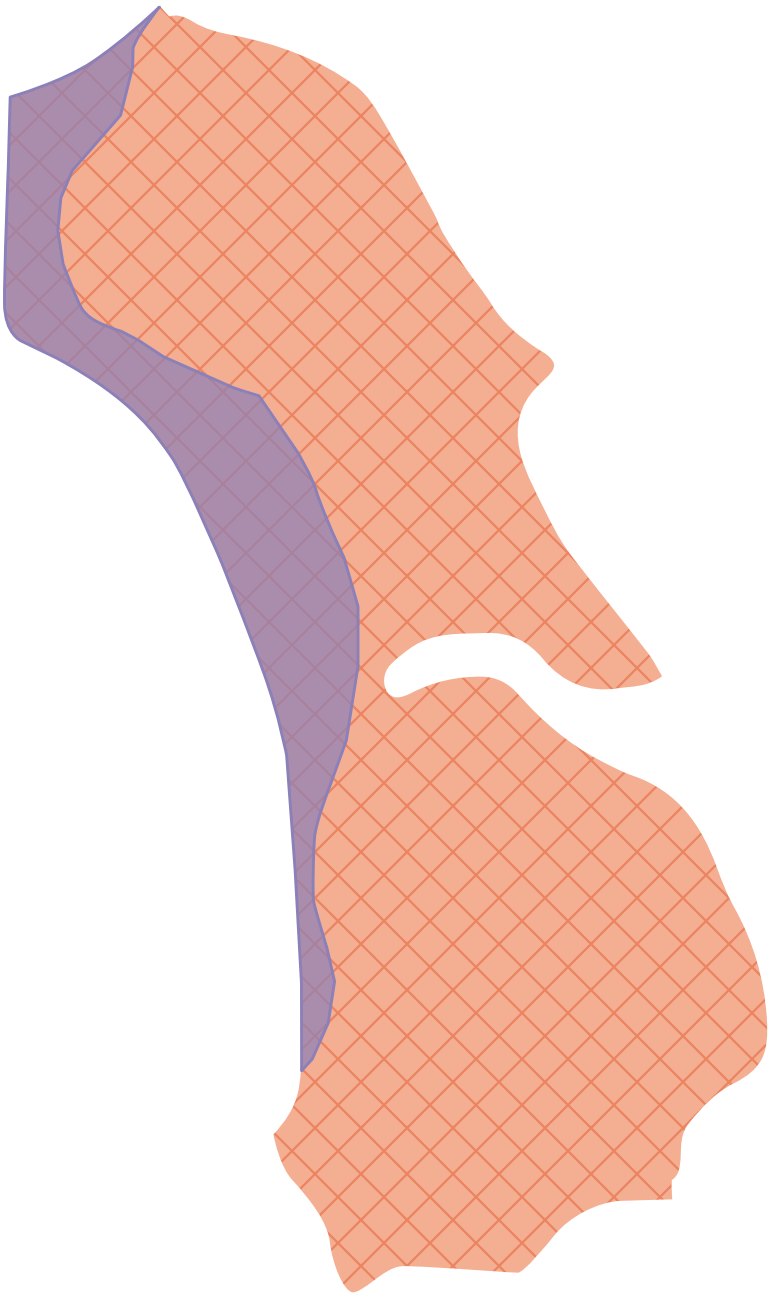
Radioactive Waste Management



Eastern England

SUBREGION 4

Contents

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 some of this subregion.

Although rock cannot generally be seen at the surface in this subregion except in man-made excavations such as quarries or road cuttings, deep boreholes and geophysical investigations, in the coalfield area south of York in particular, give us an understanding of the rocks present and their distribution.

The only rocks in which it is likely that a GDF could be sited are layers of rock salt to the east of York and Selby. The few boreholes which have been drilled through these layers suggest that they may be too thin and we would need to do more work to find out whether they have suitable properties and thicknesses.

Some of the subregion near Selby has been mined for coal to depths below 100m and there are known oil and gas resources to the west of Gainsborough. In these areas the drilling and 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 this area, much of this subregion south of the River Humber and an area to the north and east of York, 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.

Introduction

This subregion comprises the western edge of the Eastern England region from Middlesbrough in the north to Newark in the south.

Rock type

Figure 1 shows where in the subregion there are likely to be Evaporites within the depth range of interest. There are no Higher Strength Rocks (HSR) or Lower Strength Sedimentary Rocks (LSSR) in the subregion. The geology of this subregion comprises a well-known and predictable sequence of sedimentary rocks throughout the depth range of interest comprising sandstones, limestones, shales, Coal Measures and evaporites. The highest evaporite cycle in the Zechstein Group, the Sneaton Halite Formation, is likely to occur at the bottom of the depth range of interest in the area to the east of York (Figure 1). Deep boreholes have shown that this formation contains rock salt (halite), potash, anhydrite and mudstone, although there are not enough deep boreholes in this area to know whether the size and shape of the rock salt bodies would be suitable for an Evaporite host rock.

A summary of the geological attributes of the Eastern England region 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 is an area of major faulting between York and Thirsk (Figure 2) that would need to be considered in the siting of a GDF in this subregion, but most of the rocks in this subregion have not been significantly affected by folding. 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. Two principal aquifers are present within 400m of the surface in this subregion: the Sherwood Sandstone Group and the Magnesian Limestone of the Zechstein Group. The Sherwood Sandstone Group is the shallower of the two, occurring at the surface over most of the subregion, and it is widely used for public water supply, agriculture and industry. Two other rock types, which are principal aquifers in other regions where they occur at shallow depths, also occur below this subregion. There are no thick clay-rich layers in this subregion to act as barriers to vertical flow between the various more permeable units described here. Despite this, groundwater in the deeper units is reported to be older and more saline than fresh groundwater in the shallower units. This suggests that there may be hydraulic separation between them. Groundwater from depths greater than 400m is unlikely to be suitable as drinking water anywhere in the UK[2].

In some areas in the south of the subregion deep exploration boreholes may influence the connectivity between shallow and deep groundwater which would 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.

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

Resources

There are abandoned deep coal mines near Selby (Figure 4a) and active oil and gas sites to the west of Gainsborough (Figure 4b). In these areas the mining and drilling 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. These known resources would be taken into account in the siting of a GDF.

Petroleum Exploration and Development Licences[3] are currently held for much of this subregion south of the River Humber, an area to the north and east of York and a small area to the south of Middlesbrough (Figure 4b). It is not known whether oil or gas in these licence areas will be exploited but they would need to be considered during the siting process.

Areas of historic iron ore mining are also shown in Figure 4c but are not relevant to the siting of a GDF as they 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 1 The areas of the Eastern England subregion 4 where Evaporite Rock Types of Interest are present between 200 and 1,000 m below NGS datum.

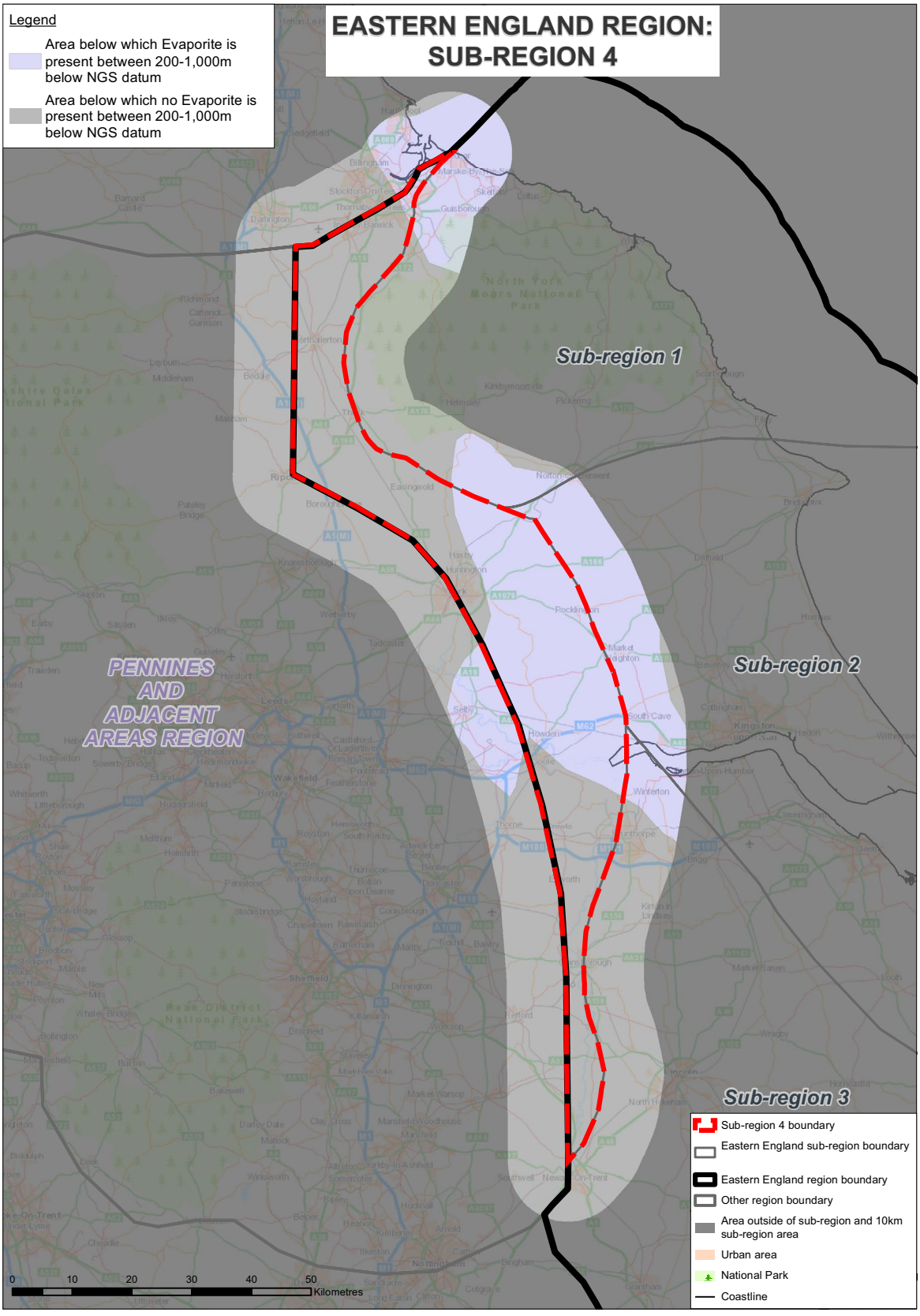


Figure 2 Location of major faults in the Eastern England subregion 4.

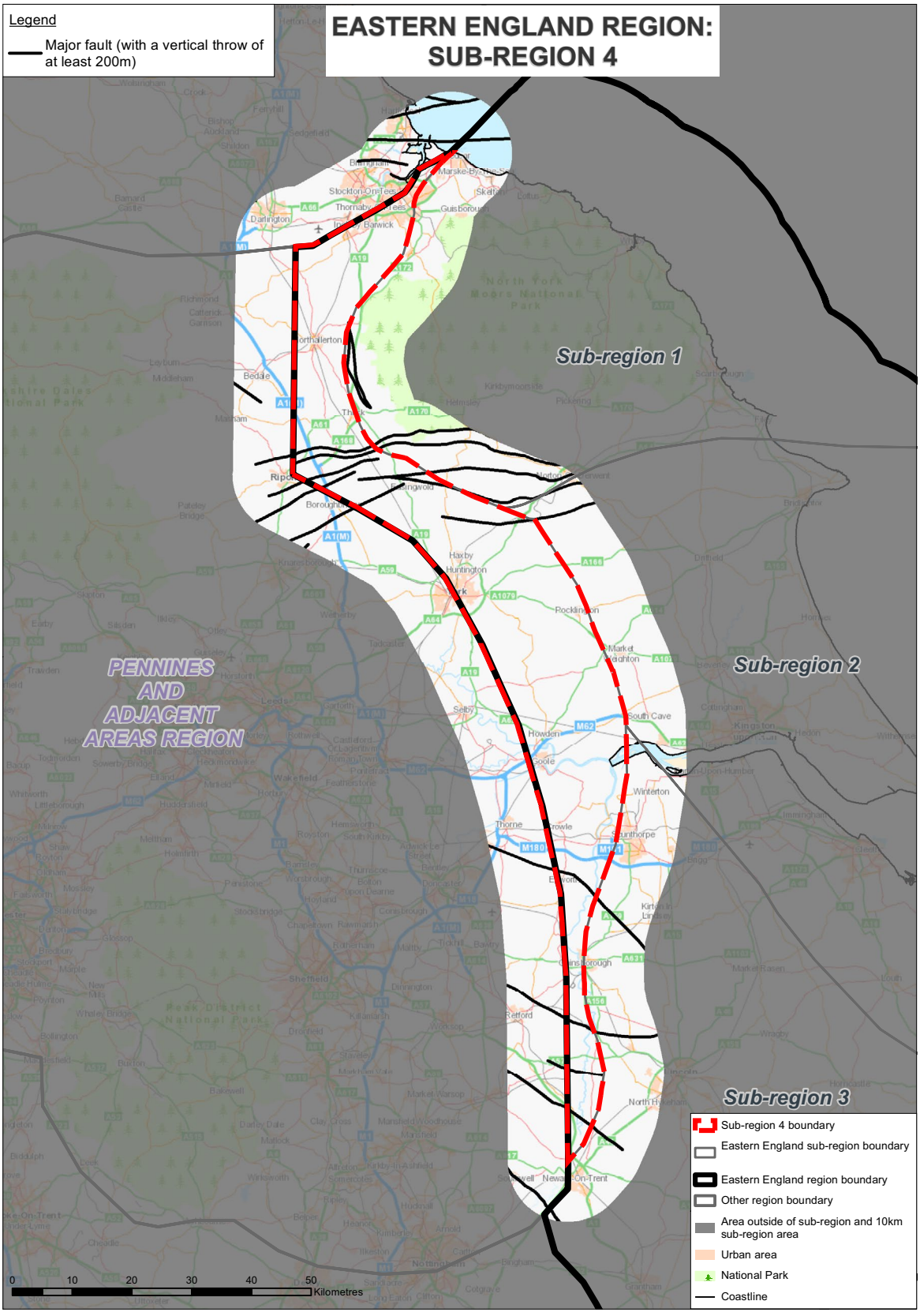


Figure 3 Areas in the Eastern England subregion 4 with concentrations of deep exploration boreholes.

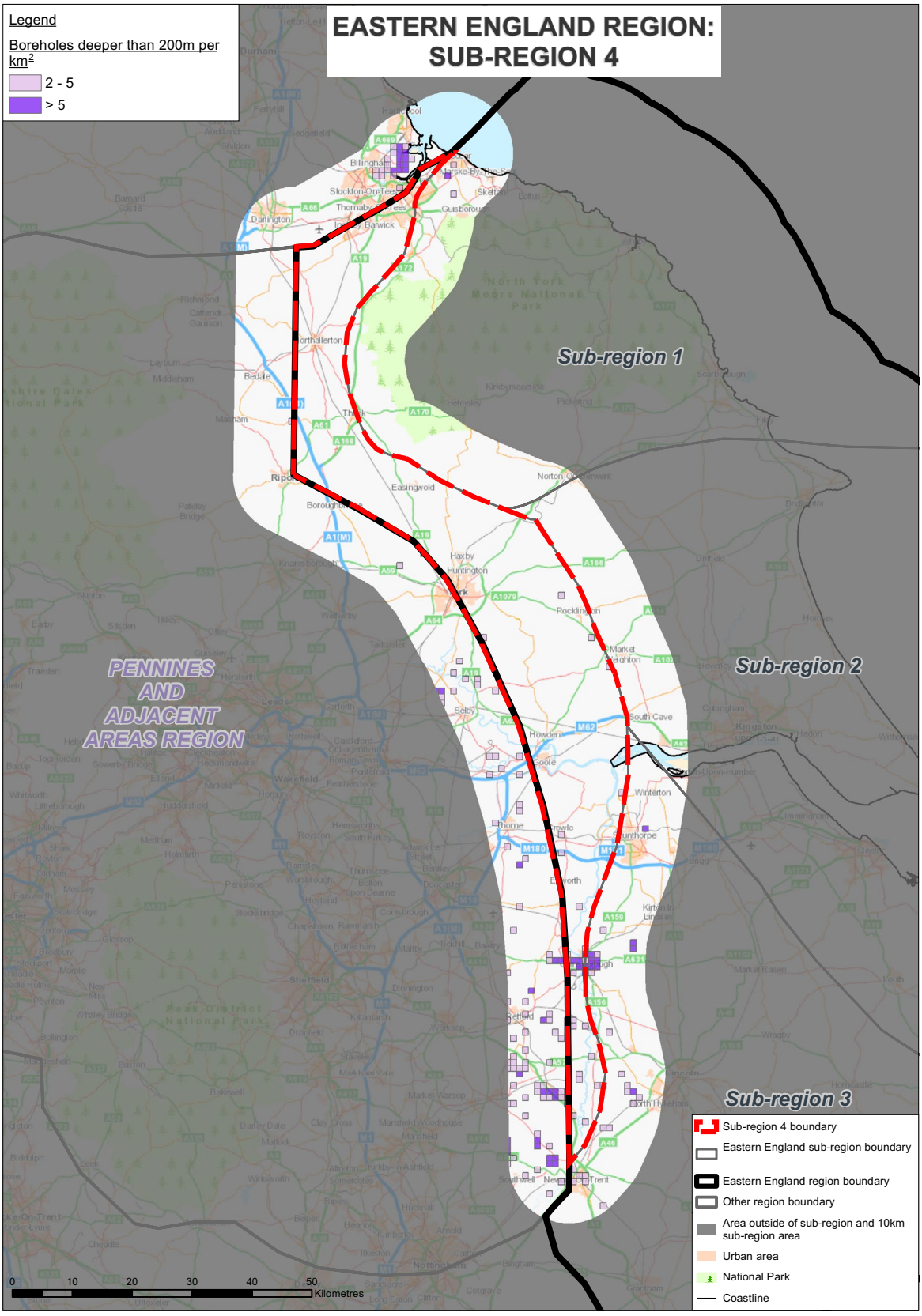


Figure 4a Areas of the Eastern England subregion 4 with coal mines present below 100m and Coal Authority Licence Areas.

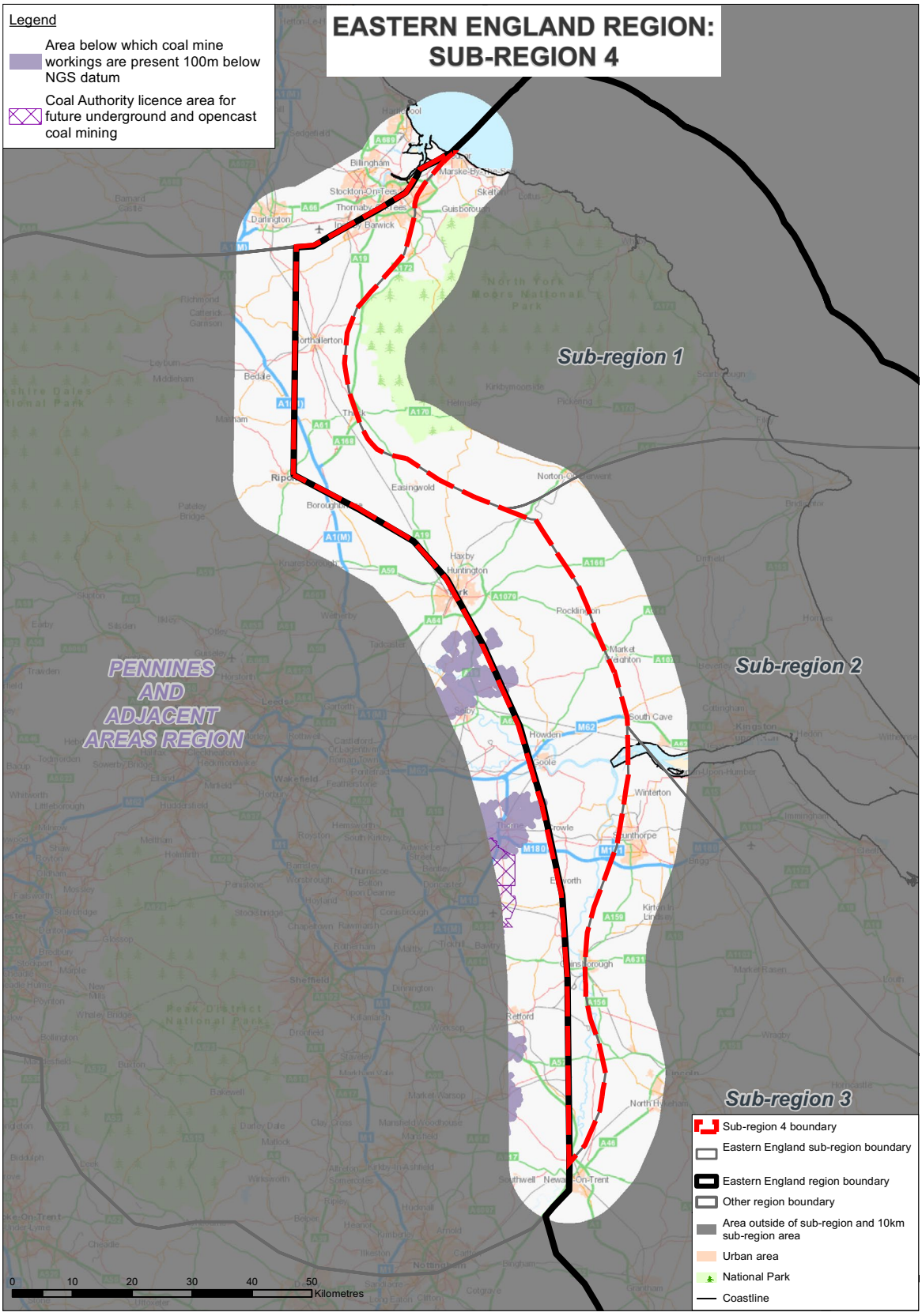


Figure 4b Areas of the Eastern England subregion 4 with oil and gas fields and Petroleum Exploration and Development Licences.

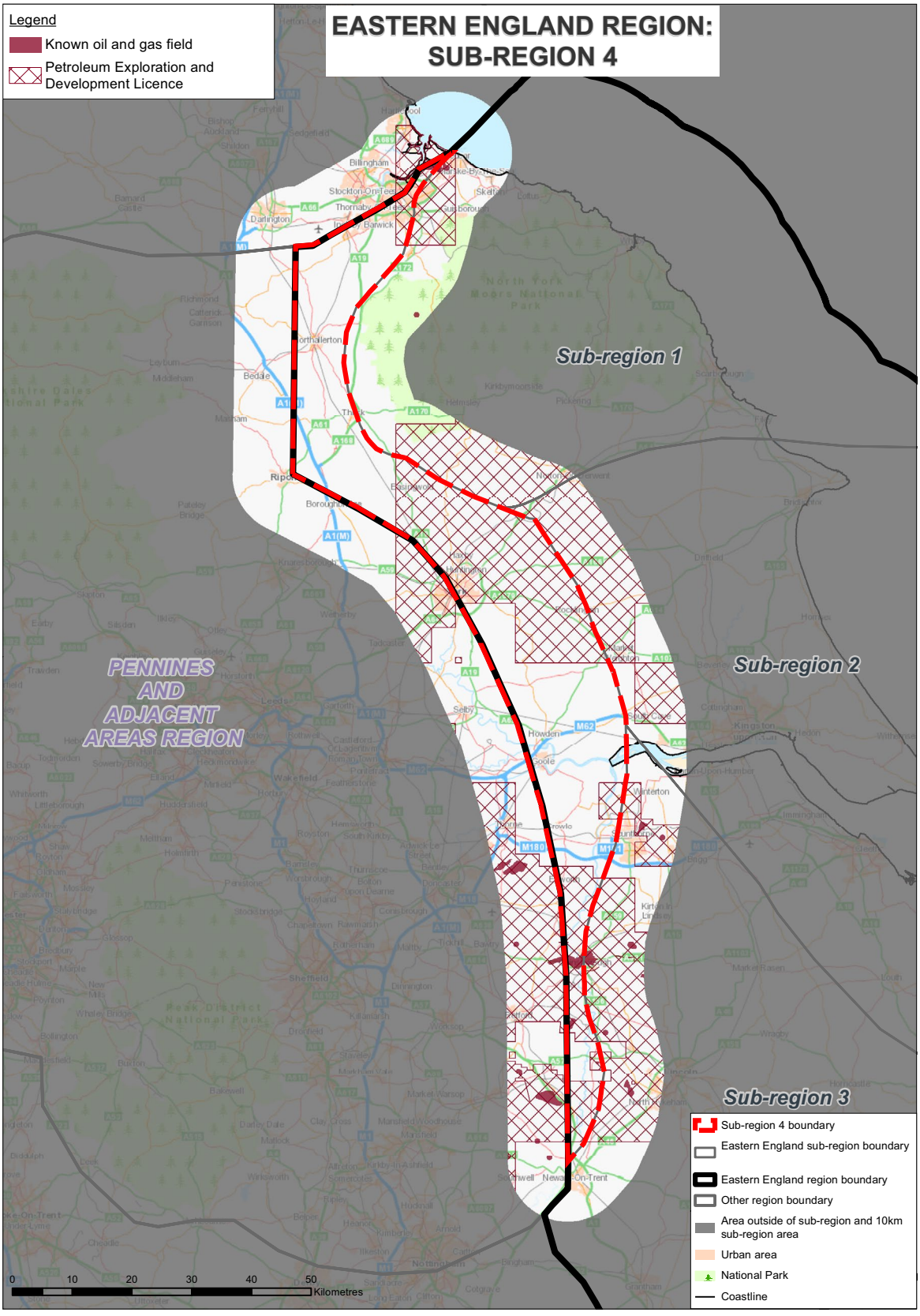
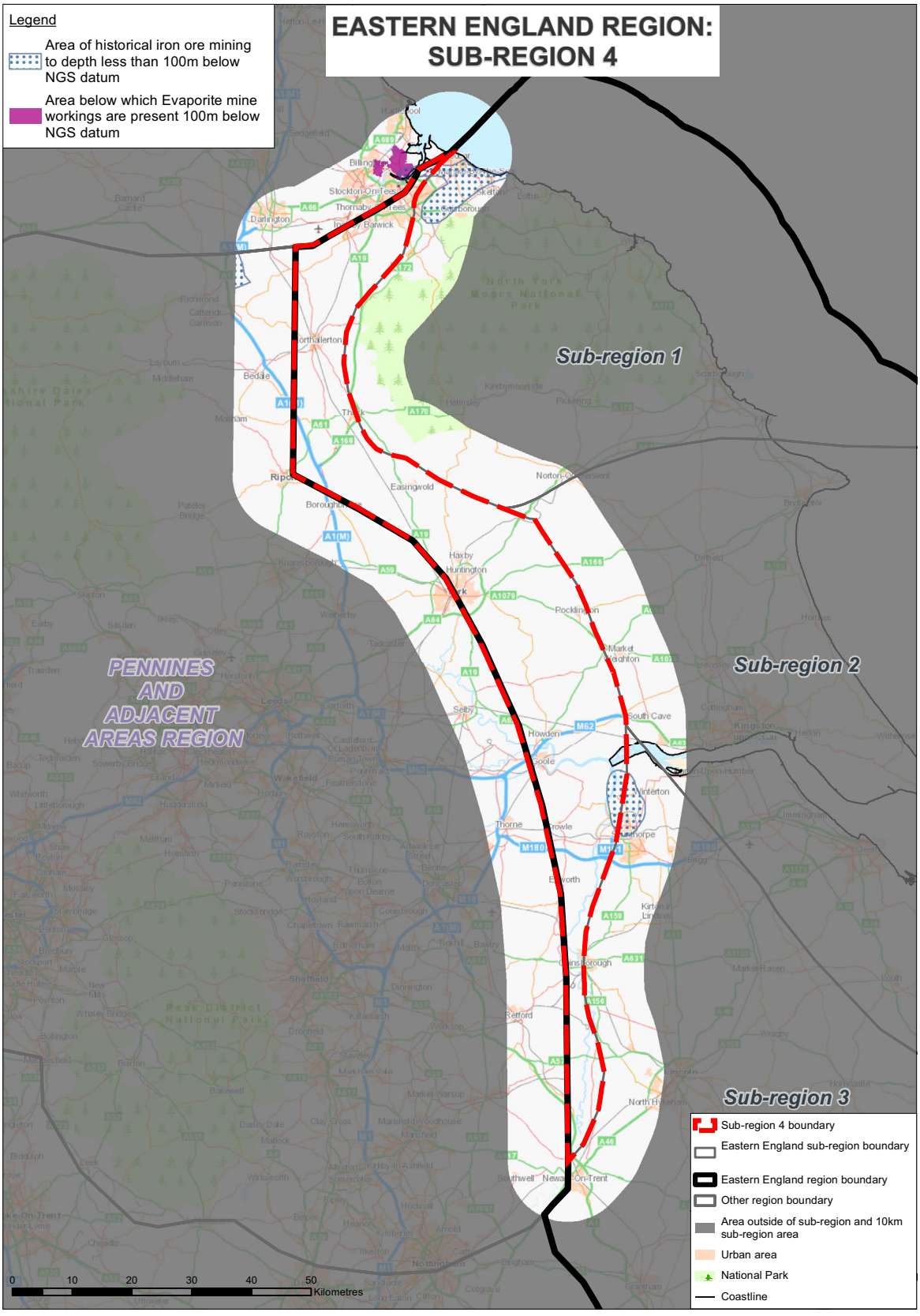


Figure 4c Areas of the Eastern England subregion 4 with historical iron ore mines less than 100m deep.



Glossary

Anhydrite
A calcium sulphate mineral that forms from the evaporation of salty seas. It contains no water and occurs at greater depths and higher temperatures than gypsum.

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.

Evaporite cycle
An evaporite cycle is a sequence of rocks left behind after a body of salty water has evaporated Often this cycle is repeated numerous times within a sequence.

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

Potash
The collective term for potassium-bearing evaporite minerals. Potash is mined in the UK for use in fertilizer.

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.

Saline
Containing salt (e.g. seawater is saline).

Sedimentary
A type of rock resulting from the consolidation of material that has accumulated in layers to form gravel, sandstone, mudstone and limestone. The layers may be built up by movement from erosion (e.g. by rivers, the sea or wind) or by chemical precipitation. Generally, the material that accumulates has originated from the weathering of other rocks. Sedimentary rocks constitute one of the three main classes of rocks identified by geologists, the others being igneous and metamorphic.

Shale
A very fine-grained and strongly layered sedimentary rock in which the grains are not visible to the naked eye. Consists of clay grains and tiny fragments of other minerals such as quartz and mica.

Radioactive Waste Management

Building 587
Curie Avenue
Harwell Oxford
Didcot OX11 0RH

T 03000 660100
www.gov.uk/rwm