

Wales
SUBREGION 1



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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 most of this subregion.

Given that most of this subregion is the [inshore](#) area which extends to 20km from the coast, rock can only be seen at the surface at a few locations in the Vale of Clwyd including man-made excavations such as quarries or road cuttings. A small number of [boreholes](#) and [geophysical investigations](#) give us an understanding of the geology at depth.

There are [clay-rich rock](#) layers under most of the subregion in which we may be able to site a GDF. There may also be layers of rock salt under the northern half of the subregion in which we may be able to site a facility. 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.

There are no known coal, oil, gas or metal [resources](#) in this subregion which means that it is unlikely that future generations may [disturb a facility](#).

Parts of this area, off the coast around Rhyl, 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 continue to monitor how this exploration programme progresses.

Introduction

The North Wales Coast and Vale of Clwyd subregion is located in the north-east of the region and is located largely in the [inshore](#) area which extends to 20km from the coast.

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. The [younger sedimentary rocks](#) contain potential Lower Strength Sedimentary Rock (LSSR) layers and [Evaporites](#). These are interbedded with sandstones, some of which are [aquifers](#) where they occur at shallow levels onshore. The major units with potential to host a GDF are the Mercia Mudstone Group, the Cumbrian Coast Group and the Warwickshire Group. There are few deep [boreholes](#) or [geophysical investigations](#) in this subregion, and so the composition of these rock units at depth is poorly known.



- The Mercia Mudstone Group of the southernmost East Irish Sea Basin is an extension of its better known occurrences in Cheshire and in the Lancashire Coastal Plain, as described in the Pennines and Central England regions. Most of the Mercia Mudstone Group lies above the depth range of interest, but the base was recorded at 291m depth in a well in Liverpool Bay. The Mercia Mudstone Group includes potential LSSR and Evaporite because it includes mudstone with some rock salt (**halite**). However, because it only occurs in the upper part of the depth range of interest, there may not be sufficient thicknesses of mudstone or rock salt to be considered as potential LSSR or Evaporite host rocks.
- The Cumbrian Coast Group also occurs off the coast in the East Irish Sea Basin, where it is separated from the overlying Mercia Mudstone Group by the Sherwood Sandstone Group. It contains sandstones, mudstones and **evaporite** layers, thickening away from the coast and therefore is a potential LSSR. In this subregion, there is likely to be a higher proportion of sandstones than further north and substantial beds of rock salt may not be present, and is therefore not considered to have particularly high potential as an **Evaporite** host rock.
- At the top of the Carboniferous sequence, the Warwickshire Group includes some beds of mudstone which may behave as LSSR. The Warwickshire Group occurs in the depth range of interest in the Vale of Clwyd; it is poorly exposed and there are few boreholes but it may be up to 300m thick at the southern margin of the subregion. However, the mudstones are interbedded with siltstones and sandstones on a metre scale and so may not form a sufficiently thick and uniform body to act as a host rock.

Subsurface engineering in mudstones can be challenging because they are relatively weak. Where these mudstones occur in the lower part of the depth range of interest the constructability of a GDF would need to be considered during the siting process.

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

The **younger sedimentary** cover in this subregion is **faulted** but not significantly **folded** (Figure 2). Like the East Irish Sea basin to the north and the Cheshire basin to the east, the Vale of Clwyd is an ancient rift basin bounded along its eastern margin by a major north-south **fault** system that juxtaposes very different rocks against each other. **Faults may act as barriers to or pathways** for groundwater movement, depending upon their characteristics, and these would need to be considered during the siting of a GDF ¹.

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.



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 in the onshore part of the Vale of Clwyd. There are 2 rock units in this subregion which can act as [principal aquifers](#) where they occur within 400m of the surface onshore: the Sherwood Sandstone Group (combined with the sandstones of the Appleby and Cumbrian Coast Group in places) and the Carboniferous Limestone aquifer. Where they occur off the coast the water present in the pores of rocks beneath the seabed is saltwater rather than fresh and they are not therefore suitable for use as aquifers. However, where the Sherwood Sandstone Group and Carboniferous Limestone aquifer occur onshore in the Vale of Clwyd they are important aquifers used for public water supply, industry and agriculture.

There is no information about deep groundwater in this subregion. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK². It is likely that the [LSSR](#) layers separate groundwater in the deeper sandstones from the seabed off the coast and act as a [barrier to vertical groundwater](#) movement between aquifers onshore, even where they are not thick enough to host a GDF.

There are no concentrations of [deep exploration boreholes](#) in this subregion, nor are there [thermal springs](#) to suggest rapid flow of deep groundwater to the surface.

Resources

There are no known [resources](#) in this subregion and therefore the [likelihood of future human intrusion](#) is considered to be low.

There are [Coal Authority Licence Areas](#) off the coast from Rhyl ([Figure 3a](#)) and two very small areas on the northern edge of the [inshore](#) part of the subregion with [Oil and Gas Authority licenses](#) ([Figure 3b](#)) allowing companies to explore for these resources. It is not known whether coal, oil or gas in these licence areas will be exploited, but they would need to be considered during the siting process.

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.

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



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

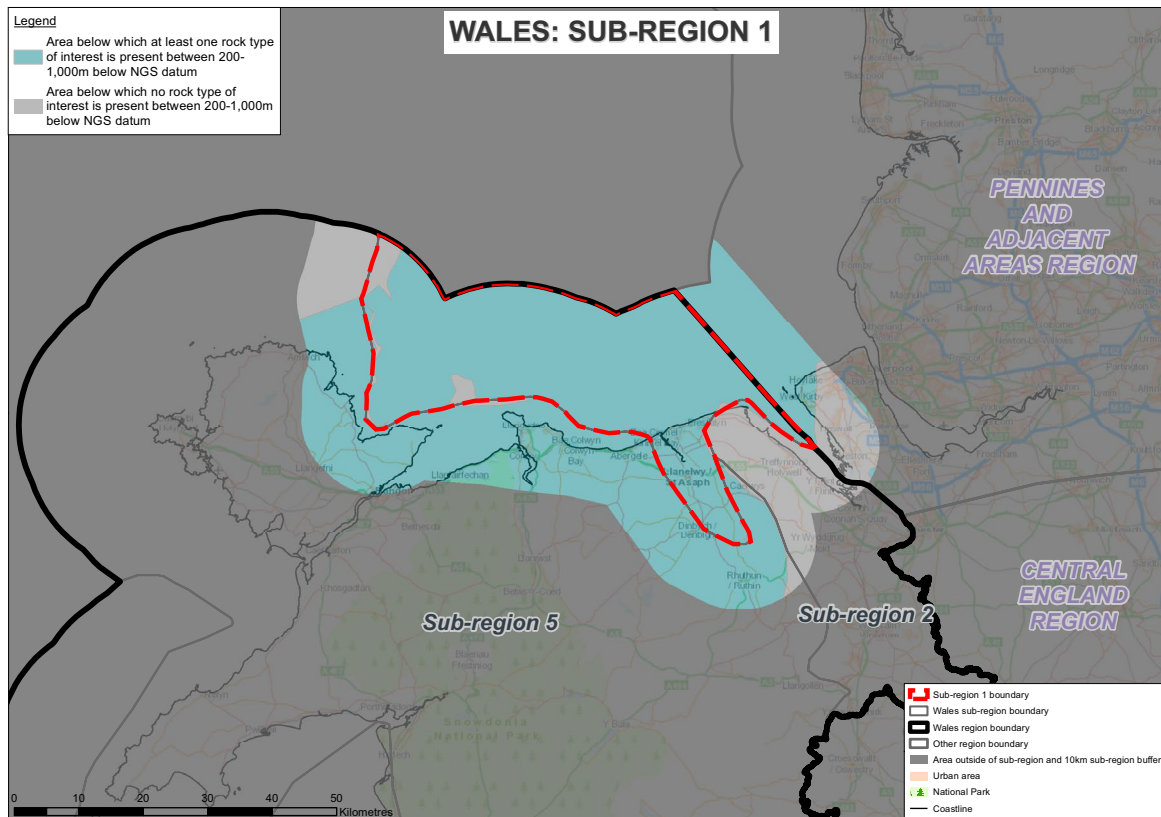


Figure 1b The areas of Wales subregion 1 where Lower Strength Sedimentary Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

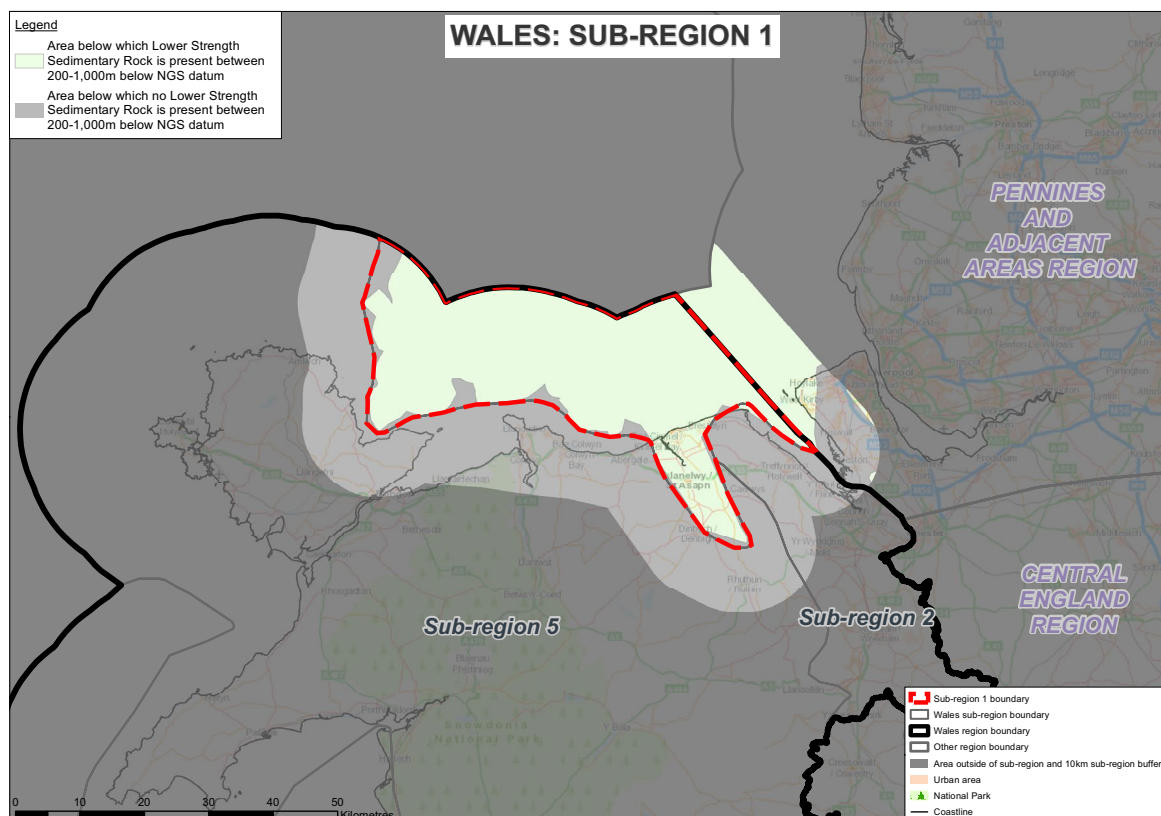




Figure 1c The areas of Wales subregion 1 where Evaporite Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

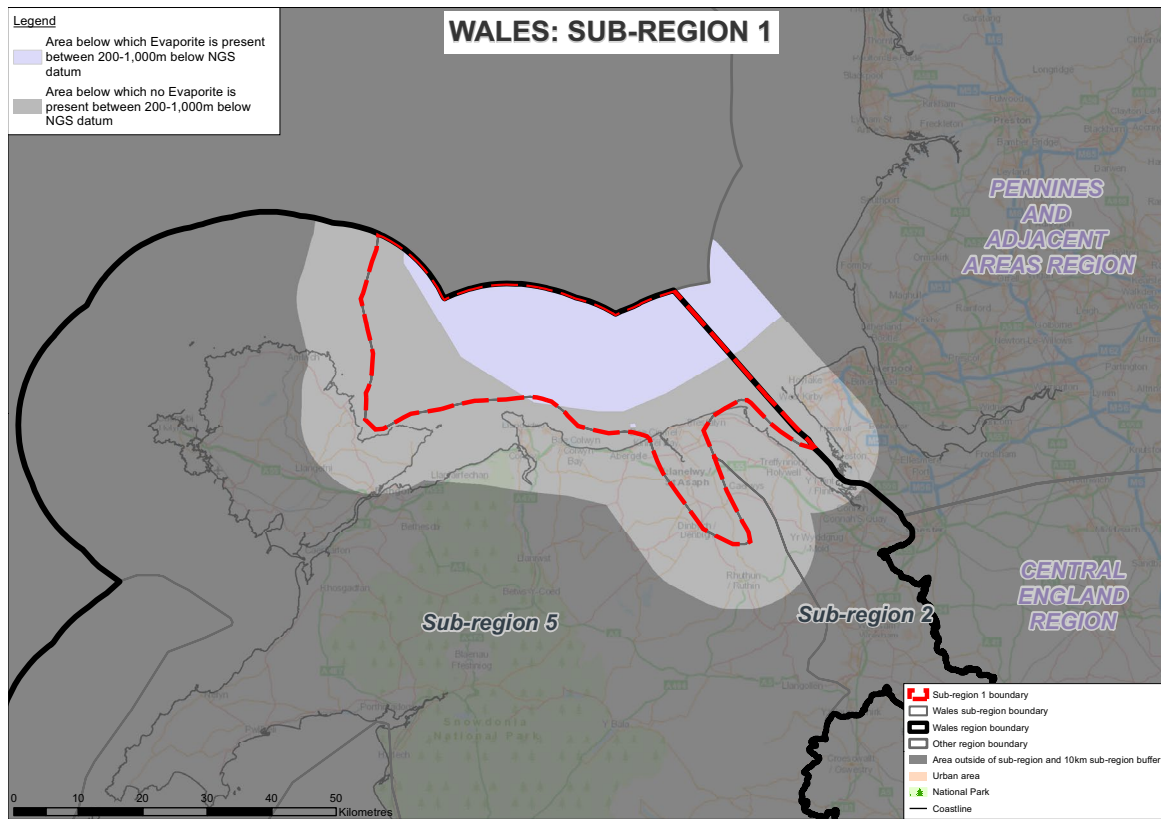


Figure 2 Major faults and areas of folding in Wales subregion 1.

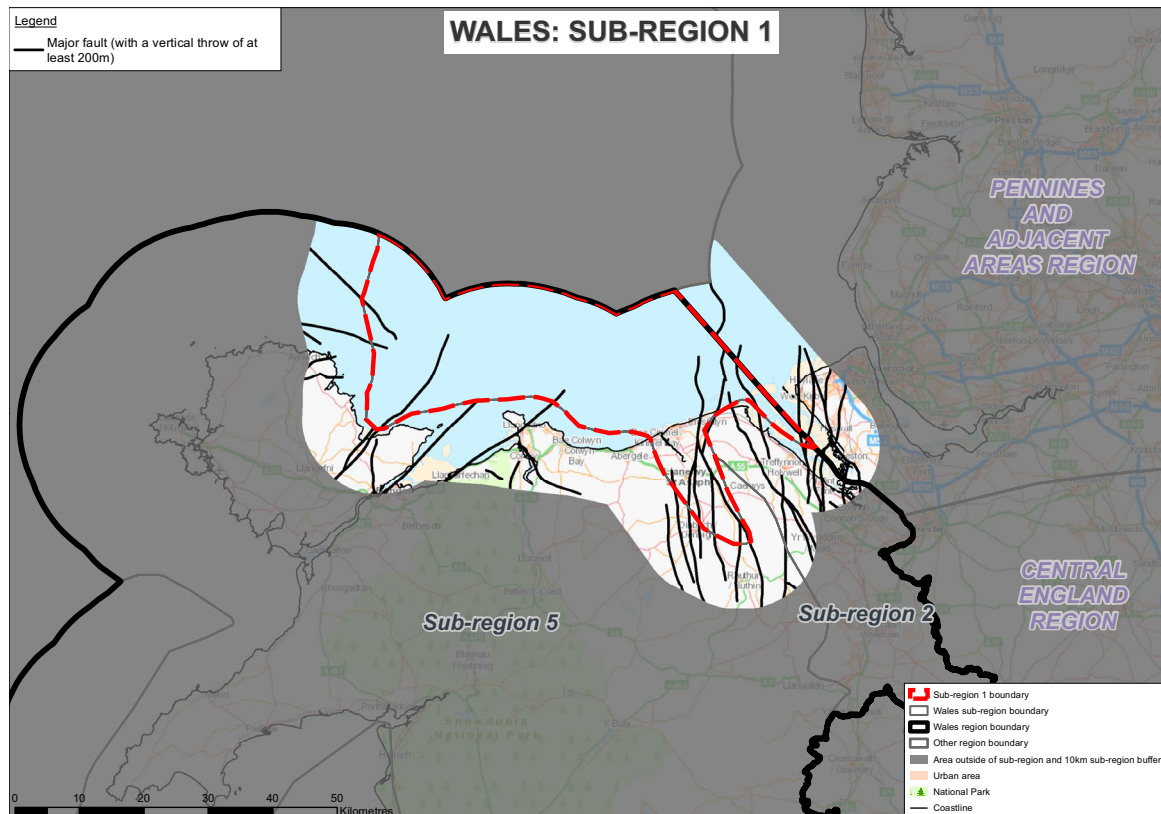




Figure 3a Areas of the Wales subregion 1 with Coal Authority Licence Areas.

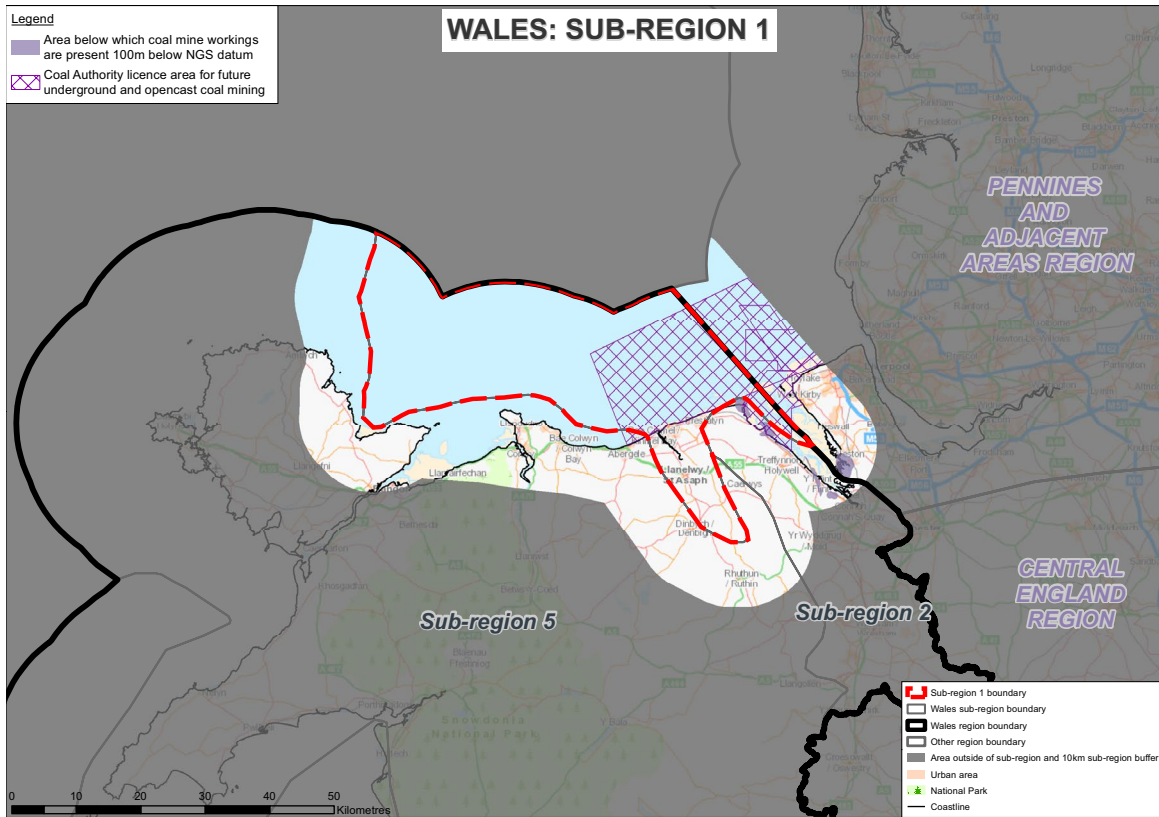
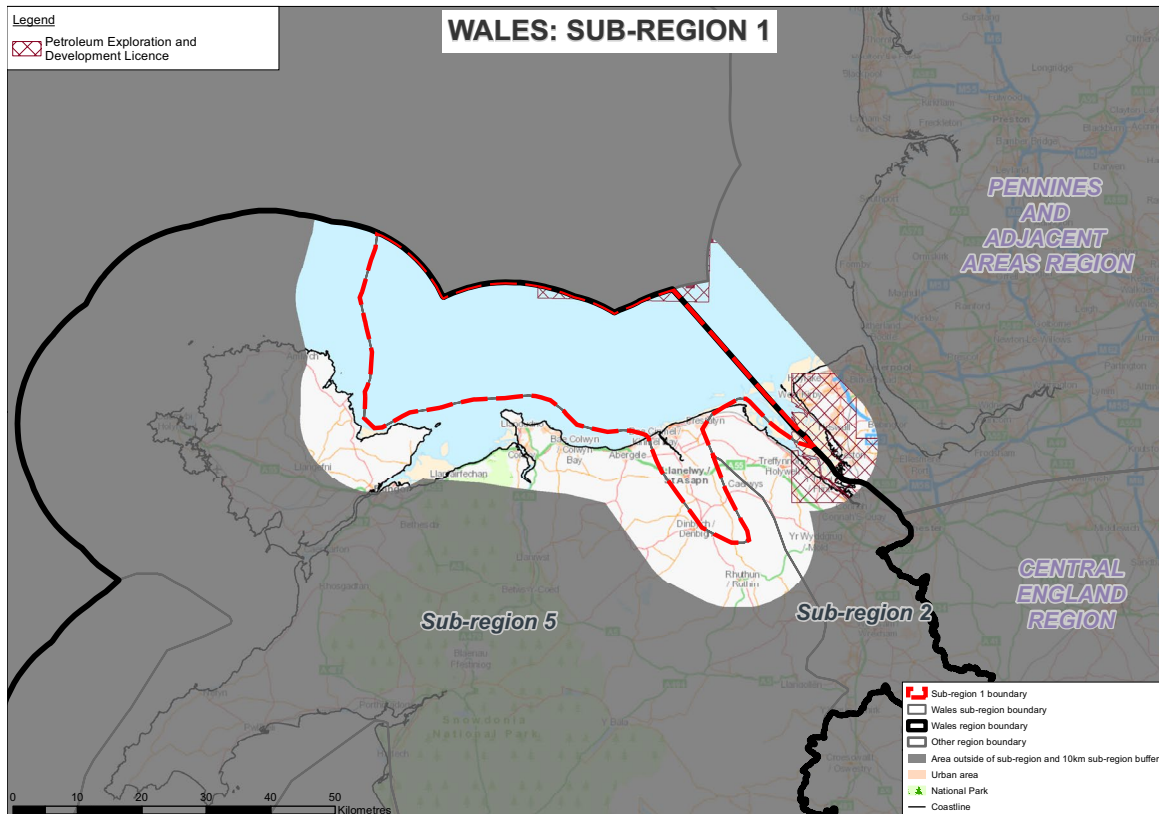


Figure 3b Areas of Wales subregion 1 with Petroleum Exploration and Development Licences.





Glossary

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.

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.



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