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Mineral Resource Information in Support of National, Regional and Local Planning:

Merseyside (comprising City of Liverpool and Boroughs of Knowsley, Sefton, St Helens and Wirral).

Commissioned Report CR/05/129N

BRITISH GEOLOGICAL SURVEY

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D J Minchin, F M McEvoy, D J Harrison, D G Cameron, D J Evans, G K Lott, S F Hobbs and D E Highley.

This report accompanies the 1:100,000 scale map: Merseyside (comprising City of Liverpool and Boroughs of Knowsley, Sefton, St Helens and Wirral).

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1 Introduction

This report is one of a series prepared by the British Geological Survey for various administrative areas in England for the Office of the Deputy Prime Minister's research project *Mineral Resource Information in Support of National, Regional and Local Planning.*

The accompanying map relates to Merseyside, comprising City of Liverpool and Boroughs of Knowsley, Sefton, St Helens and Wirral, and delineates the mineral resources of current, or potential, economic interest in the area and the sites where minerals are or have been worked. It also relates these to national planning designations, which may represent constraints on the extraction of minerals.

Three major elements of information are presented:

- the geological distribution and importance of mineral resources
- the extent of mineral planning permissions and the location of current mineral workings
- the extent of selected, nationally-designated planning constraints.

This wide range of information, much of which is scattered and not always available in a consistent and convenient form, is presented on a digitally-generated summary map on the scale of 1:100 000. This scale is convenient for the overall display of the data and allows for a legible topographic base on which to depict the information. However, all the data are held digitally at larger scales using a Geographical Information System (GIS), which allows easy revision, updating and customisation of the information together with its possible integration with other datasets. The information will form part of a *Summary of the Mineral Resources of the North West Region*.

The purpose of the work is to assist all interested parties involved in the preparation and review of development plans, both in relation to the extraction of minerals and the protection of mineral resources from sterilisation. It provides a knowledge base, in a consistent format, on the nature and extent of mineral resources and the environmental constraints, which may affect their extraction. An important objective is to provide baseline data for the long term. The results may also provide a starting point for discussions on specific planning proposals for mineral extraction or on proposals, which may sterilise resources.

It is anticipated that the maps and report will also provide valuable background data for a much wider audience, including the different sectors of the minerals industry, other agencies and authorities (e.g. The Planning Inspectorate Agency, the Environment Agency, the Countryside Agency and English Nature), environmental interests and the general public.

Basic mineral resource information is essential to support mineral exploration and development activities, for resource management and land-use planning, and to establish baseline data for environmental impact studies and environmental guidelines. It also enables a more sustainable pattern and standard of development to be achieved by valuing mineral resources as national assets.

The mineral resources covered are sand and gravel, brick clay, silica sand, building stone, peat, coal, and hydrocarbons.

1.1 Resources and reserves

Mineral resources are natural concentrations of minerals or bodies of rock (or fluids such as oil and gas) that are, or may become, of potential interest as a basis for the economic extraction of a mineral product. They exhibit physical and/or chemical properties that make them suitable for specific uses and are present in sufficient quantity to be of intrinsic economic interest. Areas that

are of potential economic interest as sources of minerals change with time as markets decline or expand, product specifications change, recovery technology is improved or more competitive sources become available.

That part of a mineral resource, which has been fully evaluated and is commercially viable to work is called a mineral reserve. In the context of land-use planning, the term mineral reserve should strictly be further limited to those minerals for which a valid planning permission for extraction exists (i.e. permitted reserves). Without a valid planning consent no mineral working can take place and consequently the inherent economic value of the mineral resource cannot be released and resulting wealth created. The ultimate fate of mineral reserves is to be either physically worked out or to be made non-viable by changing economic circumstances.

Mineral resources defined on the map delineate areas within which potentially workable mineral may occur. These areas are not of uniform potential and also take no account of planning constraints that may limit their working. The economic potential of individual sites can only be proved by a detailed evaluation programme. Such an investigation is also an essential precursor to submitting a planning application for mineral working. Extensive areas are shown as having no mineral resource potential, but some isolated mineral workings may occur in these areas. The presence of these operations generally reflects local or specific situations.

1.2 Environmental designations

The map shows the extent of selected, nationally-designated planning constraints as defined for the purposes of this study. These are defined on a common national basis and therefore represent a consistent degree of constraint across the country. No interpretation should be made from the map with regard to the relative importance of the constraints, either in relation to mineral development proposals or in relation to each other. Users should consult policy guidelines issued by the relevant Government department, statutory agency or local authority.

The constraints shown on the map are:

- National nature conservation designations – National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI)
- International nature designations – Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites
- Scheduled Monuments

Mineral development may also be constrained by many other factors not shown on the map, including local landscape designations, considerations relating to the protection of other resources, such as groundwater, and local amenity or environmental concerns, such as noise, traffic and visual impact. These have been excluded because the constraint is not defined on a national basis or the information is not generally available. The extent or degree of relevance of such constraints can be ascertained from the relevant statutory agency or the appropriate Mineral Planning Authority

2 Sand and Gravel

Sand and gravel are defined on the basis of particle size rather than composition. In current commercial practice, following the introduction of new European standards from 1st January 2004, the term 'gravel' (or more correctly coarse aggregate) is used for general and concrete applications to define particles between 4 and 80 mm, and the term 'sand' for material that is finer than 4 mm, but coarser than 0.063 mm. For use in asphalt 2 mm is now the break point between coarse and fine aggregate. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint), but other rock types may occur locally.

There is very limited extraction of sand and gravel in Merseyside. Most is marine-dredged material landed principally in the Port of Liverpool, but also at Eastham on the Mersey. Total landings in 2004 were 255,000 tonnes, representing 63% of all sand and gravel production in the region (Annual Minerals Raised Inquiry). Construction sand is also produced in association with silica sand in Sefton from intertidal deposits.

Sand and gravel resources occur in a variety of geological environments. In Merseyside these resources occur mainly within superficial or 'drift' deposits, subdivided into river sand and gravel, glaciofluvial sand and gravel and blown sand with additional resources of bedrock sand and gravel.

2.1 Superficial deposits

Generally, only exposed sand and gravel is defined, although sub-alluvial inferred resources of sand and gravel occurring beneath modern river flood plains may be extensive in some places. Narrow (< 200 m) spreads of sub-alluvial deposits are mainly excluded from the map. Their limited width is likely to preclude economic working of any sand and gravel present.

2.1.1 Glaciofluvial Sand and Gravel

These are deposits mapped as the products of deposition by glacial meltwaters and are nowadays commonly labelled on BGS maps as glaciofluvial deposits, a more accurate description of their origin. The sequence of these deposits is complex with mappable units commonly exhibiting intricate relationships. Bodies of sand and gravel may occur as sheet- or delta-like layers above till deposits or as elongate, irregular lenses within the till sequence. Areas of wholly concealed, and thus unknown, bodies of sand and gravel may occur under spreads of till and other drift deposits. Glacial till covers bedrock in the area to a depth of up to 40 m and is largely comprised of red-brown boulder clay with small, irregular sand lenses. The most extensive glaciofluvial sand and gravel deposits in the area occur to the east of Prescot. Whilst a number of these bodies may be up to 9 m thick, their lateral extent is often variable and unpredictable and resources have been sterilised by urban development.

2.1.2 River Sand and Gravel (sub-alluvial deposits)

River sand and gravel resources occur in modern floodplains and in floodplain terrace deposits associated with, and underlying, present day alluvium. The deposits are best developed along the River Alt in Sefton, Sankey Brook in St Helens, in the north of the Wirral and along the Fender, which runs parallel to the M53. These deposits date to the end of the last glaciation with a

succession of deposits formed, representing accumulations of sand and gravel in response to falling sea level in post-glacial times.

Fluvial deposits along the River Alt consist of brown silts and sands with grey sandy clays, grading westward into silty estuarine alluvium referred to as the Downholland Silt. The alluvium gives rise to a flat up to 4 km wide near Formby but narrowing to less than 600 m wide at Ince Blundell. The deposit averages 2 m thick but local thickness of 5 m has been measured in some boreholes. Deposits in the north of the Wirral are up to 3 m thick and comprise principally sand.

In many of the perennial stream valleys in the St Helens district there is a mixed infill of clays, silts, sands and gravels, often interbedded with organic material. Deposits may be between 0.8 m and 2.0 m in depth but have limited lateral extent and have therefore been excluded from the map.

2.1.3 Blown Sand

Wind-blown sands are of little importance as a source of aggregate because they are usually too fine-grained and uniform in size for use as concrete aggregate. Their narrow grain size is also an inhibiting factor for use in mortar.

An extensive belt of coastal dunes occurs in Merseyside but these are not shown as a resource on the map. Inland from the coast, the Shirdley Hill Sand is also of wind-blown origin and covers extensive parts of the west Lancashire Plain. The deposits, which are up to 3 m thick, were formerly extensively worked for glass sand (Figure 3) but they are unsuitable for construction use and are not shown on the main map.

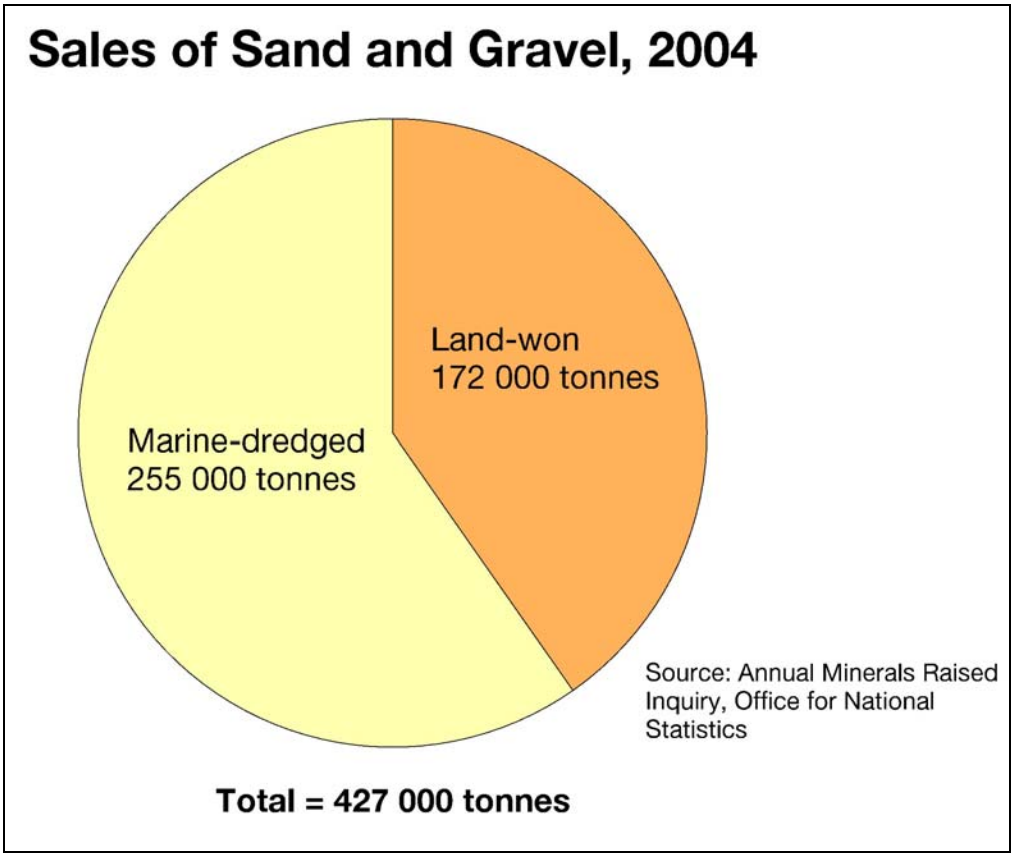

Figure 1. Sand and gravel sales in Merseyside, 2004

2.2 Bedrock resources

Sand and gravel may be won from suitable bedrock deposits.

In Merseyside the main lithology worked for sand is the Triassic, Chester Pebble Beds Formation, which occurs in the south of the county. The Chester Pebble Beds comprise a distinctive facies of cyclic sedimentation. They typically consist of red or yellow, cross-laminated, pebbly sandstones with interbedded mudstone and micaceous horizons. The unit is comparatively hard, with siliceous, ferruginous and calcareous cements. The pebbles are well rounded and consist predominantly of white vein quartz and purple quartzite. Although the formation is widespread across the southern part of the county, it is not shown on the map since exploitation is only occurring at one site - Bold Heath Pit, Widnes.

Crushed rock from Glensanda quarry on the west coast of Scotland is imported through Seaforth Docks in Liverpool (200 000 – 250 000 tonnes per year).

3 Brick Clay

Brick clay is the term used to describe ‘clay and shale’ used in the manufacture of structural clay products, such as facing and engineering bricks, pavers, clay tiles and vitrified clay pipes. These clays may also be used in cement manufacture, as a source of constructional fill and for lining and sealing landfill sites. Brick manufacture is the largest tonnage use in England. Clay bricks are a versatile construction material and one of the most visible components of the built environment. They make an important contribution to local architectural styles.

Brick clays are essentially mudstones of different geological ages and compositions. Their mineralogy, chemistry and physical properties, such as grain size, are important in determining the suitability of the raw material for the manufacture of structural clay products. These factors affect the forming behaviour of the clay and also its behaviour during drying and firing. They will also determine the technical properties of the fired product, such as strength, water absorption (porosity) and frost resistance, and thus its durability and performance in service and, importantly, its architectural appearance, such as colour and texture.

Most facing bricks, engineering bricks and related clay-based building products are manufactured in large automated factories. These represent a high capital investment and are increasingly dependent therefore on raw material with predictable and consistent firing characteristics in order to achieve high yields of saleable products. Blending different clays to achieve improved durability and to provide a range of fired colours and textures is an increasingly common feature of the brick industry. Continuity of supply of consistent raw materials is of paramount importance.

Figure 2. Brick production at Lord St Helens in St Helens

In Merseyside, brick clay has been produced for local consumption from small brick pits for over two hundred years. Historically, a variety of clays were extracted for brickmaking including boulder clay, the Triassic Mercia Mudstone, the Downholland Silt, the Etruria Formation and Coal Measures. Today, only one active brick works remains in Merseyside, at St. Helens. The quarry on site is exhausted but clay stocks remain. Clay extracted at Cronton is also used in the plant together with material brought in from outside the area. The Cronton quarry is located in the Carboniferous Etruria Formation.

The Pennine Coal Measures remains the principal brick clay resource in Northern England. Resources occur mainly in the Knowsley and St Helens unitary authorities and mudstones from the Pennine Upper Coal Measures were quarried in St Helens area for the manufacture of bricks. The suitability of Carboniferous mudstones depends, in part, on their carbon and sulphur contents. Both may lead to firing problems and sulphur may also give unacceptable emission levels, although blending of clays may reduce these problems.

The Etruria Formation is one of the most significant brick producing formations in the country contributing 16 % of current clay building brick production in the United Kingdom. In Merseyside, the Etruria Formation occurs in the southern part of St Helens around Prescot and is composed essentially of red and mottled mudstone between 250 m and 400 m thick. The relative proportions of kaolinite, illite, quartz and iron oxides, and the absence of impurities, such as carbon, sulphur, soluble salts and, except locally, calcite, makes it suitable for the manufacture of high strength and low water absorption heavy clayware, including high-quality facing and engineering bricks, pavers, and roofing and floor tiles. The clay normally fires to a red colour but the variable iron content of the Etruria Formation allows the production of a wide range of fired colours including some buff-burning horizons, which are eagerly sought after to produce to satisfy increasing demand for buff bricks.

4 Silica Sand

Silica (industrial) sands contain a high proportion of silica (SiO_2) in the form of quartz and are used for purposes other than as construction aggregates. They are essential raw materials for the glass and foundry castings industries, but also have a wide range of other industrial applications, including in ceramics and chemicals manufacture, for water filtration media and in sports and horticultural applications. They are produced from both loosely consolidated sand deposits and by crushing weakly cemented sandstones. Unlike construction sands, which are used for physical properties alone, silica sands are valued for a combination of chemical and physical properties. These include a high silica content in the form of quartz and, more importantly, very low levels of impurities, particularly clay, iron oxides and refractory minerals such as chromite. Silica sands typically have a narrow grain size distribution, generally in the range 0.5 mm to 0.1 mm, although coarser grades are required for some applications. For most applications, silica sands have to conform to very closely defined specifications and consistency in quality is of critical importance. Particular uses often require different combinations of properties. Consequently, different qualities of silica sand are usually not interchangeable in use. Silica sands command a higher price than construction sands. This allows them to serve a wider geographical market, including exports.

Silica sand processing is of varying degrees of complexity and depends on the nature of the raw material used and the end use of the sand. It typically requires a high capital investment in plant. Processing is aimed at modifying both the physical and chemical properties of the sand to meet user specifications. The ease with which contaminants (such as iron-bearing impurities and clay) can be removed, together with the level of losses incurred in removing oversize and undersize fractions from a sand, has a major bearing on its potential use. Within the UK, deposits of silica sand occur in only limited areas and quantities, and the special characteristics of silica sand extraction, in particular the cost of processing, means that the industry has a restricted distribution.

In Merseyside, silica sand is produced in Sefton from an area known as the Horse Bank off the coast from Southport, where the foreshore is characterised by a wide intertidal expanse of sandbanks and flats. Resources of sand are extensive. The extent of the workings is defined by the planning permissions. Working takes place when the sand is exposed by the tides. The top 0.5 m of sand is removed by excavator and transported by dump truck for processing onshore. Here the sand is washed and screened to remove shell fragments and coarse material, and then classified to produce different size products. The most important application of the sand is as a grinding and polishing medium for the manufacture of polished wired glass, a use for which it is particularly suited and alternatives have not been found. Other applications include roofing felt manufacture, foundry sand, industrial fillers and for sports and horticultural applications.

Large parts of the west Lancashire Plain are covered by extensive deposits of wind-blown sand known as the Shirdley Hill Sand Formation. The sands, which are up to 3 m thick, are younger than the glacial deposits and lie immediately beneath a cover of topsoil. They account for some of the most productive agricultural land in the area. The sands are fine-grained, yellow and grey and characteristically uniform in both composition and grain size distribution, reflecting their wind-blown origin. The sand deposits were formerly of considerable economic importance as a source of glass sand, particularly after the development of St Helens as a major glassmaking centre. The sands have been extensively worked in Lancashire and St Helens for the production of coloured container glass and, more importantly, flat glass. Most of the sand particles fall in the range 500 μm to 125 μm, which is ideal for glassmaking but unsuitable for construction use. For

flat glass manufacture only the top 0.5 to 1m of lower iron sand was worked directly beneath topsoil. This sand typically contains 97% SiO_2 and 0.1–0.12% Fe_2O_3, the latter component being the most critical for glassmaking. However, the thinness of the deposit, the large areas required and the consequent high working costs led to its gradual replacement by Chelford Sand from the Cheshire Basin. Extraction for flat glass manufacture ceased in 1977. Because the deposits are so thin and such large areas of land would be required to maintain production, it is unlikely that the Shirdley Hill Sand will be used as a source of glass sand in the future. In addition, current market trends are for lower iron glass, which would be difficult to achieve using the Shirdley Hill Sand. Consequently they are not shown as a resource on the main map. The sands have, however, been worked for horticultural use. The extent of the Shirdley Hill Sand and their historic planning permissions are shown on the inset map.

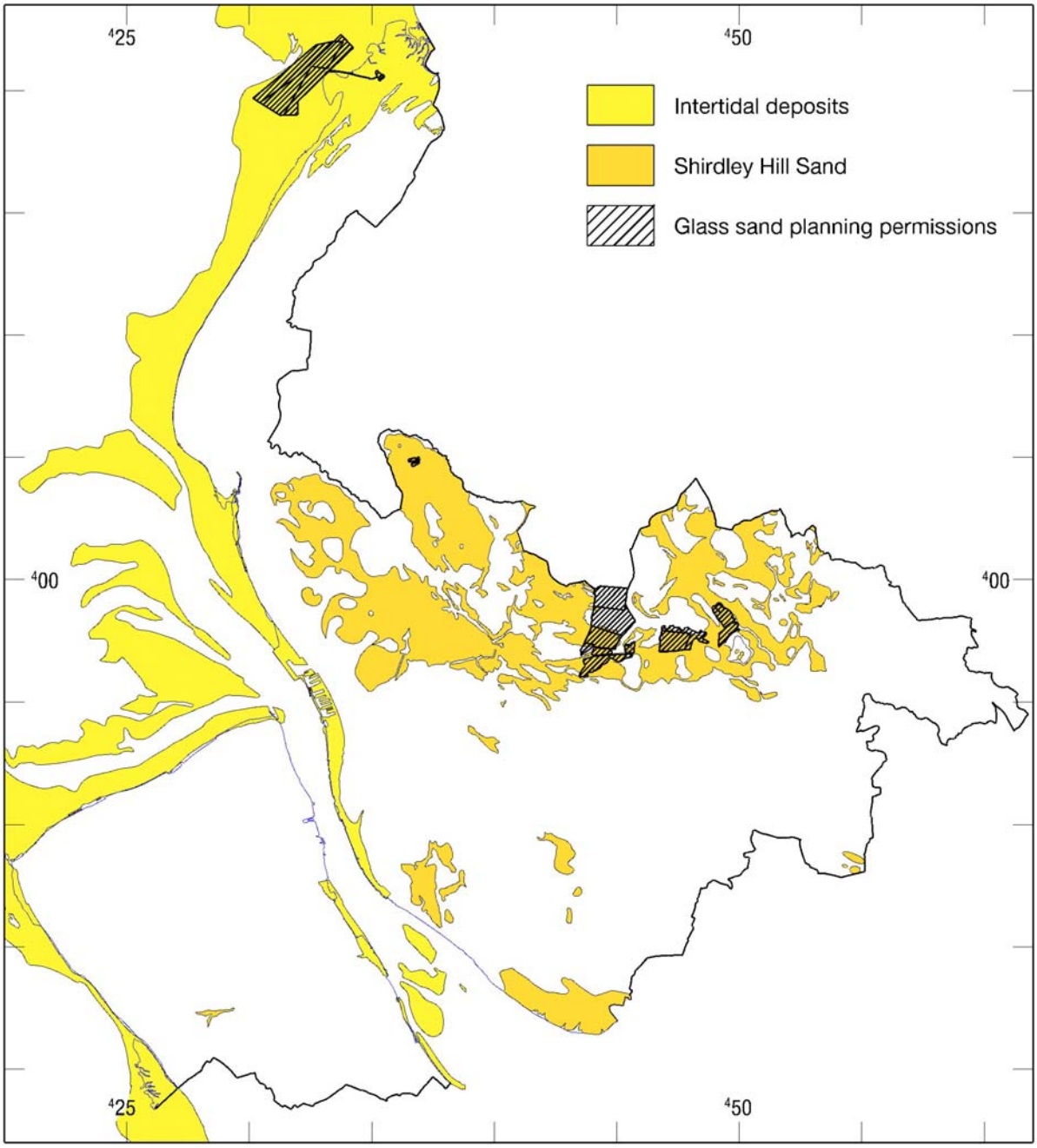

Figure 3. Map of Shirdley Hill Sand and glass sand planning permissions in the Merseyside area.

5 Building Stone

Building stone has been produced from a number of horizons within the Carboniferous and Permo-Triassic rocks of the area. In the past, working of local sandstones was widespread. However, today there is no quarrying of building sandstone in the area.

The oldest rocks that were quarried for building stone and flagstone are of Carboniferous age and crop out in the St Helens area of the South Lancashire Coalfield. The principal sandstone quarries were located in the Millstone Grit at Pimbo's Bush and in the Pennine Lower Coal Measures at Billinge, Rainsford, Thatto Heath, Crookhurst and Huyton.

The red and white sandstones of the Sherwood Sandstone Group (Permo-Triassic) were by far the most important source of building stone in the Merseyside area. Red, white and yellow sandstones were quarried extensively in many suburbs of the present city of Liverpool, for example, at Knowsley, Litherland, Bootle, St James's Mount, Everton, Anfield and Toxteth. There were also important sandstone quarries at Rainhill and Woolton Hill. Across the Mersey Estuary, in the Wirral, many large quarries also worked the Sherwood Sandstone Group around Thingwall, West Kirby, Irby, Heswell, High Bebington, Storeton, Oxton, Bidston and Wallasey.

Figure 4. Traditional stone built house, Berringtons Lane in St Helens.

6 Peat

Peat is an unconsolidated deposit of plant remains in a water-saturated environment such as a bog or fen. Bogs occur in areas where they are dependent on rainfall for supply of water and the vegetation is characterised by acid tolerant plant communities of which the genus *Sphagnum* is dominant. The two main types of bog are (i) raised bogs, characteristic of flat underlying topography and found on plains and broad valley floors and (ii) blanket bogs, which occur mainly in upland areas where conditions are suitably cool and wet. Many lowland raised bogs have been designated as sites of international and national conservation areas. Peat is dug in England mainly from raised lowland bogs, almost entirely (98%) for horticultural purposes, either as a growing medium, or as a soil improver.

In Merseyside several areas of lowland raised bogs have been mapped in Sefton and in the northern parts of Knowsley and St. Helens. The peat deposits at Sefton overlie the Downholland Silt and are on average 2 m deep. Historically, they have been locally worked for fuel. Peat deposits in Knowsley and St. Helens represent the southern end of the southwest Lancashire peat plain. Peat developed in small, confined, waterlogged basins above glacial till since the end of the last glaciation. Peat layers can be found above and below the Shirdley Hill Sand Formation. Peat is not worked in St. Helens or Knowsley, but the southwest Lancashire peat plain is worked in Lancashire therefore this resource is shown on the map.

Many of the peat deposits have been worked extensively in the past and today a large percentage of these areas have been 'reclaimed' to agricultural land. Due to a lack of up-to-date linework detailing reclamation, the entire resource as mapped is shown on the face of the map.

7 Coal

Merseyside lies predominantly within the South Lancashire Coalfield. The coal-bearing strata of the Pennine Lower and Pennine Middle Coal Measures (Upper Carboniferous) generally dip to the south. Coal seams occur at the surface east of Kirkby and become concealed by younger rocks, down to depths of 600 m below Ordnance Datum in the south of the county. A north-south striking fault separates the exposed Coal Measures east of Kirkby from the approximately 1500 m deep coal-bearing strata west of Kirkby. To the west, the Coal Measures continue below Liverpool and the Wirral to join up with the North Wales Coalfield. Coal seams are numerous with in excess of 30 named coal seams, which vary laterally in both thickness and composition, chiefly by variation in the number of dirt partings present within the seam. The Pennine Lower Coal Measures and Pennine Middle Coal Measures form the most important coal-bearing interval, with a number of seams in excess of 2 m in thickness. Coals from the Pennine Upper Coal Measures are generally thin, the exception being the Worsley Four Foot, which can be up to 1.6 m in thickness. The main coal-bearing interval typically varies from about 590 m thick in the west of the coalfield to 880 m thick in the east. Coal rank ranges from high to medium volatile and a substantial portion of the coalfield is covered by urban development.

As UK domestic production of coal has declined in recent years, Merseyside coal mining has declined with only one opencast coal site currently in operation at Crock Hey in St Helens. Crock Hey opencast works the 'Wigan Five Feet' seam and 'Wigan Four Feet' seam. Annual production has fallen from 76,176 tonnes in 2003 to 4,299 tonnes in 2005, when the site closed. The gentle dip of the coal beds in this region together with the near surface resources facilitates opencast coal working. The future potential for opencast working in Merseyside is reduced by

overlying thick drift deposits and extensive urban development. There are no deep mines in operation in the South Lancashire Coalfield. The last deep mine, Parkside, in St Helens, west of Newton-Le-Willows was closed in 1993. Future potential areas for deep coal have been identified south of the county, between Widnes, Warrington and Salford. However, it is likley that any further interest in coal resources of the area will be for opencast working.

8 Hydrocarbons

8.1 Conventional Oil and Gas

The county is dominated by the large urban developments of Liverpool, Birkenhead and St Helens. Much of this development is over the crop of the Permo-Triassic strata, whilst that of St Helens in the northeast of the county, is over the crop of Pennine Coal Measures (Westphalian) strata, forming part of the important and heavily-mined South Lancashire Coalfield.

Permo-Triassic strata represent the onshore continuation of the East Irish Sea Basin, offshore, within which hydrocarbons (mainly gas) have been discovered in the Morecambe, Lennox, Millom, Hamilton (including East and North), Bains, Calder, Dalton, Ormond South and Crossans fields. Oil has also been produced from the Douglas and Lennox fields.

Onshore, oil and gas is encountered in the Pennine Coal Measures of the South Lancashire Coalfield to the east in the Wigan area. There have also been records of oil seeps in the Formby area (most notably in the Thirty Acre Lane and Downholland Brook area) since 1637, with a shaft sunk in 1918 to investigate the Downholland seep. It is also noteworthy that just to the south of the county a few kilometres WSW of the Kemira/Ince CBM well, two CEGB wells drilled around 1984 for other purposes had methane associated with them. Consequently, the region has, for many years, attracted interest from oil companies, with the main exploration targets having been the Triassic sandstones. In 1939, D'Arcy Exploration (the forerunner of BP) commenced a drilling campaign in an attempt to prove and define the small Formby oilfield. Many wells were only shallow, with the last ones having been drilled in about 1956. They include shafts (Downholland Brook) and over 45 shallow and deeper wells, many named Formby, with others known as Flea Moss (G1 and G2) and Freshfield (G1 and G2). This oilfield straddles the Merseyside and Lancashire county boundary (Table 1). The oilfield proved almost unique; oil being trapped in Triassic sandstones with the seal formed by glacial boulder clay. It produced 71,557 barrels of oil until the oilfield was shut down in 1965. Much work has gone into trying to identify the origin of the oil, with most observers believing it represents a deeper and breached Carboniferous trap.

Following Formby, further exploration wells have proved unsuccessful (Table 2). In 1947, D'Arcy Exploration drilled the Flea Moss G1 and G2 wells, both of which were plugged and abandoned as dry. In the mid 1950s, Steel Brothers drilled two exploration wells at Croxteth. Both recorded oil shows and bituminous material but were, however, subsequently plugged and abandoned as dry with no further development. Despite these failures, companies have continued to apply for exploration licences that have, at one time or another, covered much of the county. There has also been extensive acquisition of seismic reflection data. However, Little Crosby 1, drilled by Fina Petroleum development Ltd in 1990 and currently in open acreage, stands as the only hydrocarbon exploration well drilled in the county since the 1950s. It too was plugged and

abandoned as dry. The two Croxteth wells fall within the area of one of two current hydrocarbon exploration licences (PEDL101) that exist in the county. PEDL101 was awarded in the 9th onshore licensing round and is presently operated by Mustang Oil Ltd, which also operates the adjoining 12th round license PEDL134 to the north, covering part of south Lancashire.

Many Triassic prospects have been tested in the Cheshire Basin with no success and perhaps the better hydrocarbon prospects lie in the west of the county, adjacent to the producing East Irish Sea Basin. Potential may yet exist for an intra-Carboniferous play if accumulations that have been little disturbed since their formation and charging can be found. The current licence situation reflects the fact that the hydrocarbon prospectivity of the county is not presently perceived as great. Hydrocarbon licences held in early 2005 relate mainly to coalbed methane or mine gas (methane) development (see below).

Table 1. Oil field in Merseyside/Lancashire region

Name of field	Field type (oil or gas)	Operator at time of discovery	Current operator	Discovery date	Production started	Status at 2004	Total production (tonnes / barrels)
Formby	Oil	D'Arcy Exploration Company Ltd.	Currently open acreage	1939	1939	Shut down (1965)	10,195 / 71,557

Table 2. Hydrocarbon exploration wells and shafts within Merseyside

Exploration wells	Drilling date	Original operator	Current license area and operator	Status
Croxteth 1	1953	Steel Brothers	PEDL101	P&A dry, oil shows
Croxteth 2	1956	Steel Brothers	PEDL101	P&A dry, minor traces oil & bituminous material
Downholland Brook	1918	Charles Stopforth	Open acreage	Oil seeps - several barrels yielded
Flea Moss G1	1947	D'Arcy Exploration Company Ltd	Open acreage	P&A dry
Flea Moss G2	1947	D'Arcy Exploration Company Ltd	Open acreage	P&A dry
Freshfield G1	1940	D'Arcy Exploration Company Ltd	Open acreage	P&A dry
Freshfield G2	1940	D'Arcy Exploration Company Ltd	Open acreage	P&A dry
Little Crosby 1	1990	Fina Petroleum Development Ltd	Open acreage	P&A dry

8.2 Abandoned Mine Methane (AMM) and Coalbed Methane (CBM) potential

Pennine Lower to Middle Coal Measures of the South Lancashire coalfield crop out in the north-east of the county around St Helens and dip mainly to the south. Elsewhere, to the north of the River Mersey, they subcrop beneath Permo-Triassic strata at depths of greater than 1500 m. Although there is no active mining in the county, Coal Measures in the South Lancashire coalfield have been extensively worked in many areas. The succession is up to 880 meters thick, with 33 named coals present, attaining a maximum seam thickness of >3 m and producing 20-25 m total thickness. Historically, oil and gas have been encountered in the coalfield, with some seams long known for their 'coal gas' (the fuel gas produced from a high-volatile bituminous coal, the average composition, by volume, being 50% hydrogen, 30% methane, 8% carbon monoxide, 4% other hydrocarbons, and 8% carbon dioxide, nitrogen and oxygen). Coals are high to medium, volatile bituminous types and yield a seam gas content of up to 9.5, with an average of 8.2 m^3 CH_4 per tonne.

The Wirral area is underlain by generally easterly dipping Pennine Lower-Middle Coal Measures of the North Wales coalfield. The succession includes numerous thin coal seams of mainly medium volatile coking coal at depths of between 250 and 1500 metres. Average gas seam content ranges between 7.1 and 8.4 m^3 CH_4 per tonne.

The concept of abandoned or coal mine methane capture in the UK goes back to the 1950s when Old Boston mine in the Lancashire coalfield was sealed and then tapped to supply gas to the adjacent Wood Colliery. Old Boston mine lies in the east of the county in EXL273, operated by Greenpark. This previously successful scheme has perhaps been influential in the interest generated in AMM and CBM in the South Lancashire and North Wales coalfield areas over recent years. Licences (and operators) relating to methane extraction in the county presently include: PEDL116 (Stratagas), PEDL038 (Alkane), EXL273 (Greenpark), EXL276 (Biogas), PEDL145 (Island Gas) and EXL253 (Eastern/Pegasus).

Prospects for AMM in the county to the north of the Mersey may not be perceived as particularly good because any former mines are long abandoned and thus are likely to be flooded. Coal Measures in the North Wales coalfield have been mined and prospects for AMM are good, providing mines have not flooded.

In the USA, most coalbed methane production is from coals containing 7 or more m^3 CH_4 per tonne. Gas content of the coals in the South Lancashire and North Wales coalfields is thus above the economic threshold in America. Between 1994 and mid 2003 Evergreen Resources UK held exploration licences that covered southeastern areas of the county and extended over much of the area from Warrington to south of the Mersey and down to near Wrexham. A series of pilot well schemes were drilled to evaluate the CBM potential in these areas, most notably to the west of Chester and around Warrington. Those licences in the county have now been relinquished or ownership transferred to Biogas (EXL 276) and Island (PEDL 145). Evaluation of CBM potential is presumably still ongoing in those part blocks retained, or interest has turned to AMM.

The South Lancashire coalfield has been heavily mined and therefore CBM development from virgin coal seams may only be a prospect in unmined areas of the coalfield in the south of county. CBM potential is thought to be particularly good in the North Dee area of the North Wales coalfield, although structural complexities and rapid deepening into the Cheshire Basin

may limit potential. If similar conditions extend beneath the Wirral, then similar potential may exist there.

9 Aims and limitations

The purpose of the maps in this series is to show the broad distribution of those mineral resources which may be of current or potential economic interest and to relate these to selected nationally-recognised planning designations. The maps are intended to assist in the consideration and preparation of development plan policies in respect of mineral extraction and the protection of important mineral resources against sterilisation. They bring together a wide range of information, much of which is scattered and not always available in a convenient form.

The maps have been produced by the collation and interpretation of mineral resource data principally held by the British Geological Survey. Information on the extent of mineral planning permissions has been obtained from the relevant Mineral Planning Authority (MPA). Some of these permissions may have lapsed or expired. The status of individual areas can be ascertained from the appropriate MPA. Location information on national planning designations has been obtained from the appropriate statutory body (Countryside Agency, English Nature and English Heritage). For further information the relevant body should be contacted.

The mineral resource data presented are based on the best available information, but are not comprehensive and their quality is variable. The inferred boundaries shown are, therefore, approximate. Mineral resources defined on the map delineate areas within which potentially workable minerals may occur. These areas are not of uniform potential and also take no account of planning constraints that may limit their working. The economic potential of specific sites can only be proved by a detailed evaluation programme. Such an investigation is an essential precursor to submitting a planning application for mineral working. Extensive areas are shown as having no mineral resource potential, but some isolated mineral workings may occur in these areas. The presence of these operations generally reflect very local or specific situations.

The maps are intended for general consideration of mineral issues and not as a source of detailed information on specific sites. The maps should not be used to determine individual planning applications or in taking other decisions on the acquisition or use of a particular piece of land, although they may give useful background information which sets a specific proposal within context.

10 Planning permission for the extraction of minerals

The extent of all known extant and former planning permissions for mineral working is shown on the map, irrespective of their current planning or operational status. The polygons were digitised by BGS from Plotting Sheets and other documents supplied by the Metropolitan Borough Councils of Knowsley, Sefton, St Helens and Wirral. In addition, planning permission information was digitally acquired from Ministry of Housing and Local Government maps for the area and incorporated in the data. This data has been checked and amended by the local Authorities shown below. Any queries regarding the sites shown should be directed to these authorities at the addresses shown below. The polygons cover active, former and restored mineral workings and, occasionally, unworked deposits.

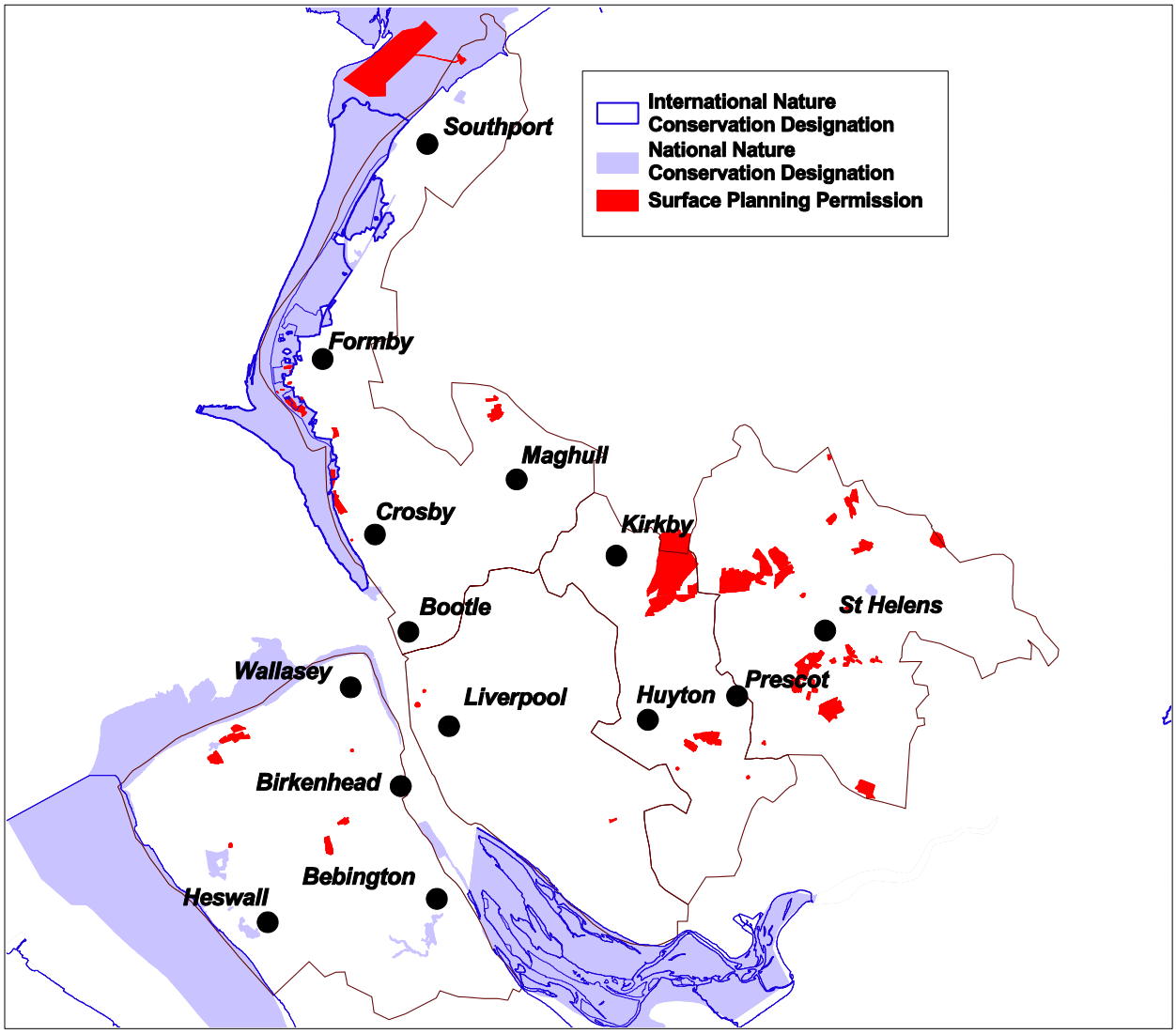

Figure 5. Surface planning permissions and national environmental designations in Merseyside

Planning Permissions represent areas where a commercial decision to work mineral has been made, a successful application has been dealt with through the provisions of the Town and Country Planning legislation and the permitted reserve will have been depleted to a greater or lesser extent. The current planning status is not qualified on the map but is available in the underlying database.

10.1 Contact addresses:

Knowsley Metropolitan Borough Council, Planning & Development Department, PO Box 26, Archway Road, Huyton L36 9FB, Tel: 0151 489 6000 , Fax: 0151 443 2370, web address: www.knowlsey.gov.uk

Liverpool City Council, Planning, Transportation & Building Surveying Services, 2nd Floor, Millenium House, 60 Victoria Street, Liverpool L1 6JF, Tel: 0151 227 3911, Fax: 0151 233 4290, web address: www.liverpool.gov.uk

Sefton Metropolitan Borough Council, Planning Department, Balliol House, Balliol Roa, Bootle L20 3NJ, Tel: 0151 934 3587, web address: www.sefton.gov.uk

St Helens Metropolitan Borough Council, Chief Executives Department, Town Hall, Victoria Square, St Helens WA10 1HP, Tel: 01744 456000, Fax: 01744 733337, web address: www.sthelens.gov.uk

Wirral Metropolitan Borough Council, Planning and Economic Development Department, Municipal Offices, Brighton Street, Wallasey L44 8ED, Tel: 0151 638 7070, Fax: 0151 691 8180, web address: www.wirral.gov.uk

11 Appendix

11.1 Topographic Base

Topography reproduced from the OS map by British Geological Survey with the permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, © Crown copyright.

11.2 Constraint Information

Constraint information published on the accompanying map has been provided from the various agencies listed below; any enquires on the information should be addressed to the relevant agency.

11.2.1 English Nature

Digital SSSI, NNR, SAC, SPA and RAMSAR boundaries © English Nature 2005

Contact address: English Nature, Northminster House, Northminster, Peterborough PE1 1UA. Tel: 01733 455000. Fax: 01733 455103. Web page: www.english-nature.org.uk

11.2.2 English Heritage

Positions of scheduled monuments at 25th September 2003.

The majority of monuments are plotted using a centred NGR symbol. Consequently the actual area and/or length of a monument protected by the legal constraints of scheduling cannot be represented here. Monuments scheduled since that date are not accounted for. © Copyright English Heritage.

Contact address: English Heritage, 23 Savile Row, London W1S 2ET. Tel: 0207 973 3132. Web page: www.english-heritage.org.uk

11.2.3 Countryside Agency

Digital AONB boundaries © Countryside Commission 1986 (now Countryside Agency).

Contact address: Countryside Agency, John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA. Tel: 01242 521381. Fax: 01242 584270. Web page: www.countryside.gov.uk

11.2.4 The Coal Authority

Coal Licence Areas © The Coal Authority 2005

Contact address: The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire NG18 4RG. Tel: 01623 427162. Fax: 01623 638338