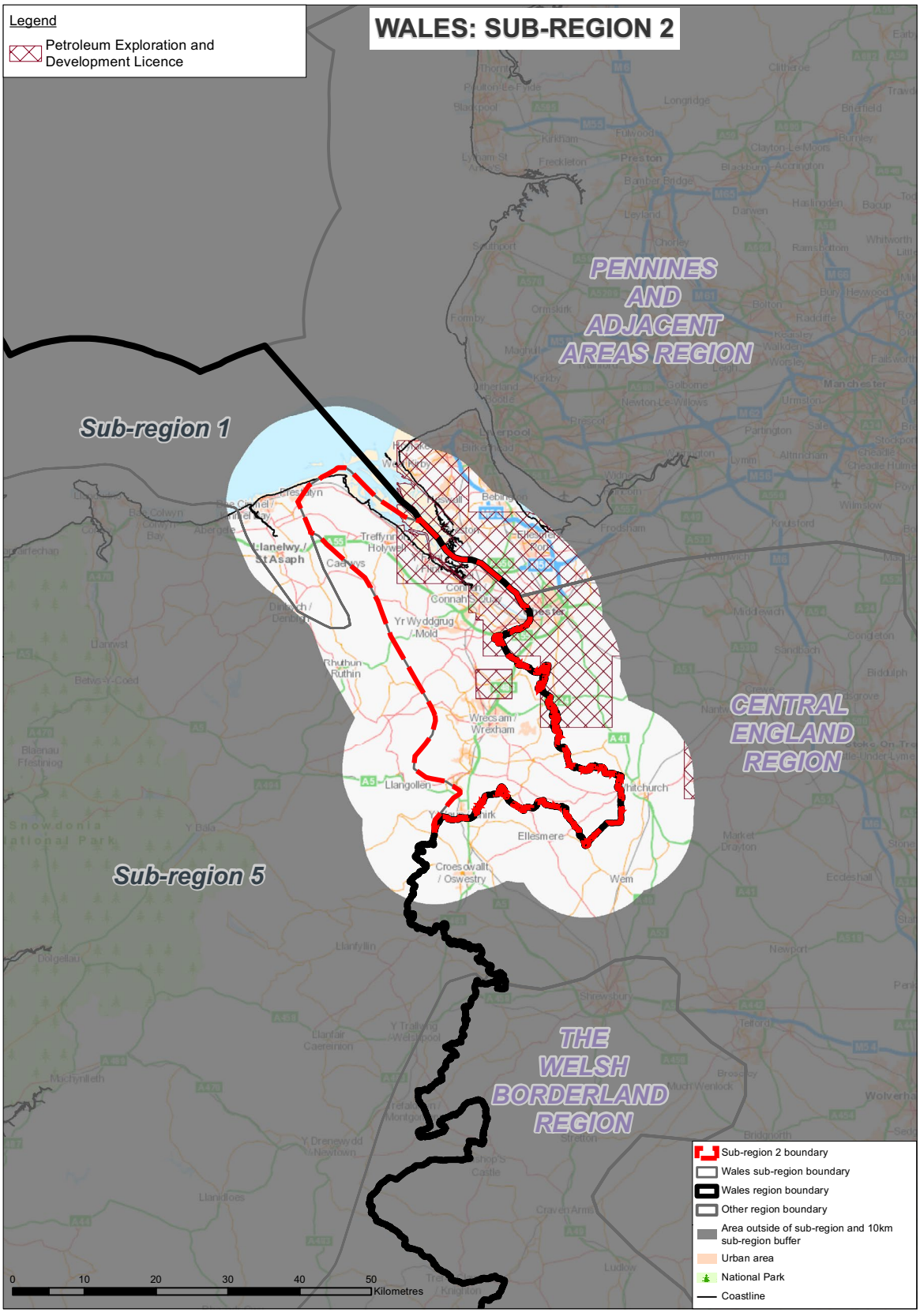
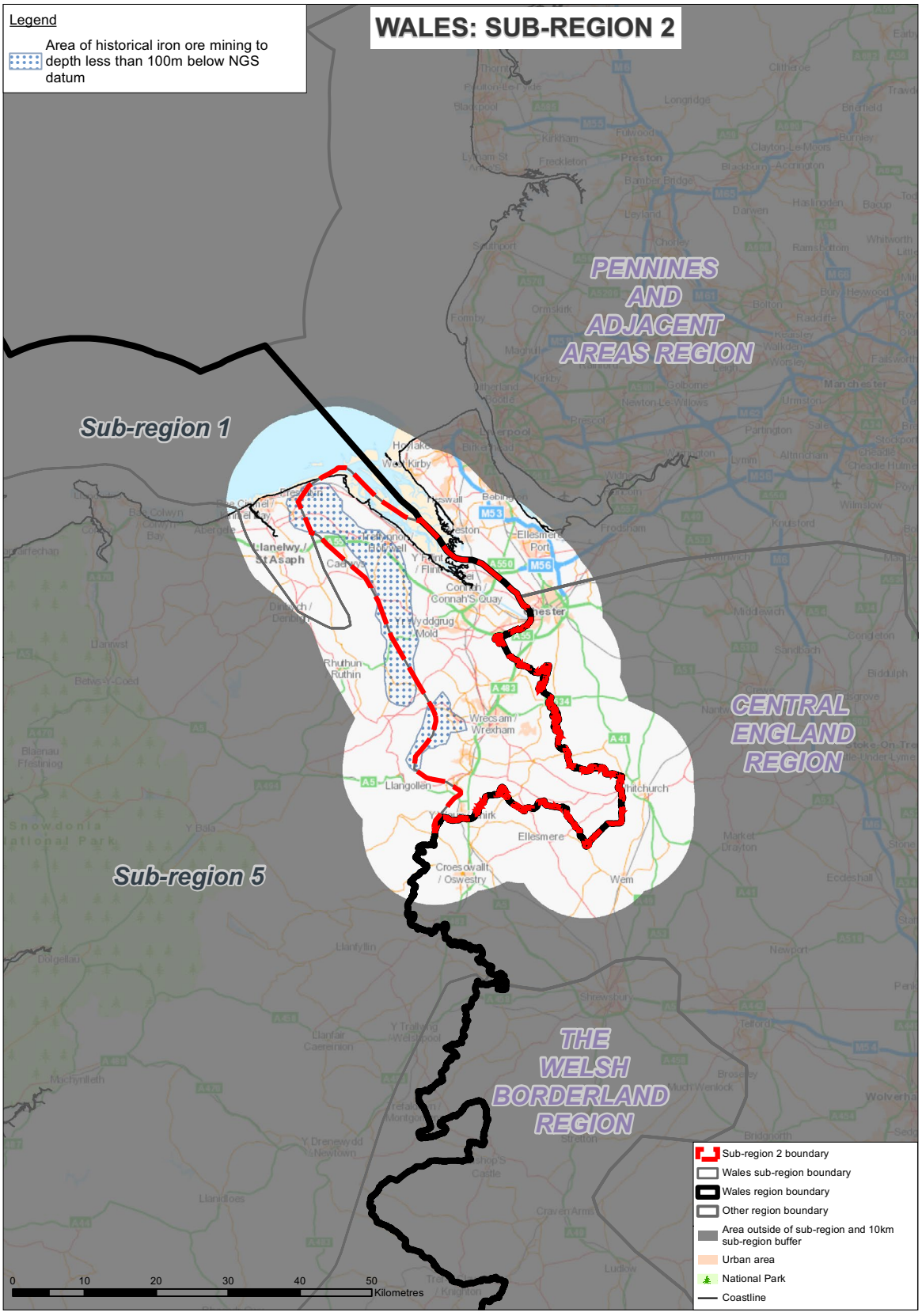


Figure 4d Areas of Wales subregion 2 with historical mining less than 100m deep.



Glossary

Adit
A horizontal entrance or passage into an underground mine.

Aquifers
Aquifers are rocks that contain freshwater in pores and/or fractures and whose porosity and permeability are sufficiently high to make the extraction of groundwater possible.

Coal bed methane
Natural gas trapped in underground coal seams and extracted using boreholes without the need for a coal mine.

Evaporite
The generic term for rock created by the evaporation of water from a salt-bearing solution, such as seawater, to form a solid crystalline structure. Gypsum, anhydrite and halite are all types of evaporite.

Fault
A fracture in the earth's crust across which the rock layers each side of it have been offset relative to one another.

Halite
A sodium chloride evaporite mineral that forms when salty water dissolves. Also known as rock salt, or just 'salt'.

Principal aquifers
An aquifer classified by the Environment Agency as: "rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage." They represent the most important aquifers in terms of water supply or base flow.

Radioactive Waste Management

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