TownRock Energy

The Heat Beneath Your Feet: Geothermal Heat Resources in UK Political Constituencies

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1. Executive Summary

Geothermal energy is playing a pivotal role in decarbonising heat around the world, and the UK sector is primed to be switched on by the next Labour government who, in their manifesto, have committed to achieve Clean Power by 2030 and initiate a Clean Homes Plan.

Geothermal energy (heat sourced from beneath the ground) represents a vast resource for low carbon heating and cooling for homes and businesses across the UK on our path to Net Zero. At present, **heating in the UK currently accounts for 40% of UK carbon emissions**. As such, the provision of a steady, constant heat source from within the Earth represents a huge opportunity to decarbonise space heating in the UK. **A geothermal system typically has a carbon footprint 90% lower than a conventional gas boiler** of comparable size.

While the UK may not have geological conditions akin to Iceland to allow the generation of electricity from steam commonly associated with the term "geothermal energy", there is a vast underdeveloped resource available to provide steady heating to millions of homes and businesses across the country.

TownRock Energy (TRE), the industry leader in UK Geothermal heating, is pleased to present this selection of maps showing the geothermal resources across various Westminster constituencies. The maps show the two key geothermal heat resource types in the UK, Mine Water and Hot Sedimentary Aquifers (HSA) and highlight the fortuitous extent of overlap between resource and demand (i.e. population centres).

The maps presented here show there are clear overlaps between centres of population (based on the density of constituencies which are all between approximately 70,000 and 77,000 voters) and the distribution of the key geothermal resource types likely to be most successful (in technological and economic terms) in the UK. These areas have been informed by extensive research and datasets that TRE have gathered and interpreted, drawing on recent experience assessing, designing, building and operating leading geothermal heat projects in the UK.

In the UK, 45% of energy is used for heating, which accounts for 40% of UK carbon emissions. Therefore, geothermal energy, with a carbon footprint 90% lower than gas central heating, represents the perfect "low hanging fruit" to decarbonise heating across the country.

A 2021 report published by the Renewable Energy Association, which TRE supported, estimated that by 2050 the UK could build 360 geothermal plants which would provide 15,000 GWh of annual heat, carbon savings of 3 megatons, and creation of 10,000 direct jobs and 25,000 indirect jobs.[1]

TownRock Energy would be pleased to discuss the contents of this report further, having been a key player in the development of UK geothermal heating systems to date. With ambitions to lead the growth of this important low carbon energy sector, we are poised to assist the next Government to return energy affordability and security to the British people.

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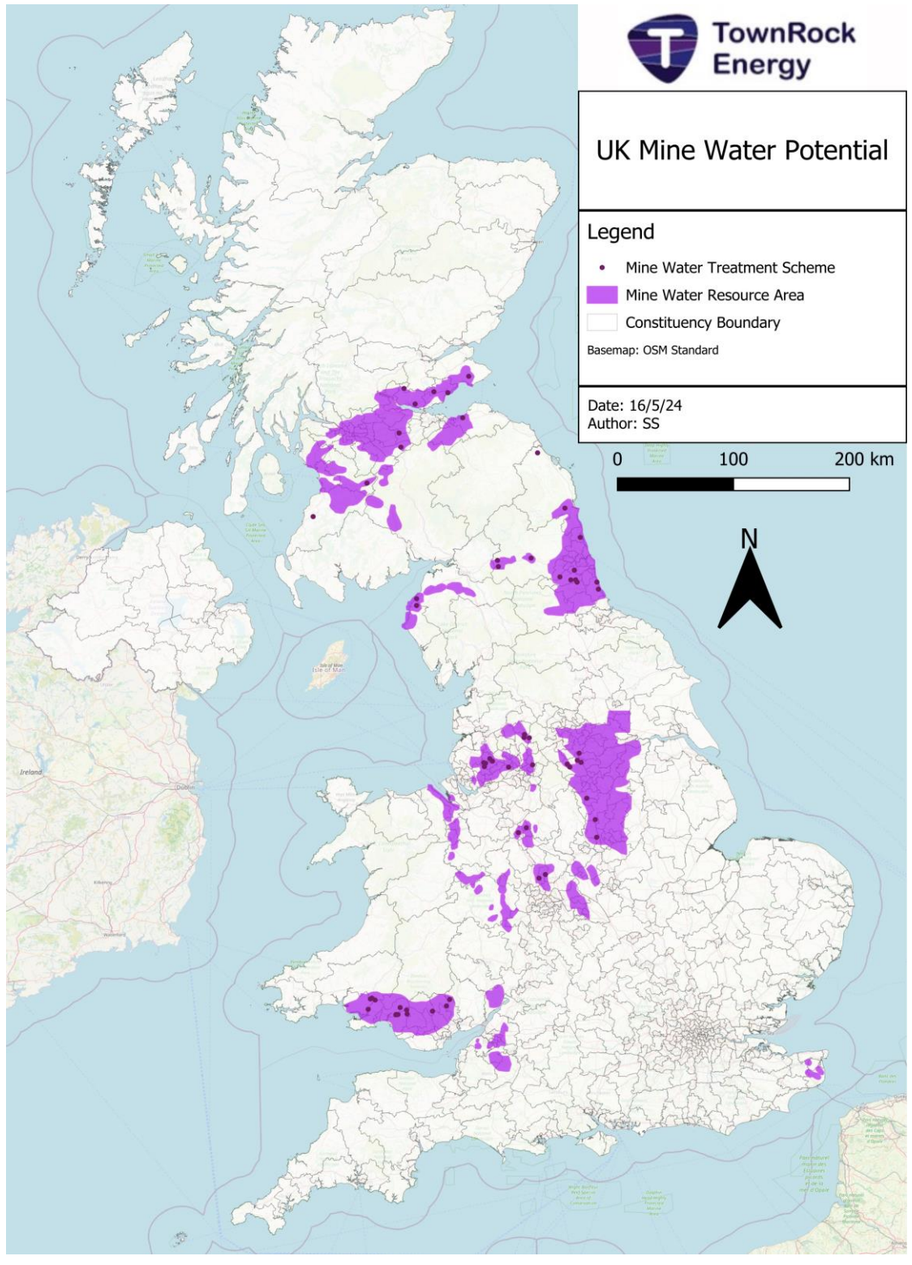
[1] https://www.r-e-a.net/wp-content/uploads/2021/05/Deep-Geothermal-Energy-Opportunities-for-the-UK.pdf

2. The Heat Beneath Your Feet



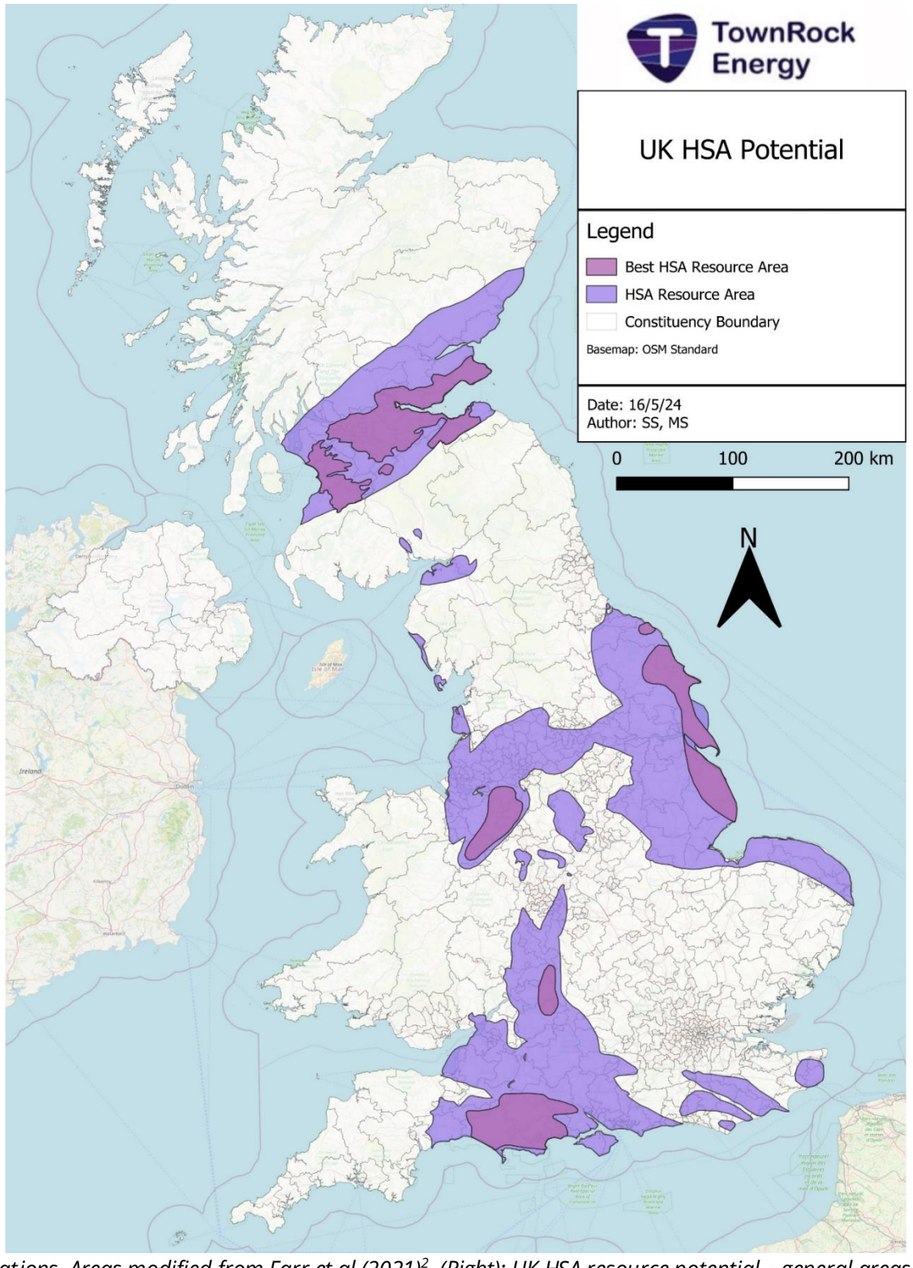


Figure 1. (Left): Map of UK Mine Water thermal resource indicating areas of mine water heat as well as treatment scheme locations. Areas modified from Farr et al (2021)[2]. (Right): UK HSA resource potential – general areas in light purple and best areas shaded darker purple. TRE original research and additional sources[3]

[2] https://www.researchgate.net/publication/345182992_The_temperature_of_Britain's_coalfields
[3] https://nora.nerc.ac.uk/id/eprint/3231/1/Devonian[1].pdf and https://doi.org/10.1144/gsjgs.143.3.0499

3. Mine Water Heating (and Cooling)

Where is the resource?

The lefthand map in Figure 1, above, shows the location of former coal mining areas where heat could be extracted from workings (labelled "Mine Water Resource Area"), as well as the locations of existing Coal Authority (CA) mine water treatment schemes. **25% of the UK housing stock lies above coal mines,** with enough energy in the flooded mine workings to heat **7 million homes.**

Mine water not only provides a renewable heating source from a previously fossil fuel asset and current environmental liability but is also most prevalent beneath ex-mining communities who often experience a higher incidence of fuel poverty and social deprivation.

The list in Appendix 1 indicates the **221 political constituencies** (correct for 2024 General Election) in which there is the opportunity to utilise **mine water energy**.

How does it work?

Mine water heating exploits the naturally warmed water in disused coal mines which became flooded following the end of mining operations. The heat from the mine water is extracted, passed through a heat exchanger and boosted via a heat pump at the surface, a device that uses electrical energy to increase the temperature of the water for heating. Typically, with a mine water heating system, the heat pump uses 1 unit of electrical energy to move 4 – 5 units of heat (**an efficiency of 400 – 500%,** compared to c. 90% for gas boilers and c. 200% for air source heat pumps on a cold winter's day).

On a warm day when cooling is required, the heat pump can be reversed to extract heat from buildings. Although predominantly a nation requiring heating, with projected rising temperatures as a result of climate change, the net cooling demand of the UK is predicted to rise significantly.

Mine water heating systems typically adopt one of two configurations:

- → Pairs of **boreholes are drilled into flooded mine workings**, with one pumping warm water to the surface, and the other reinjecting the cooled water following heat extraction;
- → Direct extraction of **heat from mine water treatment schemes**, of which the UK Coal Authority owns and operates more than 80 across the country. These are sites where polluted mine water is treated to remove contaminants before being discharged to the environment. When used for heating, heat is extracted from the mine water that is already being pumped from the mines at these sites.

4. Hot Sedimentary Aquifers

Where is the resource?

TRE have identified the key areas of the UK underlain by a Hot Sedimentary Aquifer (HSA) resource, shown in the right map in Figure 1. Lighter shades of purple indicate the broad outline of where the rocks are likely to contain sufficient heat and groundwater (labelled "HSA Resource Areas").

TRE have applied our expert subsurface knowledge to deduce the darker shaded areas as **the best areas to drill for heat** ("HSA Best Resource Areas"). This considers geological, economical, technological risk and maturity, and other influencing factors. Key centres underlain by these favourable resources include the East Yorkshire and Lincolnshire coastal towns, Dorset, Cheshire, Worcestershire and the Central Belt of Scotland.

Appendix 1 indicates those constituencies which are underlain by the more **general HSA Resource Areas (320 constituencies)** as well as those underlain by **the Best HSA Resource Areas (79 constituencies)**

How does it work?

Hot Sedimentary Aquifer's (HSAs) are bodies of rock that are at elevated temperatures and have a high enough groundwater flow to allow the heat to be extracted. Temperatures increase with depth in the earth and typically HSAs target horizons at 1 – 3 km depth. To access this heat, wells are typically drilled to the required depth and hot water pumped to the surface. Depending on the temperature, a heat pump may not be required. Techniques for the drilling of the geothermal wells required in this application are well established from the oil and gas industry and TRE maintains a close alliance with the industry leaders of onshore deep drilling in the UK.

5. Appendix 1: Constituencies with Geothermal Resources

Constituency Name	HSA Resource Area	Best HSA Resource Area	Mine Water Resource Area
Aberafan Maesteg			Y
Airdrie and Shotts	Y	Y	Y
Aldridge-Brownhills			Y
Alloa and Grangemouth	Y	Y	Y
Altrincham and Sale West	Y		
Alyn and Deeside	Y		Y
Amber Valley	Y		Y
Angus and Perthshire Glens	Y		
Arbroath and Broughty Ferry	Y		
Argyll, Bute and South Lochaber	Y		

Arundel and South Downs	Y		
Ashfield			Y
Ashford	Y		
Ashton-under-Lyne	Y		Y
Ayr, Carrick and Cumnock	Y	Y	Y
Barnsley North	Y		Y
Barnsley South			Y
Barrow and Furness	Y		
Basingstoke	Y		
Bassetlaw	Y		Y
Bath	Y		
Bathgate and Linlithgow	Y	Y	Y
Beverley and Holderness	Y	Y	
Bexhill and Battle	Y		
Birkenhead	Y		
Birmingham Erdington	Y		
Birmingham Hall Green and Moseley	Y		
Birmingham Hodge Hill and Solihull North	Y		
Birmingham Ladywood	Y		
Birmingham Northfield	Y		
Birmingham Selly Oak	Y		
Birmingham Yardley	Y		
Bishop Auckland			Y
Blackburn	Y		Y
Blackley and Middleton South	Y		Y
Blackpool North and Fleetwood	Y		
Blackpool South	Y		
Blaenau Gwent and Rhymney			Y
Blaydon and Consett			Y
Blyth and Ashington			Y
Bognor Regis and Littlehampton	Y		
Bolsover	Y		Y
Bolton North East	Y		Y
Bolton South and Walkden	Y		Y
Bolton West	Y		Y
Bootle	Y		
Boston and Skegness	Y	Y	
Bournemouth East	Y	Y	
Bournemouth West	Y	Y	
Bradford East			Y
Bradford South	Y		Y
Bradford West	Y		Y
Brecon, Radnor and Cwm Tawe			Y
Bridgend			Y
Bridgwater	Y		

Bridlington and The Wolds	Y	Y	
Brigg and Immingham	Y	Y	
Bristol Central	Y		Y
Bristol East	Y		Y
Bristol North East	Y		Y
Bristol North West	Y		
Bristol South	Y		Y
Broadland and Fakenham	Y		
Bromsgrove	Y		
Broxtowe			Y
Burnley	Y		Y
Burton and Uttoxeter	Y		Y
Bury North	Y		Y
Bury South	Y		Y
Caerfyrddin			Y
Caerphilly			Y
Calder Valley	Y		Y
Cannock Chase			Y
Canterbury	Y		Y
Cardiff North			Y
Cardiff West			Y
Carlisle	Y		Y
Central Ayrshire	Y	Y	Y
Cheadle	Y		
Cheltenham	Y		
Chester North and Neston	Y		Y
Chester South and Eddisbury	Y	Y	
Chesterfield			Y
Chichester	Y		
Chippenham	Y		
Chorley	Y		Y
Christchurch	Y	Y	
City of Durham			Y
Clwyd East	Y		Y
Coatbridge and Bellshill	Y	Y	Y
Colne Valley	Y		Y
Congleton	Y	Y	
Coventry East			Y
Coventry North West			Y
Coventry South			Y
Cowdenbeath and Kirkcaldy	Y	Y	Y
Cramlington and Killingworth			Y
Crawley	Y		
Crewe and Nantwich	Y	Y	
Cumbernauld and Kirkintilloch	Y	Y	Y
Darlington			Y

Derby North	Y		
Derby South	Y		
Derbyshire Dales	Y		Y
Dewsbury and Batley	Y		Y
Didcot and Wantage	Y		
Doncaster Central			Y
Doncaster East and the Isle of Axholme	Y		Y
Doncaster North	Y		Y
Dorking and Horley	Y		
Dover and Deal	Y		Y
Droitwich and Evesham	Y	Y	
Dumfries and Galloway	Y		
Dumfriesshire, Clydesdale and Tweeddale	Y	Y	Y
Dundee Central	Y		
Dunfermline and Dollar	Y	Y	Y
Easington			Y
East Grinstead and Uckfield	Y		
East Hampshire	Y		
East Kilbride and Strathaven	Y	Y	Y
East Renfrewshire	Y	Y	Y
East Surrey	Y		
East Wiltshire	Y		
East Worthing and Shoreham	Y		
Eastbourne	Y		
Eastleigh	Y		
Edinburgh East and Musselburgh	Y	Y	Y
Edinburgh North and Leith	Y	Y	
Edinburgh South	Y	Y	Y
Edinburgh South West	Y	Y	
Edinburgh West	Y	Y	
Ellesmere Port and Bromborough	Y		
Erewash			Y
Exmouth and Exeter East	Y		
Falkirk	Y	Y	Y
Fareham and Waterlooville	Y		
Farnham and Bordon	Y		
Filton and Bradley Stoke	Y		Y
Folkestone and Hythe	Y		
Forest of Dean	Y		Y
Frome and East Somerset	Y		Y
Fylde	Y		
Gainsborough	Y	Y	
Gateshead Central and Whickham			Y

Gedling			Y
Glasgow East	Y	Y	Y
Glasgow North	Y	Y	Y
Glasgow North East	Y	Y	Y
Glasgow South	Y	Y	Y
Glasgow South West	Y	Y	Y
Glasgow West	Y	Y	Y
Glastonbury and Somerton	Y	Y	
Glenrothes and Mid Fife	Y	Y	Y
Gloucester	Y		
Goole and Pocklington	Y		Y
Gorton and Denton	Y		Y
Gosport	Y		
Gower			Y
Grantham and Bourne	Y		
Great Grimsby and Cleethorpes	Y	Y	
Great Yarmouth	Y		
Halifax	Y		Y
Hamble Valley	Y		
Hamilton and Clyde Valley	Y	Y	Y
Hartlepool	Y		Y
Hastings and Rye	Y		
Havant	Y		
Hazel Grove			Y
Hereford and South Herefordshire			Y
Herne Bay and Sandwich	Y		Y
Hexham			Y
Heywood and Middleton North	Y		Y
High Peak	Y		
Hinckley and Bosworth			Y
Honiton and Sidmouth	Y		
Horsham	Y		
Houghton and Sunderland South			Y
Huddersfield	Y		Y
Hyndburn	Y		Y
Inverclyde and Renfrewshire West	Y	Y	Y
Isle of Wight East	Y		
Isle of Wight West	Y		
Jarrow and Gateshead East			Y
Keighley and Ilkley	Y		
Kenilworth and Southam	Y		
Kilmarnock and Loudoun	Y	Y	Y
Kingston upon Hull East	Y	Y	
Kingston upon Hull North and Cottingham	Y		

Kingston upon Hull West and Haltemprice	Y		
Kingswinford and South Staffordshire	Y		Y
Knowsley	Y		Y
Lancaster and Wyre	Y		
Leeds East	Y		Y
Leeds South	Y		Y
Leeds South West and Morley	Y		Y
Leigh and Atherton	Y		Y
Lewes	Y		
Lichfield	Y		Y
Lincoln	Y		
Liverpool Garston	Y		
Liverpool Riverside	Y		
Liverpool Walton	Y		
Liverpool Wavertree	Y		
Liverpool West Derby	Y		
Livingston	Y	Y	Y
Llanelli			Y
Lothian East	Y	Y	Y
Louth and Horncastle	Y	Y	
Lowestoft	Y		
Macclesfield	Y	Y	Y
Makerfield	Y		Y
Manchester Central	Y		Y
Manchester Rusholme	Y		
Manchester Withington	Y		
Mansfield	Y		Y
Melksham and Devizes	Y		
Melton and Syston	Y		
Meriden and Solihull East	Y		Y
Merthyr Tydfil and Aberdare			Y
Mid Cheshire	Y	Y	
Mid Derbyshire	Y		Y
Mid Dorset and North Poole	Y	Y	
Mid Dunbartonshire	Y	Y	Y
Mid Leicestershire			Y
Mid Norfolk	Y		
Mid Sussex	Y		
Middlesbrough and Thornaby East	Y		
Middlesbrough South and East Cleveland	Y		
Midlothian	Y	Y	Y
Monmouthshire	Y		Y
Montgomeryshire and Glyndwr	Y		Y

Motherwell, Wishaw and Carluke	Y	Y	Y
Neath and Swansea East			Y
New Forest East	Y	Y	
New Forest West	Y	Y	
Newark	Y		Y
Newbury	Y		
Newcastle upon Tyne Central and West			Y
Newcastle upon Tyne East and Wallsend			Y
Newcastle upon Tyne North			Y
Newcastle-under-Lyme	Y	Y	Y
Newport East	Y		
Newport West and Islwyn			Y
Newton Aycliffe and Spennymoor			Y
Normanton and Hemsworth	Y		Y
North Ayrshire and Arran	Y	Y	Y
North Cotswolds	Y	Y	
North Dorset	Y	Y	
North Durham			Y
North East Derbyshire	Y		Y
North East Fife	Y	Y	Y
North East Hampshire	Y		
North East Somerset and Hanham	Y		Y
North Herefordshire	Y		
North Norfolk	Y		
North Northumberland			Y
North Shropshire	Y	Y	Y
North Somerset	Y		Y
North Warwickshire and Bedworth	Y		Y
North West Hampshire	Y		
North West Leicestershire			Y
North West Norfolk	Y		
Norwich North	Y		
Norwich South	Y		
Nottingham East			Y
Nottingham North and Kimberley			Y
Nottingham South			Y
Nuneaton			Y
Oldham East and Saddleworth	Y		Y
Oldham West, Chadderton and Royton	Y		Y
Ossett and Denby Dale	Y		Y

Paisley and Renfrewshire North	Y	Y	Y
Paisley and Renfrewshire South	Y	Y	Y
Pendle and Clitheroe	Y		Y
Penistone and Stocksbridge	Y		Y
Penrith and Solway	Y		Y
Perth and Kinross-shire	Y	Y	Y
Pontefract, Castleford and Knottingley	Y		Y
Pontypridd			Y
Poole	Y	Y	
Portsmouth North	Y		
Portsmouth South	Y		
Rawmarsh and Conisbrough			Y
Reading West and Mid Berkshire	Y		
Redcar	Y		
Redditch	Y		
Reigate	Y		
Rhondda and Ogmore			Y
Ribble Valley	Y		
Richmond and Northallerton	Y		
Rochdale	Y		Y
Romsey and Southampton North	Y	Y	
Rossendale and Darwen	Y		Y
Rother Valley			Y
Rotherham			Y
Rugby			Y
Runcorn and Helsby	Y		
Rushcliffe			Y
Rutherglen	Y	Y	Y
Rutland and Stamford	Y		
Salford	Y		Y
Salisbury	Y	Y	
Scarborough and Whitby	Y	Y	
Scunthorpe	Y		
Sefton Central	Y		
Selby	Y		Y
Sheffield Brightside and Hillsborough			Y
Sheffield Central			Y
Sheffield Hallam			Y
Sheffield Heeley			Y
Sheffield South East			Y
Sherwood Forest	Y		Y
Shipley	Y		
Shrewsbury	Y		Y
Skipton and Ripon	Y		
Sleaford and North Hykeham	Y		

Solihull West and Shirley	Y		
South Cotswolds	Y	Y	
South Derbyshire	Y		Y
South Dorset	Y	Y	
South Holland and The Deepings	Y		
South Norfolk	Y		
South Ribble	Y		Y
South Shields			Y
South Shropshire			Y
South West Wiltshire	Y		
Southampton Itchen	Y		
Southampton Test	Y		
Southport	Y		
Spen Valley	Y		Y
St Helens North	Y		Y
St Helens South and Whiston	Y		Y
Stafford	Y		Y
Staffordshire Moorlands	Y		Y
Stalybridge and Hyde	Y		
Stirling and Strathallan	Y	Y	Y
Stockport	Y		Y
Stockton North	Y		
Stockton West	Y		
Stoke-on-Trent Central			Y
Stoke-on-Trent North	Y		Y
Stoke-on-Trent South			Y
Stone, Great Wyrley and Penkridge	Y		Y
Stratford-on-Avon	Y		
Stretford and Urmston	Y		
Stroud	Y		
Sunderland Central			Y
Sussex Weald	Y		
Sutton Coldfield	Y		
Swansea West			Y
Swindon North	Y		
Swindon South	Y		
Tamworth	Y		Y
Tatton	Y	Y	
Taunton and Wellington	Y		
Telford			Y
Tewkesbury	Y	Y	
The Wrekin	Y		Y
Thirsk and Malton	Y	Y	
Thornbury and Yate	Y		Y
Tiverton and Minehead	Y		

Tonbridge	Y		
Torfaen			Y
Tunbridge Wells	Y		
Tynemouth			Y
Vale of Glamorgan			Y
Wakefield and Rothwell	Y		Y
Wallasey	Y		
Walsall and Bloxwich			Y
Warrington North	Y		Y
Warrington South	Y	Y	Y
Washington and Gateshead South			Y
Weald of Kent	Y		
Wells and Mendip Hills	Y		Y
West Aberdeenshire and Kincardine	Y		
West Dorset	Y	Y	
West Dunbartonshire	Y	Y	Y
West Lancashire	Y		Y
West Worcestershire	Y		Y
Weston-Super-Mare	Y		
Wetherby and Easingwold	Y		Y
Whitehaven and Workington	Y		Y
Widnes and Halewood	Y		Y
Wigan	Y		Y
Winchester	Y		
Wirral West	Y		
Witney	Y		
Worcester	Y		
Worsley and Eccles	Y		Y
Worthing West	Y		
Wrexham	Y	Y	Y
Wyre Forest	Y		Y
Wythenshawe and Sale East	Y		
Yeovil	Y	Y	
York Central	Y		
York Outer	Y		Y

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