Worcestershire Minerals Local Plan Background Document

Silica Sand in Worcestershire Consultation Document

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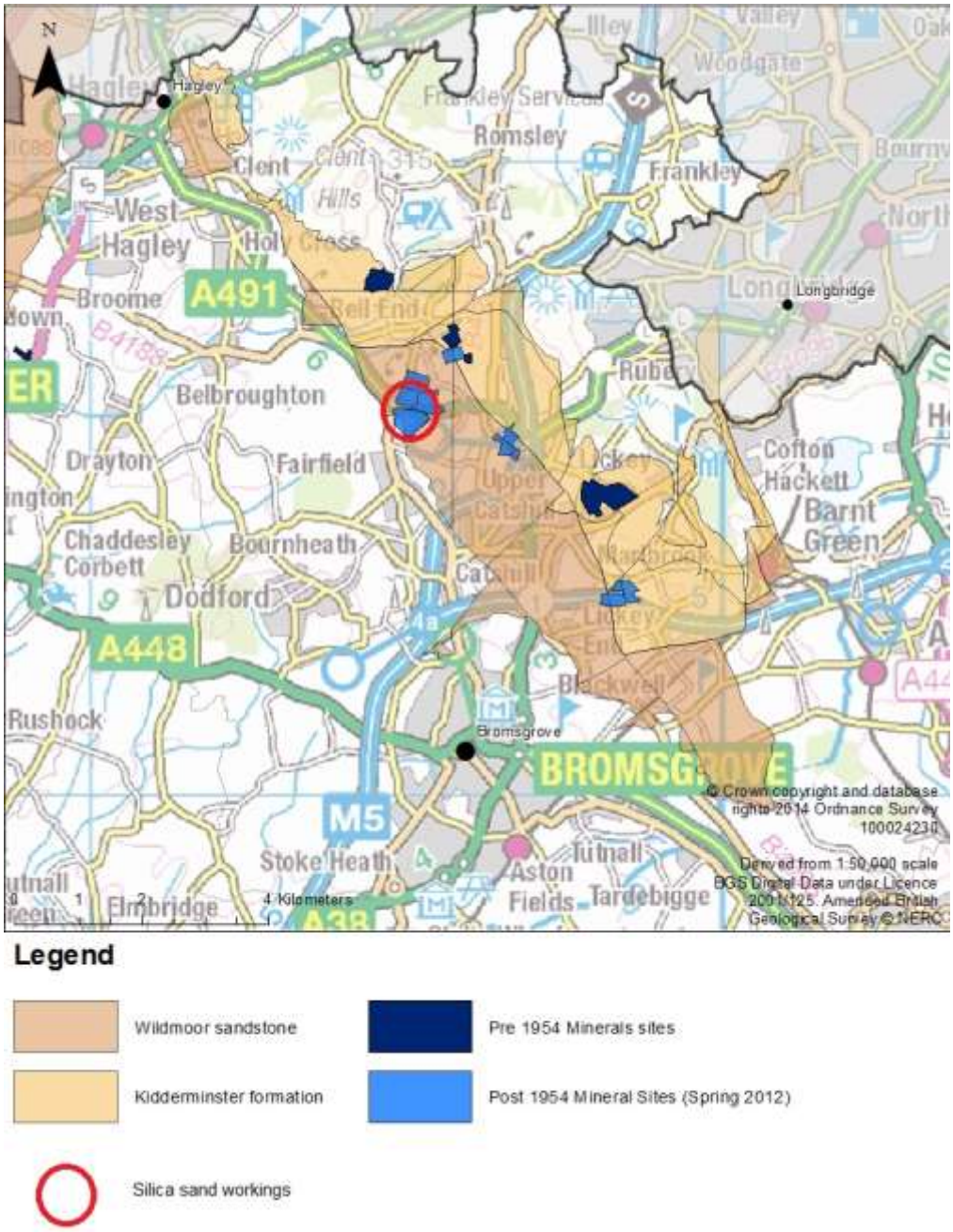
Executive summary

1.1. Silica sands are valued for their chemical and physical properties which make them ideal, and in some cases essential, for a wide range of industrial and other applications. The chemical and physical nature of different silica sands varies considerably and is reflected in the value accorded to different strata.

1.2. In Worcestershire, a type of silica sand known as "naturally bonded moulding sand", or "foundry sand", occurs as a finer-grained horizon within the solid sand deposits of the Wildmoor Sandstone Formation in the north of the county around Kidderminster and Bromsgrove. In recent times it has been worked to produce silica sand for non-aggregate purposes.

Figure 1. Wildmoor and Kidderminster Formation and existing silica sand workings



1.3. As a naturally bonded moulding sand these resources were very important in the foundry industry. The decline of that industry and the availability of more consistent synthetic sands have significantly reduced the demand for this material.

1.4. Minerals can only be extracted where they are found. The silica sand in Worcestershire is only found in the Green Belt and so special planning policies apply[1]. The scarcity of this material and its importance as a mineral of national or

[1] Mineral working is, however, considered to be "not inappropriate" in the Green Belt, provided it preserves its openness and does not conflict with the purposes of including land within it. To date, silica sand workings in this area have been permitted.

local significance means that there is some case for the remaining permitted reserves and the wider resource to be safeguarded from development which might otherwise sterilise it. Although it is not possible to safeguard silica sand deposits specifically, due to the lack of geological information to determine their extent, they could be safeguarded as part of the wider solid sand formations in the county. Existing permitted reserves could also be safeguarded to ensure continuity of supply for the diminishing demand which remains.

1.5. There is only one active working in the county, which produces sand primarily for aggregates purposes (mostly low-grade fill and mortar sands), with only a small level of sales of silica sand for non-aggregate uses. The latest known level of production in Worcestershire is around 2,000 tonnes per annum[2]. We are not aware of any evidence that further permissions are necessary during the Plan period to "… support the level of actual and proposed investment required for new or existing plant, and the maintenance and improvement of existing plant and equipment"[3].

1.6. The nature of the strata in Worcestershire means that silica sand workings have tended to be small, steeply sided pits, averaging 30m deep. The material is worked "dry" using conventional, sand and gravel plant. Once working has finished, sites have tended to be restored by infilling. The adopted Waste Core Strategy does not encourage the granting of further permissions for tipping and it may not be easy for future workings to be worked or restored in this way.

[2] ONS (February 2015) Mineral extraction in Great Britain 2013. n.b. due to confidentiality reasons, the 2014 report does not provide data for Worcestershire. It is unclear whether the 2013 figure relates to the single currently operational site, or whether it also includes production from another site, planning permission for which has now expired.

[3] Ministry of Housing, Communities and Local Government (2018) National Planning Policy Framework, paragraph 208(c).

Contents

Introduction to Silica Sand

1.7. Silica Sand, also known as industrial sand, contains high proportions of silica (normally more than 95% SiO_2) in the form of quartz. It is marketed for purposes other than for direct use in the construction industry. It is therefore not conventionally regarded as an aggregate mineral. It is produced from both unconsolidated sands and crushed sandstones. Silica sands are valued for their chemical and physical properties, particularly their chemical purity and their grain size, distribution and shape. They exhibit a wide range of physico-chemical properties and individual sands may vary markedly from each other. Particular uses often require different combinations of properties, meaning that different grades of silica sand are not usually interchangeable, and even quite small differences in chemistry and grain size distribution may have significant impacts on their suitability for different uses.

Silica sand in the UK

1.8. Historically silica sand was important in the foundry and casting industries. Silica sands are also essential raw materials for glassmaking and have a wide range of applications in industry and horticulture. Sales of silica sand in 1994, 2004, 2012 and 2014 are set out in Table 1. These demonstrate the changes in the use of the material over recent years.

Table 1. National silica sand sales by end use[4]

	1994	2004	2012	2014
Glass sand	39%	53%	38%	*
Foundry sand	36%	11%	8%	*
Sand for other industrial uses	25%†	19%	20%	25%
Sand for horticulture and leisure uses	25%†	17%	33%	35%

* Withheld to avoid disclosure.

† Combined total of 'other industrial uses' and 'horticulture and leisure uses'.

[4] Data sources:

1994: Minerals Planning Guidance 15: Provision of silica sand in England.

2004: Scottish Executive/British Geological Society (2007) Geology and mineral planning factsheets for Scotland: silica sand, available online on the West Sussex County Council website [accessed 18.09.2018].

2012: ONS (February 2014) Mineral extraction in Great Britain 2012

2014: ONS (March 2016) Mineral extraction in Great Britain 2014

Glass sand

1.9. High quality silica sand makes up around 70% of the batch of ingredients that is used to make glass. The other 30% is made up of soda ash and dolomite, which act as fluxing agents, along with a percentage of recycled glass.[5]

1.10. The principal glass products made using silica sand include colourless and coloured containers (bottles and jars), flat glass, light bulbs and fluorescent tubes, TV and computer screens, and glass fibre, both for insulation and reinforcement. Glass manufacturers are principally concerned with the chemical composition of silica sands, and particularly iron, chromite, and other refractory mineral contents.[6]

1.11. The particle size distribution of the sand grains is also a key factor when producing silica sand for glass making. The sand grains can't be too coarse, otherwise they will not melt efficiently in the furnace and this could cause some to remain as blemishes in the finished product. If the sand grains are too fine, then they will get sucked into the airflows of the furnace heat regeneration systems, causing them to be lost. Ideally, an even spread of grain sizes is needed in order to encourage "fluxing", where larger particles are melted by the ones that are already melted. [7]

1.12. Another key factor in selecting silica sand for glassmaking is the chemistry of the sand, with different chemistries needed for different types of bottle, but typically 70-74% SiO_2. Levels of iron oxide, chromes, zircon and metals (including alumina) are all strictly controlled in order to ensure that the silica sand meets the requirements and expectations of both the glassmaker and the end consumer. [8]

Foundry sand

1.13. In the foundry industry, silica sand is used as the main mould and coremaking material for both ferrous and non-ferrous castings. The physical and chemical properties of the sand are important and depend on a number of factors, such as the metal and product being cast and the type of binder used.

1.14. In the past naturally bonded moulding sands were widely used. These contained sufficient clay to give the mould strength without the addition of a bonding agent. Today such sands are of little economic importance and demand is principally for clay-free (washed) sands, which are high in silica.[9]

1.15. High-purity silica sand is washed and graded to remove any impurities and then dried before it is delivered to the foundry. Because this type of sand has a higher melting point than iron, copper, aluminium and other alloys it can be mixed with a binder to produce a mould that can hold the molten metal when producing a casting. The sand is classified into different sizes which affects the amount of binder required and the final surface finish of the casting. The sand

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[5] The Silica and Moulding Sands Association, information on glass, available on the association's website [accessed 18.09.2018]

[6] British Geological Survey (September 2009) Minerals planning factsheets: Silica sand

[7] The Silica and Moulding Sands Association, information on glass, available on the association's website [accessed 18.09.2018]

[8] The Silica and Moulding Sands Association, information on glass, available on the association's website [accessed 18.09.2018]

[9] British Geological Survey (September 2009) Minerals planning factsheets: Silica sand

mould is later broken away from the casting and can be recycled within the foundry or used elsewhere in the production of asphalt or concrete products.

1.16. Foundries in the UK vary in size and type, with some capable of producing extremely high quality, specialist parts for the aerospace, mining and automotive industries. The sand is an essential raw material for all these manufacturing companies and without the special properties of the sand, many of the vital engineering components could not be produced. In most cases there is no other suitable alternative method of production.

Sand for other industrial uses

1.17. Because of its unique properties, closely-sized grades of silica sand are the principal filtration medium used by the water industry to extract solids from water. The sand is used in a wide variety of water filtration applications including potable and waste water treatment, swimming and leisure, brewing, paper processing, chemical processes and power generation.

1.18. Low-iron silica sands are ingredients of clay-based whiteware ceramics such as tableware, sanitary ware and wall and floor tiles. They are also components of ceramic glazes and enamels.

1.19. Ultra-high-purity silica sand is an essential material for the hydraulic fracturing process, where it is known as 'frac sand'. The sand is "packed tightly into the fractures and props them open, hence they are also referred to as “proppants”. This forms a permeable pathway for the oil and gas to escape from otherwise impermeable rock formations, such as shale. Approximately 70% of the proppants used in fracking are naturally-occurring silica sand. Other types of proppants include resin-coated silica sand, and ceramic proppants, which are most commonly comprised of calcined bauxite or kaolin".[10]

1.20. Silica sand is also used for enhancing production of oilfield reservoirs, as fillers in plastics, paints and rubber sealants, and for various other specific industrial processes.

Sand for horticulture and leisure uses

1.21. Silica sand can be used in a wide range of horticultural applications due to consistent grain size and lack of impurities. It is used in professional and amateur growing media blends and as a top dressing in seedling production. Sand is also one of the essential ingredients in traditionally formulated John Innes compost. It is also used as a soil conditioner and improver in a variety of horticultural sectors including market gardening, ornamental production, forestry and garden design and in urban planting soils where particle size and purity is essential. The unique quality of silica sand is also favoured for use in horticultural fertiliser manufacturing.[11]

1.22. Closely graded silica sand, often mixed with organic matter, is used in top dressing and root zones for sports surface construction, such as football and

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[10] Mitchell, C (June 2015) *Strict specifications: UK frac sand potential*. Industrial Minerals, 575. 57-59. Available online through the NERC website [accessed 18.09.2018]

[11] The Silica and Moulding Sands Association, information on silica uses: horticulture, available on the association’s website [accessed 18.09.2018]

hockey pitches and golf course tees and greens. Silica sands are also used in equestrian surfaces, golf course bunkers and synthetic football pitches.

Economics of silica sand

1.23. Silica sands command a higher price than construction sands. This allows them to serve a wider geographical market, including exports[12].

1.24. Total permitted reserves of sand and gravel in the England and Wales for all non-aggregate uses in 2005 were 25.2mt of which 356,000t were in the West Midlands[13]. In 2009 reserves had increased to 30.4mt and 377,000t respectively[14], and in 2014 they were 31.6mt, with no figure available for the West Midlands. These figures include silica sand and other types of sand for non-aggregate uses but no further breakdown is available. Sales of industrial sand[15] (England only) are set out in Table 2.

[12] British Geological Survey (2009) Minerals planning factsheet: silica sand.

[13] Department for Communities and Local Government (May 2007) Collation of the results of the 2005 Aggregate Minerals Survey for England and Wales, Appendix B and Table 4f.

[14] Department for Communities and Local Government (May 2011) Collation of the results of the 2009 Aggregate Minerals Survey for England and Wales, Table B1.

[15] ONS (2016) Mineral extraction in Great Britain 2014 Business Monitor PA1007.

Table 2. Sales of industrial sand in England

Year	Industrial sand sales (including - but not solely - silica sand, and including sand for agricultural, horticultural and leisure purposes)
1970[16]	5,782,000t
1994[17]	4,038,000t
1999[18]	3,504,000t
2009[19]	3,293,000t
2010[20]	3,633,000t
2011[21]	3,533,000t
2012[22]	3,361,000t
2013[23]	3,620,000t
2014[24]	3,630,000t

1.25. The British Geological Survey's minerals planning factsheet on silica sand[25] notes that: The steady reduction in the demand for foundry sand resulting from the progressive decline in UK heavy industry "appears to have stabilised and there is a requirement for foundry sand to be of higher quality due to the typical applications now being served by UK foundries, (such as aerospace, military and precision automotive parts). There has been a recent increase in demand for glass sand". It also states that "Of total output in 2007, just under 90% was produced in England, with most of the remainder from Scotland. However, with significant identified resources, Scotland may become of increasing importance as a source of silica sand for UK industry in the future".

[16] Office of the Deputy Prime Minister (September 1996) Minerals Planning Guidance 15: Provision of silica sand in England, Table 1: Great Britain: Production of silica sand (000 tonnes) [replaced by the National Planning Policy Framework on 27 March 2012]

[17] Office of the Deputy Prime Minister (September 1996) Minerals Planning Guidance 15: Provision of silica sand in England, Table 1: Great Britain: Production of silica sand (000 tonnes) [replaced by the National Planning Policy Framework on 27 March 2012]

[18] ONS (2000) Mineral extraction in Great Britain Business Monitor PA1007 1999, reports for 2009-12. Available through the National Archives website [accessed 18.09.2018]. This is the first year that statistics on Industrial sand were produced for the whole of England and Wales.

[19] ONS (2010) Mineral extraction in Great Britain 2009 Business Monitor PA1007.

[20] ONS (2011) Mineral extraction in Great Britain 2010 Business Monitor PA1007.

[21] ONS (2013) Mineral extraction in Great Britain 2011 Business Monitor PA1007.

[22] ONS (2014) Mineral extraction in Great Britain 2012 Business Monitor PA1007.

[23] ONS (2015) Mineral extraction in Great Britain 2013 Business Monitor PA1007.

[24] ONS (2016) Mineral extraction in Great Britain 2014 Business Monitor PA1007.

[25] British Geological Survey (2009) Minerals planning factsheet: silica sand.

Silica sand resources in Worcestershire

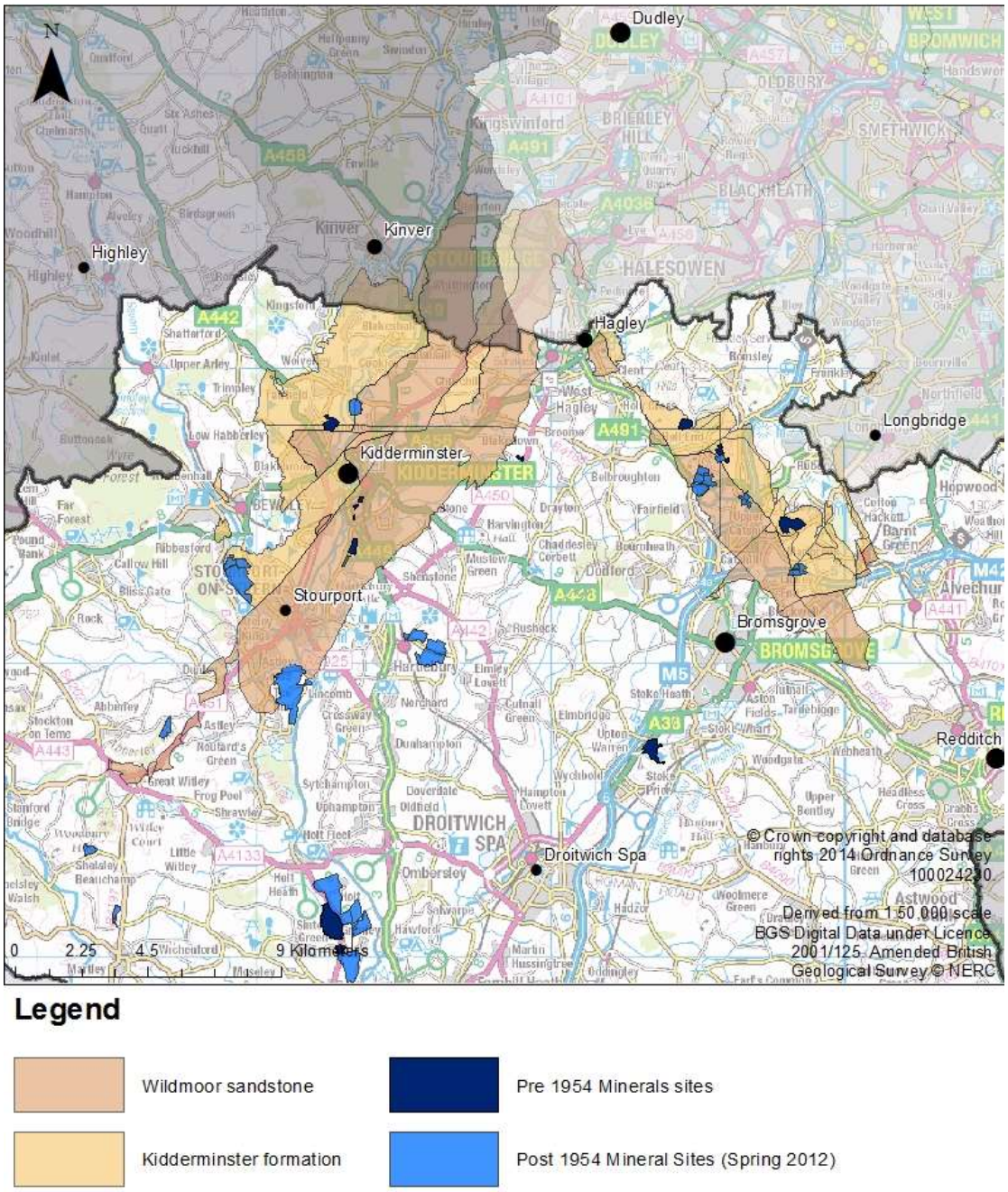
Resources

1.26. The geological maps of north Worcestershire show many "Foundry Sand Workings". The Wildmoor Sandstone Formation was recorded alongside other resources elsewhere in the country as a nationally important resource in 1996 in *Mineral Planning Guidance Note 15: Provision of Silica Sand in England* (MPG15)[26]. MPG15 has, however, been superseded by the National Planning Policy Framework and now has no formal status. The NPPF refers to silica sand as a mineral of national and local importance, but does not detail any particular formations or geographical locations or identify any strata as particularly important.

1.27. The Wildmoor Sandstone Formation (formerly the Upper Mottled Sandstone), is generally described as red-brown and orange, fine to medium grained, feldspathic sandstone with sparse, thin mudstone beds. Generally the formation is characterised by a remarkably uniform, very weakly cemented, fine-grained, silty, micaceous sandstone and an absence of pebbles (in contrast to the Kidderminster Formation with which it is commonly associated in the county) although sparse pebbly stringers are recorded. The fine grain-size and soft, poorly cemented nature of the sandstone in some areas of this formation made it ideal for exploitation as moulding sand for use in the foundry industry. These sands were of great importance in the past and the Wildmoor Sandstone was intensively worked in different parts of the West Midlands for this purpose. However not all of the sandstone in the Wildmoor formation is useable as silica sand and there does not appear to be any information available to indicate which areas are or are not silica sand. Map 2 shows the broad location of the Solid Sand resources in Worcestershire. To date, planning permissions to extract silica sand have only been granted in the Wildmoor Sandstone Formation north of Bromsgrove.

[26] Office of the Deputy Prime Minister (September 1996) Minerals Planning Guidance 15: Provision of silica sand in England, paragraphs B1, B6 and B9, and Map 1 [replaced by the National Planning Policy Framework on 27 March 2012]

Figure 2. Wildmoor Sandstone and Kidderminster Formation resources in Worcestershire



1.28. The Wildmoor formation ranges in thickness; a borehole near Hagley proved 175m of red hard and soft sandstone, although some of this could be attributed to the underlying Kidderminster Formation, since the lower boundary is indistinct. The BGS memoir for Droitwich, Abberley and Kidderminster recorded that the greatest depth of the Wildmoor formation was proved in a borehole at Wildmoor, east of Fairfield, where 398' (121.3m) were passed through without the bottom being touched. Information submitted with planning applications provides further details about the resource. These have all been for surface workings and have been much shallower:

- Material supporting the 1979 application for planning permission to deepen Chadwich Lane pit reported that the silica sand deposit "varies with the height of the land" and depth is "unknown".
- Supporting material for the 1998 application to extend the Chadwich Lane Pit indicated a depth of 80' (24.4m), based on the depths of material in and adjoining the existing pit.
- Material supporting the 1971 application for the pit to the south of Chadwich Lane, (Wildmoor Quarry, formerly known as John Williams Cinetic Sand and later operated by the Salop Sand and Gravel Company), reported a depth of 80' (24.4m).
- The mean average working depth of all the workings in the Wildmoor area is 30.3m)

1.29. The general distribution of silica sand resources is relatively well known. However, while they are in the ground, there is generally a lack of detailed information on their suitability for particular end-uses, their physical and chemical characteristics, and the nature and extent of processing which would be required to make them suitable for specific uses. The future supply of silica sand generally is likely to depend on the increasing use of processing techniques to upgrade sands to the required specifications. Plant required to upgrade sands may be costly.

1.30. Silica sand-bearing deposits may be overlain or inter-bedded with inferior grade sands that are not capable of use in industrial applications and hence are only suitable for construction uses. The use of such sands for construction aggregate can maximise recovery and thus ensure the efficient use of the total resource, in line with the principles of sustainable development.

Workings

1.31. Silica sand is currently worked and sold as foundry sand at one site in the county, namely Wildmoor Quarry (formerly John Williams Cinetic Sand), off the A491 Sandy Lane, Bromsgrove. Most of the material at the site is, however, sold as aggregate (mortar and construction sand)[27].

Sales of silica sand in Worcestershire

1.32. There is very limited data for the overall sales of silica sand in Worcestershire in recent years as any information has been withheld to avoid disclosure of confidential data.[28] However, as shown in Table 3, older figures show a significant decline in sales, with figures in 2010 being over 80% lower than those in 1999.

[27] Applications for planning permission John Williams Cinetic Sand Ltd 407328 (B41/05) and 403642 (B5913) and Stanley N Evans Ltd 407219 (B41/02)

[28] ONS (2016) Mineral extraction in Great Britain 2014: Business Monitor PA1007

Table 3. Industrial sand (Moulding sand for foundry uses)[29] sales in Herefordshire and Worcestershire

Year	Sales in Herefordshire and Worcestershire combined[30]
1999[31]	17,000t
2010[32]	3,000t
2011[33]	3,000t
	Sales in Worcestershire
2012[34]	Not released
2013[35]	2,000t
2014[36]	Not released

1.33. This decline is in line with patterns nationally. Iron founding and steelmaking have significantly declined in the UK over the last 30 years. In addition, changes in the specification of the sand needed have significantly affected demand for silica sand from Worcestershire, as the properties of the silica sand from the Wildmoor Sandstone Formation cannot be controlled as easily as synthetic foundry sand made by combining other materials with chemical binders.[37]

Wildmoor quarry

1.34. Some information is known regarding silica sand sales at Wildmoor Quarry (formerly John Williams Cinetic Sand). An application for planning permission to extend the quarry in 1993 showed a significant decline in sales from 104,940t in 1970 to approximately 25,000t in 1987, and sales remained at this level until 1993.[38] The operator states that it sells Silica sand for non-aggregate uses other than for Foundry sand. Although the Annual Mineral Sales in Great

[29] This is the only category for which sales of industrial sand are recorded for Worcestershire, alone or in combination with other counties.

[30] In order to protect commercial confidentiality the Office for National Statistics and Aggregates Working Parties have combined sales figures for some kinds of minerals from the two counties for many years.

[31] ONS (2000) Mineral Extraction in Great Britain 1999 Business Monitor PA1007

[32] ONS (2011) Mineral extraction in Great Britain 2010 Business Monitor PA1007.

[33] ONS (2013) Mineral extraction in Great Britain 2011 Business Monitor PA1007.

[34] ONS (2014) Mineral extraction in Great Britain 2012 Business Monitor PA1007.

[35] ONS (2015) Mineral extraction in Great Britain 2013 Business Monitor PA1007.

[36] ONS (2016) Mineral extraction in Great Britain 2014 Business Monitor PA1007.

[37] Mineral Resource Information for Development Plans, Herefordshire and Worcestershire: Resources and Constraints BGS/DETR 1999 page16

[38] Application 407328 (B41/05) 1993.02.09

Britain PA 1007 reports include sales of "Industrial Sand" for "other industrial uses" and for "agricultural, horticultural and leisure uses" there is no published data for these sales in Worcestershire.

1.35. Correspondence with the operator in 2014 shows further decline but indicates that there is still some market demand for the material:

"Silica sand (sales are) about 5-10,000 tonnes per year and supplies as you can imagine many small individual foundries. We are the only source of foundry sand for many of these foundry sand in Britain and support many many jobs. Foundries are using often only 1 pallet a month so that gives you a feel of the amount of business we support. The remainder of our sales are building sand mainly to builders merchants and we supply every builder's merchants in Worcestershire just about. Tonnages of building sand per Annum vary between 50.000 and 130,000 tonnes depending on the economy. We also produce cable sands[39] and crusher run[40] sands as required for localised use." [41]

Future provision

1.36. The NPPF states that "Minerals planning authorities should plan for a steady and adequate supply of industrial minerals by […] maintaining a stock of permitted reserves to support the level of actual and proposed investment required for new or existing plant, and the maintenance and improvement of existing plant and equipment. It also states that "These reserves should be at least 10 years for individual silica sand sites [and] at least 15 years for […] silica sand sites where significant new capital is required".

1.37. There are significant problems in planning for this supply in Worcestershire. Notably, there is very little publicly available data on sales or reserves of silica sand in the county (there are only two sites in the county and, under long-standing agreements between operators, local authorities and government, data is not published that could enable sales or reserves from an individual site to be identified). The council has no information about the levels of actual and proposed investment under consideration. One possible way to monitor the levels of supply that will be needed over the life of the Plan could be to use national data on the levels of sales of industrial sand[42]. These show sales of Foundry Sand from Hereford and Worcester of 3,000tpa in 2011 and from Worcestershire alone of 2,000t in 2013. Over the life of the Plan this would amount to 75,000 tonnes (2,000tpa x 15 year plan period) + (3,000tpa x 10 years) = 75,000 tonnes.

1.38. There is no evidence that permitted reserves at the two sites currently producing silica sand in the county are below these levels. However there will

39 Cable Sand is an ‘as dug’ material and commonly used for blinding and laying cable and water pipes (a non-aggregate use).

40 Crusher run is the common name for dense graded aggregate or DGA, a grade of material generally used as a base under asphalt, roads, and concrete or interlocking walls (these are all aggregate uses).

41 Correspondence Richard Parton 2014.11.20

42 ONS (2013) Mineral Extraction in Great Britain 2010 Business Monitor PA 1007

be problems monitoring the effectiveness of any assumptions we make in the Plan in the absence of data on sales or reserves.

Development Issues

1.39. Minerals can only be worked where they are found, and those locations are predetermined by the underlying geology. As there are only a small number of deposits containing sand suitable for use specifically as silica sand, there are only a limited number of locations where extraction is economically feasible and where material is available in sufficient quantities to justify the capital investment required.

1.40. Different kinds of silica sand need different working methods to prepare them for sale, but extraction is almost exclusively by open cast mining (the single exception is the Lochaline mine in north-west Scotland, where the mineral is won underground by 'pillar and stall' methods). In Worcestershire silica sand occurs as bedrock which is firm but weakly cemented and can be extracted with a conventional face shovel or excavator. Blasting is not necessary and the material is readily crushed and processed in a conventional sand and gravel plant. Since at least 1990 these deposits have been worked above the water table and water has to be added to the sand as part of the working process. Officers are not aware of any evidence that alternative methods have been used in the county.

1.41. In general terms, it can be complex and costly to process and treat silica sands to particular specifications, and the physical size of the plant may mean that screening is both difficult and expensive. It should also be noted that replacing old or developing new process lines at existing sites also involves major investment. In some cases - but not, to date, in Worcestershire - the plant required to process silica sand sometimes needs to operate for 24 hours a day and delivery of sands sometimes also needs to take place continuously. Dried foundry sand must be delivered within a certain temperature range or its setting time in the foundry plant may be affected, and glass manufacturing factories usually operate round the clock. Consequently, transport of sands may also be necessary 24 hours a day. Some types of sand, notably colourless glass sand, may require chemical treatment, while sands for foundry purposes require drying and some undergo a special resin coating process.

1.42. It is important that silica sand resources are used as efficiently as possible. Within the general definition of silica sand, there are high-grade materials which, wherever possible, should be reserved for industrial end-uses which require such sand and for which there is no readily available alternative. It is in the national interest that high-grade silica sand should not be wasted and that its use in the construction industry should be minimised. However, it would normally be appropriate to use lower-grade silica sand found within a silica sand deposit - which would otherwise be wasted - as construction sand. In some cases, such materials may be returned to the quarry during site restoration. To a large extent the scarcity and high value of the various grades ensure that the market operates to meet the right end-uses.

1.43. The potential quality of a mineral extracted from a single site can vary considerably. Multiple extraction faces within one quarry, or supplies of specific feedstock from several different quarries, may be needed to enable blending of lower-specification material with that of a higher grade. This may still result in

only a small proportion being suitable for specific industrial end-uses, with remaining minerals being used for alternative purposes, such as aggregates.

1.44. There may be environmental impacts arising from the consuming industries' demands for higher-specification sands. These impacts may take the form of increased energy consumption and waste disposal associated with more sophisticated processing, and/or more extensive quarrying of the deposit in order to produce a balanced plant feed from the often complex geology of the deposit. The latter could result in larger areas of quarrying rather than smaller confined workings[43]. In contrast to other uses, the material produced in Worcestershire is ideally suited to particular kinds of foundry applications and was sold almost 'as dug', apart from being crushed to its natural grain size.

History of Silica sand working in Worcestershire

1.45. The geological maps of north Worcestershire show many "Foundry Sand Workings." Planning permissions were granted during the 1950s at sites in Brookhouse Lane, Shepley, Chadwich Lane, Madeley Heath and Wildmoor, Bromsgrove. However, changes in foundry technology have led to a decline in the use of this material and production is now confined to a single site near Bromsgrove. Even at this site most of the material is sold as aggregate (mortar and construction sand)[44].

Re-use of existing silica sand

1.46. There is no evidence on the re-use of the silica sand in Worcestershire. The former *Minerals Planning Guidance 15*, now revoked, states "at present, (1996) levels of recycling of foundry sand vary from 50% to 80% depending on the nature of the operation. Recycling of foundry sand is constrained by technology and costs. In the manufacture of castings, much foundry sand is recovered for re-use, although there is degradation in sand quality after several castings[45]."

1.47. There does not appear to be any data on the use or otherwise of recycled or secondary silica sand generally or of the material produced in Worcestershire in particular. In theory there would appear to be no reason why the material should not be suitable for general aggregate use, if only as bulk fill, but it appears to be used outside the county and we have no information about whether - and if so how - it is recycled.

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[43] Office of the Deputy Prime Minister (September 1996) Minerals Planning Guidance 15: Provision of silica sand in England [replaced by the National Planning Policy Framework on 27 March 2012]

[45] Office of the Deputy Prime Minister (September 1996) Minerals Planning Guidance 15: Provision of silica sand in England [replaced by the National Planning Policy Framework on 27 March 2012]

Re-opening old quarries

1.48. There is no evidence in general on the viability or otherwise of re-opening old silica sand sites. Former workings have tended to be landfilled. None of the older workings exist as quarries and none appear to be available for extraction to re-commence. There is little suggestion therefore that re-opening old silica sand quarries in Worcestershire is likely to be realistic.

Policy context for Silica Sand

National Planning Policy Framework

1.49. The National Planning Policy Framework (NPPF) sets out policies on the development of mineral resources, including silica sand. It states that "It is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs".[46]

1.50. It does not set out any specific targets for silica sand production but states that minerals planning authorities should "plan for a steady and adequate supply of industrial minerals by [among other things]:

- co-operating with neighbouring and more distant authorities to ensure an adequate provision of industrial minerals to support their likely use in industrial and manufacturing processes;
- encouraging safeguarding or stockpiling so that important minerals remain available for use;
- maintaining a stock of permitted reserves to support the level of actual and proposed investment required for new or existing plant, and the maintenance and improvement of existing plant and equipment."[47]

1.51. The reserves mentioned above should be "at least 10 years for individual silica sand sites [and] at least 15 years for silica sand sites where significant new capital is required."[48]

1.52. A stock of permitted reserves (areas with planning permissions for the winning and working of minerals) enables the minerals supply industry to respond speedily to fluctuations in demand. It also assists the Mineral Planning Authority and the minerals industry to take a long term view of the needs of the consumer industries and of the planning and environmental implications of meeting those needs. In practice, there are difficulties in achieving this in Worcestershire because production data in the county is confidential; in the absence of this data, it is very difficult to calculate the stock of silica sand reserves or to make specific provision in the Minerals Local Plan.

1.53. It is national policy that each production site is adequately provided for, unless exceptional circumstances prevail. However, this needs to be balanced against the Government's other policies encouraging competition, and protecting the environment and local amenity. The need for the mineral must be balanced against environmental constraints and there may be overriding environmental reasons why the stock of permitted reserves at some sites may not be

[46] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 203.

[47] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 208.

[48] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 209, footnote 68.

replenished as they are used up. In locally specific terms there are other problems in Worcestershire in that the demand for the kind of material produced in the county is now very low and has been declining for decades. Care and flexibility will be needed in balancing these issues.

1.54. It should also be noted that applications for planning permission must be determined in accordance with the development plan, unless material considerations indicate otherwise. A general commitment to maintain a stock of permitted reserves does not remove the discretion of a mineral planning authority, or the Secretary of State, to refuse planning permission if proposals are not sustainable.

Planning Practice Guidance (PPG)

1.55. National Planning Practice Guidance (PPG) provides guidance on the implementation of policy contained in the NPPF. The PPG sets out how minerals planning authorities should plan for minerals extraction, and sets out a range of environmental issues that should be addressed in any application, including: noise, dust, air quality, lighting, visual impact, landscape character, archaeological and heritage features, traffic, contamination, soil, geological structure, best and most versatile agricultural land, blast vibration, flood risk, land stability/subsidence, designated wildlife sites, protected habitats and species, and ecological networks, nationally protected landscapes, nationally protected geological and geo-morphological sites and features, site restoration and aftercare, surface and ground water, and water abstraction.[49]

Restoration of mineral sites is a priority of the NPPF, and its importance is reflected in the detailed information contained in the PPG. It states that the key stages that must be considered when considering restoration and aftercare conditions are:

- stripping of soils and soil-making materials and either their storage or their direct replacement (i.e. 'restoration') on another part of the site;
- storage and replacement of overburden;
- achieving the landscape and landform objectives for the site, including filling operations if required, following mineral extraction;
- restoration, including soil placement, relief of compaction and provision of surface features; and
- aftercare[50].

1.56. Specific guidance with regard to silica sand is limited to defining it as a mineral of national importance and advice on how to calculate the required stock of permitted reserves for silica sand sites. It states that the required stock of permitted reserves for each silica sand site should be based on the average of

[49] Ministry of Housing, Communities and Local Government (2014) Planning Practice Guidance: Minerals, paragraph: 013 Reference ID: 27-013-20140306, Revision date: 06 03 2014.

[50] Ministry of Housing, Communities and Local Government (2014) Planning Practice Guidance: Minerals, paragraph: 038 Reference ID: 27-038-20140306, Revision date: 06 03 2014.

the previous 10 years sales. The calculations should have regard to the quality of sand and the use to which the material is put[51].

Local Planning Policies

1.57. There are a number of local planning policies and guidelines in place in Worcestershire that make reference to local materials, historic conservation and building stones, but none of the plans expressly refer to the provision of silica sand. There are also parts of two Areas of Outstanding Natural Beauty (AONBs) within the county. The management plans for these areas contain guidance on issues related to the supply and use of minerals, particularly building stone, but there are no known reserves of silica sand in either AONB or evidence of industries that depend on it, and the management plans do not specifically refer to silica sand.

1.58. The saved policies of the adopted County of Hereford and Worcester Minerals Local Plan 1997 form part of the existing Development Plan. The Plan makes brief mention of "moulding sand" resources in the county (in paragraph 2.8) where it states that "These sands are found within the boulder clay in the north-east of the county. The sand is in part used for constructional fill and this element is included within the aggregate figures and part is used for industrial purposes"[52] but does not otherwise consider Moulding, Silica, or Industrial sand in any way. The new Minerals Local Plan will address all types of minerals including silica ("moulding") sand and will replace the 1997 Plan.

Bromsgrove District Plan

1.59. The Bromsgrove Development Plan 2011-2030 strategic objective SO9 aims to "safeguard and enhance the District's natural resources"[53]. So far as we are aware silica sand has only ever been worked in Worcestershire in Bromsgrove District but the Plan does not explicitly refer to it.

Borough of Redditch Local Plan no. 4

1.60. The Borough of Redditch Local Plan No.4 includes three key themes that touch on the use of local materials and heritage conservation: creating safe and attractive places to live and work, protecting and enhancing Redditch's historic environment, and creating and sustaining a green environment.

1.61. Under the key theme of creating and sustaining a green environment, Policy 15: Climate Change states that "all proposals must demonstrate that the use of sustainable, locally sourced and recycled material has been considered"[54].

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[51] Ministry of Housing, Communities and Local Government (2014) Planning Practice Guidance: Minerals, paragraph: 090 Reference ID: 27-090-20140306, Revision date: 06 03 2014.

[52] Worcestershire County Council (1997) *Adopted Minerals Local Plan para 2.8* [online] Available from the Worcestershire County Council Minerals Local Plan website.

[53] Bromsgrove District Council (2017) The Bromsgrove District Plan 2011-2030

[54] Redditch Borough Council (2017) Borough of Redditch Local Plan No.4 (2011-2030)

Wyre Forest Core Strategy

1.62. The Wyre Forest District Council Core Strategy 2006 - 2026 does not refer to minerals generally, or to silica sand in particular.

South Worcestershire Development Plan

1.63. The South Worcestershire Development Plan 2006 - 2030 includes a number of policies relevant to mineral use and working, but there are no known silica sand resources in the Plan area and the Plan does not refer to silica sand.

Other policies and strategies

Geodiversity Action Plan for Worcestershire

1.64. The Earth Heritage Trust is a charity active in Worcestershire and Herefordshire. It aims to record, protect and promote geology and landscape, and to raise awareness of Earth Heritage by engaging the public in educational programmes.[55]

1.65. The Trust has produced a Geodiversity Action Plan (GAP) for Worcestershire, which identifies a number of objectives and actions to "provide long term and sustainable support for the conservation of geodiversity within Worcestershire"[56]. These include identifying and protecting features or sites representative of the different minerals and strata in the county. Whilst these would include silica sand, it is not expressly referred to in the Geodiversity Action Plan.

Abberley and Malvern Hills Geopark

1.66. The Earth Heritage Trust was instrumental in developing the Abberley and Malvern Hills Geopark. The Geopark encompasses parts of Gloucestershire, Herefordshire, Shropshire and Worcestershire and is driven by a collection of local organisations. The Geopark "can be enjoyed by all and provides the opportunity to experience and learn about its impressive landscape and all to be found within it – geology, wildlife, archaeology, art and heritage"[57]. The Geopark also aims to promote geoconservation. It follows the western edge of the county but extends as far east as Kidderminster where the Wildmoor Formation occurs, although we have no evidence that the Wildmoor Formation in this area has ever been worked for silica sand.

[55] Earth Heritage Trust (2013) Welcome page [online] available from the Earth Heritage Trust website [Accessed 21.09.2018]

[56] Earth Heritage Trust (2009) *Geodiversity Action Plan Worcestershire* [online] available from the Earth Heritage Trust website [Accessed 21.09.2018]

[57] Abberley and Malvern Hills Geopark (2016) [online] Available from the Welcome to the Abberley & Malvern Hills Geopark webpage [Accessed 21.09.2018]

Planning issues arising from winning and working silica sand

1.67. The emerging Minerals Local Plan will provide a policy framework which ensures that the environmental, amenity and other impacts from the winning and working of any minerals, including silica sand, are acceptable. The potential impacts and other planning issues are similar to those generated by a sand and gravel pit, with the significant exception that in Worcestershire the Wildmoor Sandstone deposits from which silica/moulding sands are dug are sufficiently firm to enable workings to be relatively small in area but deep with steep sides. Planning permissions to work silica sand in Worcestershire to date have been to allow an average depth of 30m. In part this reflects the local need to keep workings above the water table, meaning that all of the workings in Worcestershire have been worked "dry".

1.68. The actual impacts from silica sand workings vary depending on the strata and location of the site; even a small site located within a designated area may have the potential to be as damaging as a large aggregates quarry located in a less sensitive, undesignated area. In general terms the scale of production at a quarry largely determines the amount of road traffic as well as the amount of noise, dust, and vibration caused. In Worcestershire silica sand working has increasingly been subordinate to the production of aggregates, particularly building sand, and the current operations generate the same kind and volume of traffic as a conventional gravel pit.

1.69. Impacts on traffic, emissions and noise from silica sand workings are comparable to aggregate or crushed rock operations.

Traffic

1.70. Silica sand workings are always likely to cause some traffic impacts. These will be most acute near the quarry site. It may be possible to mitigate some of these impacts and any future applications would need to include a transport assessment. As most sand pits operate with a small number of employees, the traffic impacts due to commuting are negligible.

1.71. Traffic noise can be reduced through natural screening using trees and hedgerows, and through acoustic fences or earth berms. To keep local traffic to a minimum, the use of other means of transport including rail, private roads and waterways should be encouraged, but these modes are not currently practicable in the Wildmoor area.

Emissions

1.72. As explained above, the emissions generated by silica sand workings are comparable to aggregate or crushed rock operations.

Dust

1.73. Dust can be created during sand extraction ("winning"), processing ("working") and during transportation of material around and off the site. Sand can also be blown off sand piles. The NPPF requires that "any unavoidable […] dust and particle emissions […] are controlled, mitigated or removed at source".[58]

1.74. Concerns about dust generally fall into two categories: nuisance effects and health effects. There is also the possibility of negative impacts on the wider environment, including heritage, ecology, and agriculture and designated nature conservation sites.

1.75. The Planning Practice Guidance states that "Where dust emissions are likely to arise, mineral operators are expected to prepare a dust assessment study, which should be undertaken by a competent person/organisation with acknowledged experience of undertaking this type of work. There are 5 key stages to a dust assessment study:

- establish baseline conditions of the existing dust climate around the site of the proposed operations;
- identify site activities that could lead to dust emission without mitigation;
- identify site parameters which may increase potential impacts from dust;
- recommend mitigation measures, including modification of site design
- make proposals to monitor and report dust emissions to ensure compliance with appropriate environmental standards and to enable an effective response to complaints.

1.76. Special care must be taken to ensure that facilities that are sensitive to dust are not unduly impacted by silica sand workings. Dust impacts arising from extraction can be mitigated through the following means:

- Using dust filters on equipment where possible
- Restricting dust-creating activities to certain times or locations
- Using water sprays and wheel-washes
- Protecting materials and active work areas from wind

Noise

Noise can be created by excavators and dump trucks on the site, and from lorries off the site. The NPPF requires mineral planning authorities to "ensure that any unavoidable noise […is…] controlled, mitigated or removed at source, and establish appropriate noise limits for extraction in proximity to noise sensitive properties". The Planning Practice Guidance states that mineral development proposals should be accompanied by a noise impact assessment,

[58] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 205.

and sets out what this should identify[59]. It also sets out noise standards and noise limits for certain mineral development activities. The NPPF also, however, recognises that some noise related to minerals sites may be unavoidable and states that, among other things, planning policies should, "when developing noise limits, recognise that some noisy short-term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction"[60].

1.77. In addition to setting noise limits, there are a number of other ways to mitigate the noise impacts caused from sand pits:

- Limiting working hours
- Taking care with reversing alarms
- Minimising drop heights from lorries or plant
- Using rubber linings in chutes or transfer points where appropriate
- Switching off machinery when not in use.

To the best of officers' knowledge, blasting or high explosives have not been used at sand pits in Worcestershire.

Green Belt

1.78. The north-eastern part of Worcestershire lies within the Green Belt, and Kidderminster, Bromsgrove and Redditch are completely surrounded by Green belt land. All of the silica sand workings permitted to date have been within the Green Belt around Bromsgrove. National policy on mineral working in Green Belt land therefore applies.

1.79. The NPPF states that there should be no inappropriate development in the green belt; however, it also states that mineral extraction is, along with certain other uses, "not inappropriate in the Green Belt provided [it] preserve[s] its openness and do[es] not conflict with the purposes of including land within it".[61]

Visual impacts

1.80. Any large mineral working will have visual impacts on the landscape, as will any large buildings or machinery. Smaller quarries will likely have correspondingly smaller visual impacts.

1.81. Key issues for landscape are especially acute within designated areas, but any mineral working must consider the effect it will have on the surrounding area. Planting of trees, hedgerows or other vegetation may help mitigate visual impacts where this is appropriate to the landscape type.

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[59] Ministry of Housing, Communities and Local Government (2014) Planning Practice Guidance: Minerals, paragraph: 019 Reference ID: 27-019-20140306, Revision date: 06 03 2014

[60] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 204.

[61] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 146.

1.82. In Worcestershire silica sand pits have been worked for much longer periods than conventional gravel pits, which means that all but the most recent working faces begin to weather. In some conditions exposures can be colonised by vegetation thereby helping reducing their visual impact.

1.83. The nature of the strata in the county means that workings in Worcestershire have been worked to create large, deep, excavations in the landscape. These have tended to be landfilled. The effect has been to minimise their ultimate effect on the landscape. The county currently has sufficient permitted landfill space to last the foreseeable future and the adopted *Waste Core Strategy* places significant restrictions on what should be permitted in future. It can no longer be assumed that silica sand pits will be restored by landfilling. The potential long-term visual impact is therefore likely to be a key consideration in the design and, possibly, the suitability of future silica sand workings.

Geological and historic conservation

1.84. Natural England and the RSPB's involvement in conservation efforts in aggregate quarries has led to a focus on biological and ecological conservation opportunities for quarries[62]. There is a developing interest in geological and archaeological conservation opportunities for quarry operators as well, and in the case of silica sand workings geological conservation may be of special interest because of the very limited distribution of the Wildmoor Sandstone strata. One sand pit at Marlbrook Lane in Worcestershire revealed an exposure of sufficient value to be designated a Site of Special Scientific Interest (SSSI). The site was, however, destroyed by unauthorised tipping on adjoining land. The loss of the site cannot be defended. The principle that such features can be exposed by working sand pits is important. Local sites can also be designated for a variety of purposes including nature and geological conservation, and the County Council regards these sites as material considerations.

1.85. Disused (and active) silica sand quarries could also, in theory, provide sites of historical and archaeological interest in terms of the industrial heritage of the workings, or of other unrelated items uncovered as part of the quarrying process. These features may also be worth protecting.

Climate change and resilience

1.86. The Council's Minerals and Climate Change background paper outlines some of the key climate change sustainability issues for the minerals sector and areas in which the minerals industry can contribute to sustainability targets. These include energy efficiency and renewable energy, transportation and other emissions, flood mitigation, habitat creation and biodiversity[63].

1.87. The capacity for silica sand workings to contribute to these targets may be influenced by the particular characteristics of individual sites.

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[62] Thompson, A. et al. (2004) *Planning for the Supply of Natural Building and Roofing Stone in England and Wales (The Symonds Report)* Office of the Deputy Prime Minister, London.

[63] Worcestershire County Council (2018) *Minerals and Climate Change Background Paper* [online] available from the Minerals Background Documents webpage [accessed 24.09.2018]

Potential for restoration

1.88. Mineral working is ultimately a temporary land use, and sand pits present excellent opportunities for biological, geological and cultural conservation. Restored sites can theoretically make an important contribution toward green infrastructure goals, including recreation opportunities. The NPPF requires that planning authorities ensure "that worked land is reclaimed at the earliest opportunity, taking account of aviation safety, and that high quality restoration and aftercare of mineral sites takes place"[64].

1.89. Much of the best practice guidance for quarry restoration applies to large-scale sand and gravel or aggregate extraction sites that are able to progressively return large areas of former workings to productive use and contribute to biodiversity or habitat creation targets. The silica and other sand workings sector is somewhat behind the aggregates industry in terms of conservation and restoration[65]. In this county this is probably a reflection of the fact that workings have been deep and long-lived and. It also reflects the fact that, with one exception, all of the sites in the county were granted planning permission to create landfill space. This is unlikely to be the case in the future and the aims of the Minerals Local Plan with regard to restoration and the positive legacy of mineral workings will apply equally to silica sand workings as to any other mineral type.

1.90. This is likely to require a change of approach to working silica sand deposits in the county to strike a balance between maximising the use of resources whilst enabling a positive restoration scheme to be implemented.

Safeguarding

1.91. National Planning Policy states the importance of safeguarding mineral reserves of local and national importance and, where appropriate, the safeguarding of associated infrastructure, against other types of development. Guidance from the British Geological Survey recommends creating Mineral Safeguarding Areas of "known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come"[66]. This concept of safeguarding supply is especially pertinent in the case of workings that produce scarce resources such as silica sand which are either unique or have a very limited geological distribution. In practice, however, demand for the kind of silica sand produced in Worcestershire has fallen significantly over the last 30 years and is now very low. Alternative materials exist and have the advantage of consistency.

1.92. Whilst we recognise the importance of silica sand as a mineral of local or national importance, there is no information available to differentiate between

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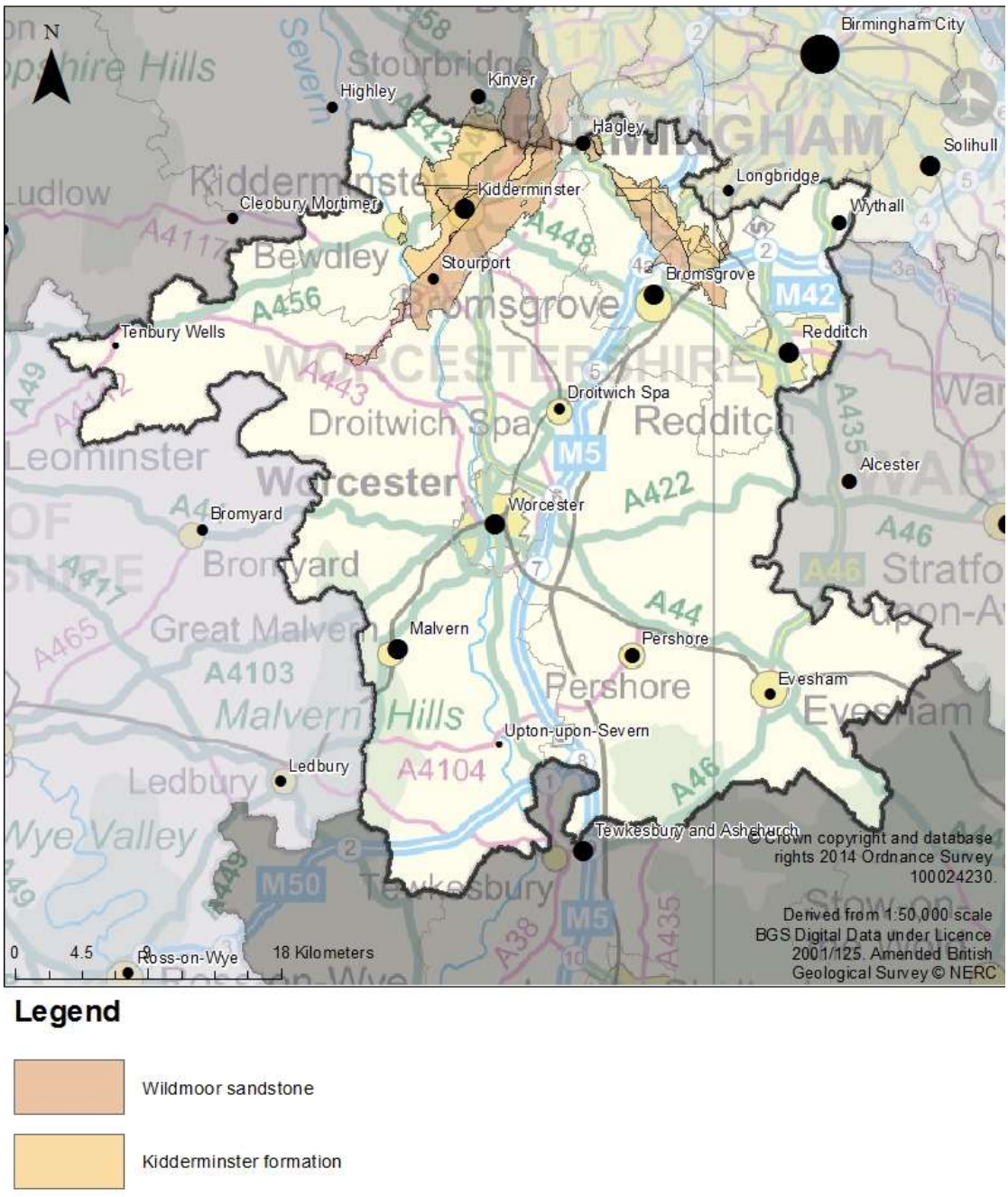
[64] Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, paragraph 204.

[65] Thompson, A. et al. (2004) *Planning for the Supply of Natural Building and Roofing Stone in England and Wales (The Symonds Report)* Office of the Deputy Prime Minister, London

[66] British Geological Survey (2007) *A Guide to Mineral Safeguarding in England* British Geological Survey.

parts of the Wildmoor Formation which contain silica sand and those which do not. However, safeguarding requirements also apply to aggregate minerals. The Minerals Local Plan could therefore ensure that silica sand is safeguarded by basing Mineral Safeguarding Areas on the presence of the Wildmoor Formations. Although this will not safeguard silica sand from use for aggregate purposes, it will safeguard it from being sterilised by other forms of development. This could be re-assessed should more specific geological information become available. The resources safeguarded would therefore be those set out in Figure 3:

Figure 3. Possible future safeguarded areas for Silica Sand



Conclusions

1.93. Although there are silica sand resources in Worcestershire, the active workings are limited and production of sand for non-aggregate uses is low. The existing site primarily works sand for aggregates, with only a small level of sales of silica sand for non-aggregate uses.

1.94. The latest known level of production in Worcestershire is around 2,000 tonnes per annum[67]. We are not aware of any evidence that further permissions are necessary during the Plan period to "… support the level of actual and proposed investment required for new or existing plant, and the maintenance and improvement of existing plant and equipment"[68].

1.95. Although it is not possible to safeguard silica sand deposits specifically, due to the lack of geological information to determine their extent, they can be safeguarded as part of the wider solid sand formations in the county. Existing permitted reserves could also be safeguarded to ensure continuity of supply for the diminishing demand which remains.

[67] ONS (February 2015) Mineral extraction in Great Britain 2013. n.b. due to confidentiality reasons, the 2014 report does not provide data for Worcestershire. It is unclear whether the 2013 figure relates to the single currently operational site, or whether it also includes production from another site, planning permission for which has now expired.

[68] Ministry of Housing, Communities and Local Government (2018) National Planning Policy Framework, paragraph 208(c).

Appendix 1: Glossary

Designated areas: A collective term that includes a number of statutory designations including European designated sites (Special Areas of Conservation, SACs), National Nature Reserves, Sites of Special Scientific Interest, Scheduled Monuments, Areas of Outstanding Natural Beauty, Conservation Areas, Listed Buildings, Battlefields, Local Geological Sites, Registered Parks and Gardens, and Local Nature Conservation Sites.

Quarry: A site where rock or minerals are extracted from the earth.

Restoration: A process whereby a former mineral extraction site is returned to beneficial after-use. Mineral extraction is often a temporary or intermittent land use: once the mineral has been won, the site is no longer useful for mineral extraction and an after-use will have to be established. This is often referred to as "restoration", even though sites are not always returned to their original use or condition. For example, it may be more appropriate for low-grade agricultural land to be "restored" as a lake or nature reserve rather than returned to agriculture.

Sandstone: A sedimentary rock made up of sand-sized grains that are generally visible to the naked eye.

Silica Sand: also known as 'industrial sand', silica sand is sandstone which contains high proportions of silica in the form of quartz. It is marketed for purposes other than for direct use in the construction industry, and is therefore not conventionally regarded as an aggregate. Silica sands are valued for their chemical purity and physical properties – principally grain size, distribution and shape. They exhibit a wide range of physico chemical properties and individual sands may vary markedly from each other. Particular uses often require different combinations of properties, meaning that different grades of silica sand are not usually interchangeable and even quite small differences in chemistry and grain size distribution may be significant**.**

Wildmoor Sandstone Formation: (formerly the Upper Mottled Sandstone), is generally described as red-brown and orange, fine to medium grained, feldspathic sandstone with sparse, thin mudstone beds. Generally the formation is characterised by a remarkably uniform, very weakly cemented, fine-grained, silty, micaceous sandstone and an absence of pebbles, (in contrast to the Kidderminster Formation with which it is commonly associated in Worcestershire) although sparse pebbly stringers are recorded.

Kidderminster Formation: (formerly the "Kidderminster Conglomerate Formation" or "Bunter Pebble Beds") is generally described as pebble conglomerates and reddish brown sandstones. The sandstones are cross-bedded and pebbly. The conglomerates have a reddish brown sandy matrix and consist mainly of pebbles of brown or purple quartzite, with quartz conglomerate and vein quartz. It lies unconformably on the Bridgnorth Sandstone, the Clent Breccia or older rocks and merges upwards into the Wildmoor Sandstone Formation, the upper boundary being placed arbitrarily above the highest pebble bed in the sequence.

Appendix 2: Additional resources

There are resources about mineral working in Worcestershire (and nationally) available online. The following represents a list of some of the most comprehensive and useful websites and projects.

The Silica and Moulding Sands Association (SAMSA) website

Nature After Minerals

Online resources about quarry restoration and minerals planning for biodiversity.

Available on the Nature After Minerals website.

British Geological Survey Mineral Planning Fact Sheet: Silica Sand

Information sheet available for download on the BGS website.

Earth Heritage Trust

A charity whose aim is to record, protect and promote geology and landscape in Worcestershire and Herefordshire. Further information is available on the Earth Heritage Trust website.

Appendix 3: Bodies consulted on initial draft of this document

Worcestershire County Council

- County Councillor Mrs S Blagg (Local Member)

Minerals Industry:

- British Geological Society
- Mineral Products Association
- British Aggregates Association
- Veolia Ltd
- Richard Parton (Wildmoor Quarry)

Conservation organisations:

- English Heritage
- Malvern Hills AONB Partnership
- Cotswold AONB Partnership
- Environment Agency
- Natural England
- Earth Heritage Trust

Mineral Planning Authorities adjoining Worcestershire:

- Gloucestershire County Council
- Warwickshire County Council
- Herefordshire Council
- Staffordshire County Council
- Shropshire Council
- Solihull Metropolitan Borough Council
- Dudley Metropolitan Borough Council
- Birmingham City Council

Local Planning Authorities in Worcestershire:

- Bromsgrove District Council

- Malvern Hills District Council
- Redditch Borough Council
- Wychavon District Council
- Wyre Forest District Council
- Worcester City Council

Other Local Planning Authorities adjoining Worcestershire:

- Forest of Dean District Council
- Tewkesbury Borough Council
- Cotswold District Council
- Stratford-on-Avon District Council
- South Staffordshire District Council

Other:

- Worcestershire LEP
- Greater Birmingham and Solihull LEP
- Belbroughton Parish Council
- Wildmoor Residents Assoc.