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Mineral Planning Factsheet

Construction aggregates

This factsheet provides an overview of aggregates supply in the UK. It forms part of a series on economically important minerals that are extracted in Britain and is primarily intended to inform the land-use planning process. It is not a statement of planning policy or guidance; nor does it imply Government approval of any existing or potential planning application in the UK administration.

June 2019

Aggregates are the most commonly used construction minerals in the UK. They are widely distributed with a range of potential sources and, while a low cost product, are used in very large quantities. They are essential for constructing and maintaining what is literally the physical framework of the buildings and infrastructure on which our society depends.

Aggregates are normally defined as being hard, granular[1] materials which are suitable for use either on their own or with the addition of cement, lime or a bituminous binder in construction. Important applications include concrete, mortar, roadstone, asphalt, railway ballast, drainage courses and bulk fill. European Standard (BS EN12620) defines aggregates as 'granular material used in construction. Aggregates may be natural, manufactured or recycled.' These are further defined as:

Natural aggregates — aggregates from mineral sources which have been subject to nothing more than physical processing (crushing and sizing).

[1] However, a proportion of aggregates sales are for constructional fill or other uses where soft and non-granular material may be acceptable or even specified.

Gravel aggregate.

Manufactured aggregates — aggregates of mineral origin resulting from an industrial process involving thermal or other modification e.g. slag.

Recycled aggregates — aggregates resulting from the processing of inorganic materials previously used in construction e.g. construction and demolition waste.

In Britain, however, it is common practice to distinguish between **primary** aggregates and alternative sources, such as **secondary** aggregates and **recycled** aggregates.

Primary aggregates are produced from naturally occurring mineral deposits, extracted specifically for use as aggregates and used for the first time. Most construction aggregates are produced from hard, strong rock formations by crushing to produce **crushed rock aggregates** or from naturally occurring particulate deposits such as **sand and gravel**. The most important sources of crushed rock in Britain are limestone (including dolomite), igneous rock and sandstone. Sand and gravel can be either land-won or marine dredged. Primary aggregates fall within the European definition of **natural aggregates**. The term **aggregate mineral** is also used for any naturally occurring material that is suitable for aggregates use. Some rock types, notably limestone/dolomite, are suitable for both aggregates and non-aggregates applications.

Secondary aggregates are usually defined as (a) aggregates obtained as a by-product of other quarrying and mining operations, such as china clay waste, slate waste and colliery spoil (minestone), or (b) aggregates obtained as a by-product of other industrial processes, such as blast furnace/steel slag, coal-fired power station ash, incinerator ash, and spent foundry sand. In European specifications, mineral waste sold as aggregates is classified as **natural aggregates**, and by-product aggregates derived from industrial processes are classed as **manufactured aggregates**.

Recycled aggregates are an important source of aggregates in Britain. They arise from various sources including demolition or construction of buildings and structures, or from civil engineering works. Other forms of recycled aggregates are asphalt planings from resurfacing roads, and railway track ballast. 'Recycling' involves the removal of deleterious materials, such as fines, wood, plastic or metal and processing by crushing and screening as required so that it can be reused, often for less demanding applications. Once a material is processed into a saleable product it becomes a resource rather than a 'waste'.

Demand

Aggregates are used in construction and they are the largest tonnage of material used by this sector. Demand is driven by activity in the construction industry and the economy as a whole. The relationship is not simple and demand forecasting has proved to be difficult. Past forecasts have proved to be too high or too low. It is difficult to forecast far ahead with any reliability and, therefore, it is important that estimates are regularly reviewed and revised.

Efficient and effective transportation, affordable housing and investment in essential assets, such as new and improved roads, rail links, airport facilities, homes, flood defences and water and sewage facilities, all consume aggregates. Thus there will be a continuing demand for aggregates. Despite a substantial increase in the use of recycled aggregates, it is likely that the major proportion of future aggregates demand will be supplied from primary sources because there are limitations on the availability of material to be recycled into aggregates.

Aggregates have a wide range of uses in construction. Table 1 shows sales of primary aggregates by major end-use in 2014. Data for more recent years are not available. Most aggregates are used in the production of concrete for buildings and civil engineering structures, or as roadstone in road building, repair and maintenance. Aggregates are also used in mortars and finishes in construction, as railway track ballast and as constructional fill.

The main use of sand and gravel is for concrete (63% of the total sand and gravel sold). Other uses for sand include mortar and for gravel include drainage layers or construction fill. The main use for crushed rock is as roadstone in road construction (40% of the total crushed rock sold), where it is either coated with bitumen in asphalt or used uncoated. A further 15% of crushed rock is used in concrete.

Concrete is made from a mixture of water, air, cement, coarse aggregates (natural gravel, crushed limestone or other hard rock) and fine aggregates (generally quartz sand, but limestone

Principal uses	**Thousand tonnes**			
	Sand & gravel*	**Crushed rock**	**Total**	**%**
Concrete aggregates	35 381	14 279	49 660	32.1
Other screened, graded aggregates and surface dressings	6 555	19 572	26 127	16.9
Roadstone, coated	181	17 597	17 778	11.5
Roadstone, uncoated	–	22 179	22 179	14.4
Building/asphalting sand	6 960	–	6 960	4.5
Railway ballast	–	2 990	2 990	1.9
Armourstone/gabion	–	976	976	0.6
Constructional fill	7 052	20 831	27 883	18.0
Total sales	**56 129**	**98 423**	**154 552**	**100**

Table 1 Great Britain: Sales of primary aggregates by major end-use, 2014.
Source: Annual Minerals Raised Inquiry, Office for National Statistics (ONS)
**including marine dredged*

sand and other crushed rock fines are also used). The water and cement form the paste binder, whilst the aggregates form an inert filler. Fine and coarse aggregates are added either separately or as combined 'all-in' aggregates. The properties of the aggregates used influence the mix proportions and the performance of the concrete. Particle size, form and shape are important. For example, finer sand sizes require more cement, which has additional cost implications because cement is the most expensive component of concrete. (See also the Factsheet on **Cement Raw Materials**.)

Modern flexible road pavements consist of discrete layers. The sub-base provides strength and a solid platform, the binder course is the main load-bearing layer and the surface course protects the lower layers from the weather and provides an even, skid resistant running surface. Aggregates used in road pavement construction may be unbound or bound by a bituminous (asphalt) or cementitious binder. Unbound layers are usually used for the sub-base but may occasionally be used for the whole structure in minor roads. Over 95% of Britain's roads are asphalt roads. A wide range of crushed rock types, as well as natural gravel and sand and certain secondary and recycled aggregates, are used as roadstone. Well-cemented limestones and sandstones are generally of sufficiently high strength, as are most igneous rocks. Road surfacing aggregates are required to be hard wearing (abrasion resistant) and skid resistant; sandstone or igneous rock aggregates are generally preferred for this purpose. These materials are the premium products of the quarrying industry.

There are numerous other applications for aggregates: large volumes are used for constructional fill (which might need to be permeable as in free draining rock fill or which could use impermeable material to raise or level the height of a construction site); as hard core used for hard standings and tracks; and for drainage materials in pipe bedding and drains. Substantial amounts of coarse aggregates (generally igneous rock) are used as railway track ballast, where the ballast layer supports and maintains alignment of the railway track, and provides a free draining base. Fine aggregates (generally fine-grained sand) are used in mortar, to bond masonry or as a surface plastering and rendering material.

Some rocks suitable for use as aggregates, notably limestone/dolomite, have a wide range of industrial applications, such as in the manufacture of chemicals, as a flux in iron and steelmaking and in the reduction of sulphur dioxide emissions from coal-fired power stations. Quarries supplying limestone and dolomite for industrial and agricultural uses invariably also supply crushed rock aggregates from material that is unsuitable for high quality industrial use. (See also Factsheets on **Industrial Limestone** and **Industrial Dolomite**.) Many crushed rock aggregates quarries also produce small amounts of building stone and conversely some building stone quarries supply modest quantities of aggregates as by-product of quarrying and processing building stone. (See also Factsheet on **Building Stone**.)

Specifications

The suitability of aggregates for a particular purpose depends principally on their physical and mechanical properties, although for some applications mineralogical or chemical properties are also important. For general purpose applications, aggregates of high strength and durability with low porosity are required. There is a reasonable correlation between aggregates quality and porosity. The assessment of aggregates properties is carried out, by using a range of standard test methods (e.g. BS EN 1097), to determine the aggregates' likely in-service performance. Different considerations apply according to the end use proposed, with the most stringent specifications being for structural concrete and road pavement construction. Specifications for less demanding uses will vary considerably providing the opportunity to use a range of weaker aggregates.

Road pavement

The performance of aggregates in a road pavement depends on the mineralogical, physical and mechanical properties of the rock, particle shape and grading (particle-size distribution). Aggregates that are used in the load-bearing layers should be resistant to crushing and impact loads, as well as chemical and physical weathering. Good pavement drainage is also essential, a characteristic which is affected by the grading, by the pore size distribution within the aggregates, and also the method of laying the pavement. Aggregates used in pavement surfacing are required to be sound, strong and durable. They must also be resistant to polishing (for skid resistance) and show resistance to stripping (the aggregates must maintain adhesion with the binder). Specifications for materials used in road making in Britain are given in the design manual *Specifications for Highway Works* and in the product standards BS EN 13043, *Aggregates for bituminous mixtures and surface treatments* and BS EN 13242, *Aggregates for unbound and hydraulically bound materials.* Supporting National Guidance is given in PD 6682-2 and PD 6682-6.

Concreting aggregates

For concrete some of the most important parameters are particle-size distribution, resistance to impact, volume stability/ frost susceptibility, relative density and water absorption, as well as the absence of deleterious constituents, such as mudstone or chalk. The product standard is BS EN 12620 with the supporting National Guidance given in PD 6682-1. The properties of the aggregates used affect concrete characteristics such as density, strength, durability, thermal conductivity and shrinkage. The shape and surface texture of the aggregates particles and their grading are important factors influencing the workability and strength of concrete. The aggregates must be strong enough not to reduce the bulk shear strength of the concrete, and they should have a low porosity. Particles with a high porosity (>1%) have a high surface area and therefore an excessively high water requirement in concrete. However, provided that is recognised in the mix characteristics, high strength concrete can be produced from porous aggregates. Concrete aggregates should also be clean (with limits on clay, silt and dust content) and not contain impurities (e.g. mudstone, pyrite, coal, mica) that would affect the strength or durability of the concrete. In addition, they should be resistant to attack by alkaline cement pore fluids (the alkali-silica reaction).

Mortars

Specifications for mortar sands indicate that sands should be hard, durable, clean and free from clay, either in pellet form or as adherent coatings. However, minor quantities of clay and silt are normally present in dry screened mortar sand and can impart useful properties. Most specifications emphasize particle size distribution (BS EN 13139 and National Guidance PD 6682-3). Colour, both consistency and particular colour, is an important consideration for mortar sand.

Railway ballast

For aggregates for railway ballast, the product standard is BS EN 13450 with supporting National Guidance given in PD 6682-8. Track ballast is required to be strong, clean and angular with a high resistance to abrasion. In common with many aggregates specifications, the selection of suitable materials for railway ballast is often based on experience and judgement as well as on experimental test data.

Construction fill

Large quantities of construction fill are used in engineering structures, such as highway embankments, embankment dams and foundations for buildings. A wide range of rock fills with differing properties may be used, including clay/shale. An important element of their use is the way they are laid to ensure adequate compaction.

Supply

A wide range of aggregates types contributes to overall supply. There is a significant variation in aggregate mineral resource types across the UK and local resources may have particular properties that affect use.

Crushed rock, and sand and gravel are the most important sources of aggregates. Substantial quantities of alternative materials are also used, notably recycled aggregates, but also materials from secondary sources. Of the estimated total supply of aggregates in Great Britain in 2017, very broadly 64% is obtained

Primary (natural) aggregates	Thousand tonnes	%
Sand & gravel	61 811	25
Land-won sand & gravel	47 537	
Marine-dredged sand & gravel (1)	14 274	
Crushed rock (2)	114 469	45
Total primary aggregates	**176 280**	**70**
Recycled and secondary aggregates (3)	**75 500**	**30**
GRAND TOTAL	**251 780**	**100**

Table 2 Great Britain: Summary of aggregates supply, 2017.
Sources: Mineral Products Association and Crown Estate.

Notes:
1. Landed at GB ports, excluding for beach nourishment. In addition, 1.6 million tonnes were used for beach nourishment.
2. Data by rock type are not available.
3. Data for secondary and recycled aggregates are not routinely collected, are difficult to obtain and the published reports are inconsistent in their methodology. The figure provided here is an estimate published by the Mineral Products Association.

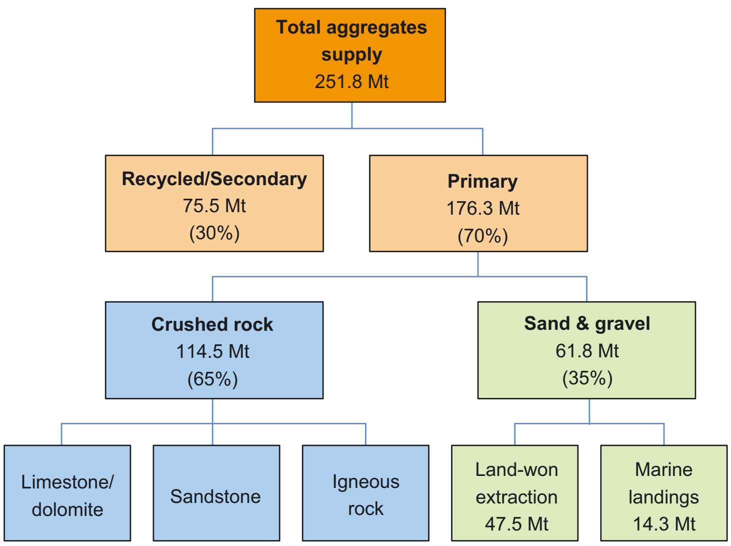

Figure 1 Great Britain: Aggregates supply chain, 2017.

from natural deposits on land (sand and gravel, crushed rock), 6% from marine sources and 30% from recycled and secondary sources.

The supply of aggregates in Great Britain is summarised in Table 2 and Figure 1. This table does not include imported or exported aggregates.

Primary aggregates supply by region and country is summarised in Table 3. Sales of primary aggregates in Great Britain peaked at 300 million tonnes in 1989 but have since declined considerably. In 2017 primary aggregates sales for Great Britain were 176.3 million tonnes, comprising 114.5 million tonnes of crushed rock and 61.8 million tonnes of sand and gravel, including marine dredged.

Sales of primary aggregates, including marine-dredged landings, for the period 1972–2017 in England, Wales and Scotland are shown in Figure 2, Figure 3 and Figure 4 respectively (note: the vertical axis are not to the same scale in these three Figures). Crushed rock aggregates account for about 65% of the total for Great Britain. In England and Wales the principal source of crushed rock is limestone (including dolomite), whereas in Scotland igneous rock is the dominant source of crushed rock, reflecting its underlying geology. No marine dredged sand and gravel is landed in Scotland, whilst in England and Wales marine sources accounted for 25% and 40% of total sales of sand and gravel, respectively.

The effects of the 2008/2009 global recession can clearly be seen in Figures 2 to 4 by the significant drops in sales of aggregates. Sales in England fell by 36 per cent between 2007 and 2010. In Wales sales fell by 39 per cent, and in Scotland they fell by 23 per cent over the same period. Although there have been some increases and decreases in aggregates sales since 2010, sales have not yet reached 2007 levels. In England sales in 2017 are 11% below 2007, in Wales they remain 33% lower and in Scotland they are 22% down.

In 2009 the former Department for Communities and Local Government (DCLG) published the *National and Regional Guidelines*

	Sand and gravel (land won and marine)	Crushed rock	Total primary aggregates
		Thousand tonnes	
North East	1 872	5 084	6 955
North West	2 788	5 357	8 145
Yorks & the Humber	2 489	10 949	13 438
East Midlands	6 046	27 206	33 252
West Midlands	6 166	4 419	10 585
East of England	13 483	0	13 483
South East	13 125	51	13 176
London	4 839	0	4 839
South West	3 491	25 895	29 386
England	**54 298**	**78 961**	**133 259**
Wales	**1 654**	**12 319**	**13 973**
Scotland	**5 859**	**23 190**	**29 049**
Great Britain	**61 811**	**114 469**	**176 280**
Northern Ireland	**2 610**	**10 060**	**13 900**
UNITED KINGDOM	**64 421**	**124 529**	**190 000**

***Table 3** UK: Sales of primary aggregates by English Region and country, 2017.*
Sources: Mineral Products Association for Great Britain and Department for the Economy, Northern Ireland. (The figures for crushed rock in Northern Ireland are somewhat overstated because sales for non–aggregates use are not separately disclosed. Figures for Northern Ireland are dependent on the number of returns and estimates are not made for missing returns.)

for Aggregates Provision in England for 2005 to 2020. These Guidelines forecast that total aggregates provision during this period would be:

	Million tonnes
Land-won sand and gravel	1 028
Land-won crushed rock	1 492
Marine-dredged sand and gravel	259
Alternative materials	993
Net imports to England	136

Of the forecast demand for aggregates for the period 2005 to 2020 of 3908 million tonnes, the DCLG assumed that 36% would be supplied from alternative sources. The national guidelines for England are split to region level. These national figures are allocated (or apportioned) by region and Mineral Planning Authority area in order that they can be incorporated into local planning strategies. The guidelines are no longer being reviewed or revised but are still available on the Government's website.

Trade

The UK has large resources of rocks that can be profitably worked for use as aggregates. Historically, therefore, the UK has been self-sufficient in the supply of primary aggregates and imports have not been necessary. The UK is a net exporter of aggregates. This is primarily due to exports of sand and gravel dredged on the UK Continental Shelf but landed at foreign ports, principally in the Netherlands, Belgium, France and Denmark. According to the Crown Estate, exports landings of sand and gravel were 3.1 million tonnes in 2017, about 18% of the total marine production. These figures for sand and gravel exports are, however, different from the figures officially reported by HM Revenue and Customs (Table 4).

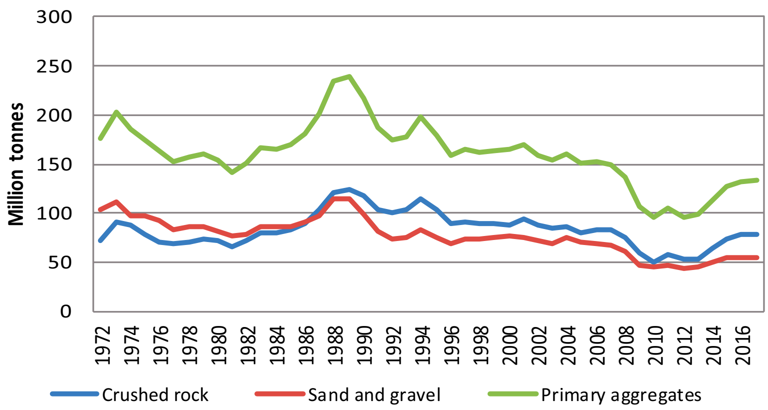

Figure 2 England: Sales of primary aggregates, 1972–2017.

Source: Annual Minerals Raised Inquiry, ONS to 2014; Mineral Products Association 2015 to 2017

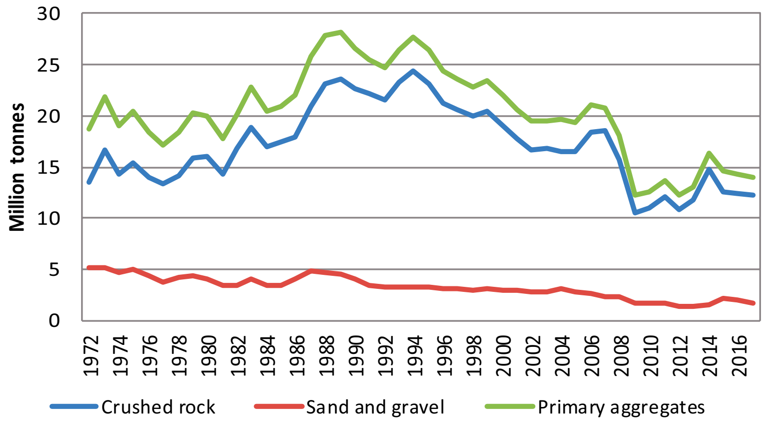

Figure 3 Wales: Sales of primary aggregates, 1972–2017.

Source: Annual Minerals Raised Inquiry, ONS to 2014; Mineral Products Association 2015 to 2017

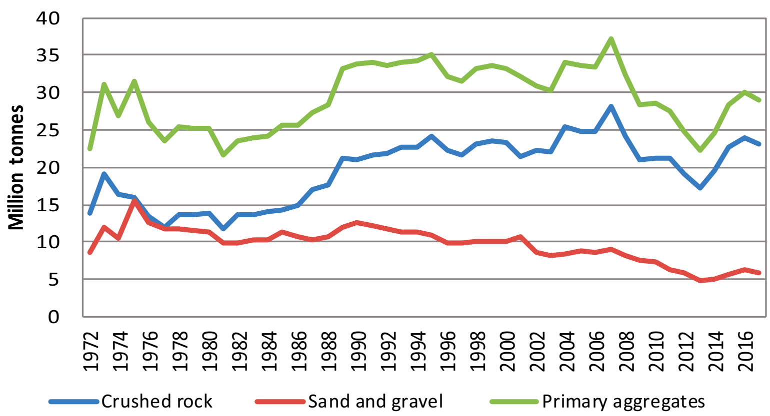

Figure 4 Scotland: Sales of primary aggregates, 1972–2017.

Source: Annual Minerals Raised Inquiry, ONS to 2014; Mineral Products Association 2015 to 2017

Official trade statistics indicate that the UK is a net exporter of crushed rock, with exports being 4.4 million tonnes against imports of 0.4 million tonnes in 2017 (Table 4). Imports, comprising crushed rock aggregates and armourstone, are mainly from Norway and the EU, particularly Ireland and the Netherlands. However, in the past there has been some uncertainty about the accuracy of the data[2]. Armourstone is believed to have been classified as 'granite, crude or roughly trimmed' in trade accounts in some years. Most of the imports are landed in the South East, including London, although landings are made elsewhere in England.

Currently imports account for <1% of total aggregates supply in Great Britain.

Consumption

Aggregates are extracted in larger quantities in the UK than any other mineral. According to data from the UK Minerals Yearbook, of the 283 million tonnes of minerals extracted in the UK in 2017, primary aggregates accounted for about 68%. For comparison the extraction of fossil fuels (coal, oil and gas combined) amounted to 27%.

Apparent consumption of primary aggregates (production plus imports minus exports) in the UK was about 188 million tonnes in 2017, with a per capita consumption of less than three tonnes. This is low by international standards and compares to a European average of five tonnes per capita.

Consumption of aggregates is fundamentally driven by activity in the construction sector. However, whilst the value of construction activity is increasing in real terms, consumption of primary aggregates has declined substantially from a peak consumption of about 300 million tonnes in 1989. A measure of the intensity of use of primary aggregates is provided in Figure 5, which shows aggregates consumption per £1000 of construction new

[2] The role of imports to UK aggregates supply. *British Geological Survey Commissioned Report.* CR/05/041N.

	Thousand tonnes							
Exports	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Sand and gravel	6 082	5 413	4 572	4 327	3 518	2 223	2 446	2 410
(of which marine S&G)	*5 192*	*5 413*	*4 548*	*4 089*	*2 995*	*2 153*	*2 767*	*3 127*
Crushed rock	4 911	5 387	4 251	4 897	4 966	4 252	3 816	4 353
Total exports	**10 993**	**10 800**	**8 823**	**9 224**	**8 484**	**6 475**	**6 261**	**6 763**
Imports								
Sand and gravel	344	358	519	493	550	722	879	632
Crushed rock	1 896	1 705	1 273	430	382	281	433	357
Total Imports	**2 240**	**2 063**	**1 792**	**923**	**932**	**1 003**	**1 312**	**989**
Crude granite	271	283	997	1 190	1 938	2 684	3 002	2 307

Table 4 UK: Imports and exports of natural aggregates (and imports of crude granite), 2010–2017.
Source: HM Revenue & Customs and the Crown Estate Commissioners

work in 2017 constant values. This is different from previous versions of this 'intensity of use' graph because the Office for National Statistics (ONS) has substantially changed the way it records construction output. The values used here are for 'new work' only and ignore the construction output generated by repair and maintenance.

Declines in the quantity of primary aggregates consumed per unit of construction new work, may be caused by several reasons:

- changes in the structure of the economy with a decline in manufacturing and growth in service industries;
- a decline in road construction;
- a decline in house building;
- the introduction of environmental taxation (the Landfill Tax and the Aggregates Levy) and increasing usage of alternative aggregates, mainly construction and demolition waste;
- changes in construction methods with increased use of steel and glass externally and plasterboard for internal walls; and
- less waste of construction materials at construction sites.

Declines in the intensity of use of primary aggregates cannot continue indefinitely because all construction still requires aggregates. As shown in Figure 5, the intensity of use will rise if more investment is put into particular types of construction, e.g. transport infrastructure, flood prevention and house building.

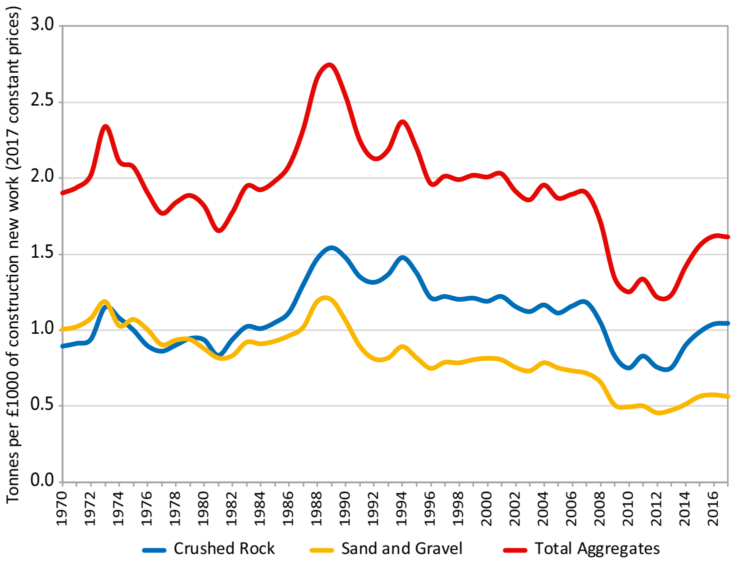

Figure 5 Great Britain: Intensity of use of primary aggregates per unit (£1000) of construction new work, in 2017 constant values, 1970-2017.
Sources: Office for National Statistics; Mineral Products Association; values adjusted for inflation using Bank of England calculator; BGS calculations.

Whilst the UK is self-sufficient in primary aggregates, and indeed is a net exporter, there are significant regional imbalances in supply, which require large inter-UK and inter-regional movement of aggregates. Regional imbalances are greatest in London, the North West and South East (Table 5; includes data for England and Wales only; similar data for Scotland or Northern Ireland are not available). The main sources for these net regional imports are the East Midlands, South West England and North Wales.

Economic importance

As noted above, aggregates are extracted in larger quantities than any other mineral in the UK. Consequently, ensuring a sufficient supply of aggregates forms a fundamental part of the *UK Mineral Strategy*, published in July 2018 by the UK minerals and mineral products industry. Aggregates are also essential to the delivery of the *UK Industrial Strategy*, published by the UK Government in November 2017 and the associated *Construction Sector Deal* published in July 2018.

Sales of primary aggregates in the UK were some 190 million tonnes in 2017 with an estimated value of £2258 million based on ex-quarry values. However, this figure considerably undervalues the contribution that aggregates make to the construction industry and to the economy as a whole. For example, transport is a key element of the supply process and of the delivered price of aggregates, and a substantial industry is required to move aggregates to the market.

More importantly, however, aggregates are at the start of the supply chain and are sold in a number of value-added products. Table 6 shows the value of sales of some of the principal value-added products that contain aggregates as an essential raw material. These too are near the start of the supply chain and the ultimate value of aggregates resides in their use by the construction industry in buildings and infrastructure.

The construction industry is a critical sector of the national economy. The Gross Value Added (GVA) of the construction industry in 2016 was £104.7 billion, accounting for 6.0% of total UK GVA.

Region	Sales of primary aggregates (thousand tonnes)	Consumption of primary aggregates (thousand tonnes)	Net imports as a percentage of consumption
South West	25 362	18 995	-
South East	14 279	19 197	26%
London	5 054	9 573	47%
East of England	12 568	16 118	22%
East Midlands	30 407	17 819	-
West Midlands	9 651	12 043	20%
North West	8 419	15 363	45%
Yorkshire & Humber	11 549	12 265	6%
North East	5 575	6 118	9%
England	**122 864**	**127 489**	**4%**
South Wales	9 043	7 150	-
North Wales	5 095	2 798	-
Wales	**14 138**	**9 948**	**-**
England and Wales	**137 002**	**137 438**	**0%**

Table 5 Sales and consumption of primary aggregates in England and Wales, 2014.
Source: Collation of the results of the 2014 Aggregate Minerals Survey for England and Wales, BGS.

Industry	Total sales of the principal products of the industry
	£ Million
Ready-mix concrete	1 907
Mortars	241
Coated roadstone	1 040
Concrete products for construction purposes	2 283
Total	**5 471**

Table 6 UK: Total manufacturing sales of selected mineral-based industries, 2017.
Source: ProdCom, ONS.

The GVA for construction in 2009 declined by 18.9% compared to 2007, as a result of the recession, but this had followed a period of continuous growth which amounted to 111.6% between 1997 and 2007. From 2009 to 2016 the GVA of the construction industry grew by 35.8%.

In 2007 the GVA of the construction industry was £95.1 billion, which amounted to 6.8% of the UK's total GVA. In 2009 this had fallen to £77.1 billion, or 5.5% of the UK's total GVA. This suggests that the construction industry was hit harder during the 2008/09 recession than the UK economy as a whole.

Structure of the industry

There are about 1400 aggregates quarries in the UK, roughly split 45:55 between sand and gravel sites and crushed rock. There are also a large number of aggregates producers, which range from single quarry owners to multi-national companies operating many sites throughout the country. In 2018, five large companies (four of which are part of global construction materials groups) accounted for just over 70% of total output, they are: Tarmac (owned by CRH plc), Hanson (owned by the Heidelberg Cement Group), Aggregate Industries (owned by Lafarge Holcim), Cemex and Breedon. The Brett Group are also an important producer.

The Mineral Products Association (MPA) is the principal trade association representing the majority of the aggregates industry. This trade association also represents the cement, asphalt, concrete, dimension stone, lime, mortar and silica sand industries, as well as aggregates. The British Marine Aggregates Producers Association, a constituent body of the MPA, represents the marine dredging industry. The British Aggregates Association (BAA) represents independent and privately-owned quarry companies throughout the UK, some of its members are also members of the MPA.

Resources

The UK has large resources of material suitable for use as aggregates and in comparison with other mineral resources in the UK they are relatively widespread. Historically, therefore, the UK has been self-sufficient in the supply of primary aggregates (crushed rock, sand and gravel). However, the geological distribution of primary aggregates resources is uneven. In particular, there is an almost total absence of hard rock suitable for crushed rock aggregates in southern, eastern and parts of central England, where demand represents a significant proportion of the UK's total.

Crushed rock aggregates

A variety of rocks are, when crushed, suitable for use as aggregates. Their technical suitability for different aggregates applications depends on their physical characteristics, such as crushing strength, porosity and resistance to impact, abrasion and polishing. Higher quality aggregates are required for demanding applications, such as in road pavements and in concrete. Lower quality aggregates may be acceptable for other applications, such as constructional fill, capping layers, local variants to type 1 sub-base and in situations of low intensity of use. Most hard rocks are potentially suitable for coarse aggregates. However, high quality crushed rock aggregates are commonly derived from hard, dense and cemented sedimentary rock (most limestones and certain sandstones) and the tougher, crystalline igneous rocks.

Limestone
Limestones (Figure 6) are sedimentary rocks composed mainly of calcium carbonate

Construction aggregates

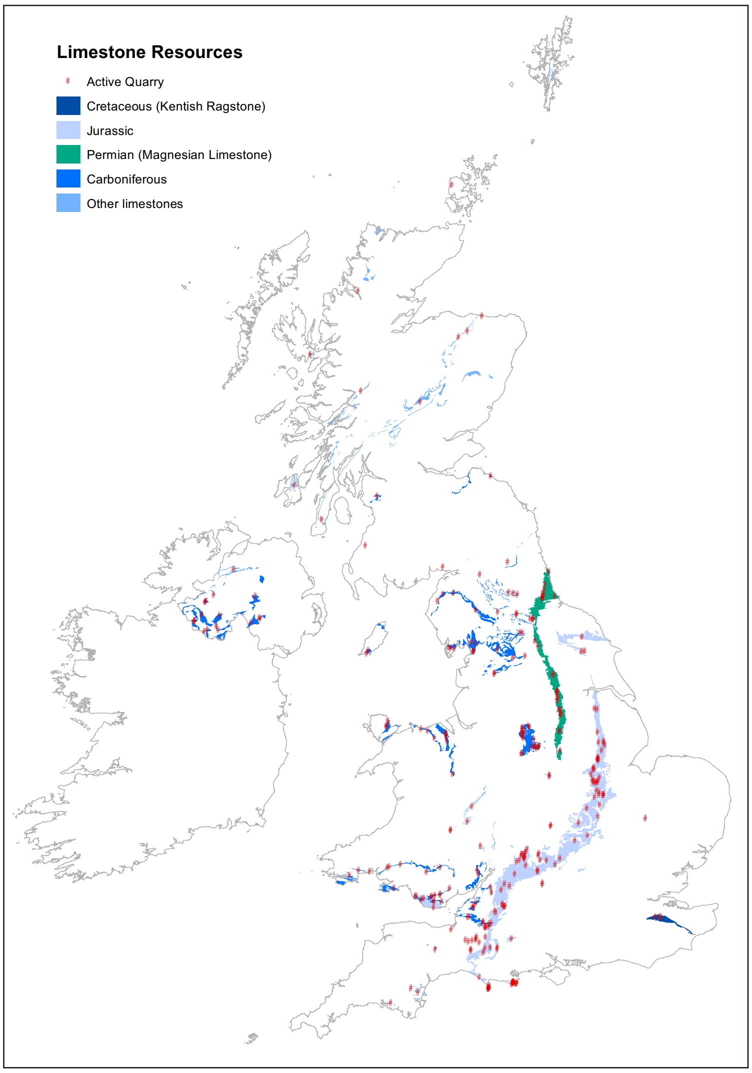

Figure 6 Distribution of limestone resources and quarries in the UK.

($CaCO_3$). With an increase in magnesium carbonate ($MgCO_3$) content they grade into dolomite ($CaMg(CO_3)_2$). Most limestones and dolomites are hard and durable and useful for aggregates. They are common rock types and consequently widely extracted for use as aggregates. Limestone is also used for cement manufacture (see **Cement Raw Materials Factsheet**) and both limestone and dolomite are valued for a range of industrial uses which, like cement manufacture, utilise their chemical properties (see **Industrial Limestone** and **Industrial Dolomite Factsheets).** Chalk is a form of fine-grained limestone but is soft and porous and generally unsuitable for aggregates use.

In Great Britain, limestone (including dolomite) provided 52% of the crushed rock aggregates produced in 2014. Limestones of Carboniferous age are the major source of limestone aggregates and it represents one of the largest resources of good-quality aggregates in Britain. These limestones are commonly thickly bedded and consistent which enable them to be quarried extensively and economically. They typically produce strong and durable aggregates, with low water absorption, suitable for roadstone (sub-base and lower layers) and concreting aggregates. The quality of the limestone resources and their ease and economy of working may be affected by a number of geological factors (such as waste content, alteration by dolomitisation, degree of faulting and folding etc).

The two main producing areas, the Mendips (in Somerset) and Derbyshire, are distinctly different due to major differences in local geology. The limestones of the Mendips are faulted and folded with many clay-filled fissures contaminating the resource. These limestones are ideal for large scale quarrying for crushed rock aggregates but are generally unsuitable for high purity industrial uses. In contrast, the limestones of Derbyshire are flat-lying and noted for their chemical uniformity and consistency over wide areas. They are quarried for industrial use as well as for aggregates. A significant proportion of Mendip limestone output is exported to south-east England, mostly by train, from two large quarries in eastern Mendips.

Other major limestones being worked for aggregates include the Devonian limestones of south Devon, the Permian Magnesian Limestone of north-eastern England and to a lesser extent Silurian limestones of the Welsh Borders. Certain of the harder, less porous Jurassic and Cretaceous (the Chalk) limestones are also quarried for less demanding aggregates applications.

The Permian limestone, which crops out in a narrow, easterly-dipping belt for some 230 km between Newcastle and Nottingham, is mainly dolomites and calcareous dolomites, but in places there is gradation into limestone. These Permian limestones and dolomites are highly variable, are much softer than typical Carboniferous limestone and have a higher porosity. Hence, they are generally quarried for their industrial uses or for lower quality aggregates applications. However, some beds are sufficiently strong, sound and durable to be used as concreting aggregates and several quarries near Maltby, South Yorkshire and near Durham produce high-quality aggregates.

Igneous and metamorphic rock

Igneous rocks (Figure 7) tend to produce strong aggregates with a degree of skid resistance and are hence suitable for many road surfacing applications, as well as for use in the lower parts of the road pavement. Aggregates for the most demanding road surfacing applications are, however, often produced from durable sandstones. The high strength and attrition resistance of certain igneous rocks results in their use as railway ballast. In Great Britain igneous and metamorphic rock accounted for 39% of the crushed rock aggregates produced in 2014.

Resources of igneous and metamorphic rocks are predominantly concentrated in Scotland and Northern Ireland, mostly in remote upland areas of the Highlands where demand is limited. In England and Wales resources are more localised and only occur in the north, midlands and west.

Quarrying of igneous rocks is centred on the outcrops that are best placed to serve the main markets, unless they have a coastal location with seaborne access. The small outcrops of Precambrian/Cambrian igneous rock (slightly metamorphosed diorite and granodiorite intrusions) in Leicestershire provide a source of hard rock in the Midlands, which is well placed to serve markets in the South East. The deposits are of economic importance out of proportion to their relatively small size. They are worked in large quarries at Bardon, Croft, Mountsorrel and Cliffe Hill, all of which are rail-linked.

Elsewhere extraction is mainly concentrated on fine to medium-grained intrusions, mostly

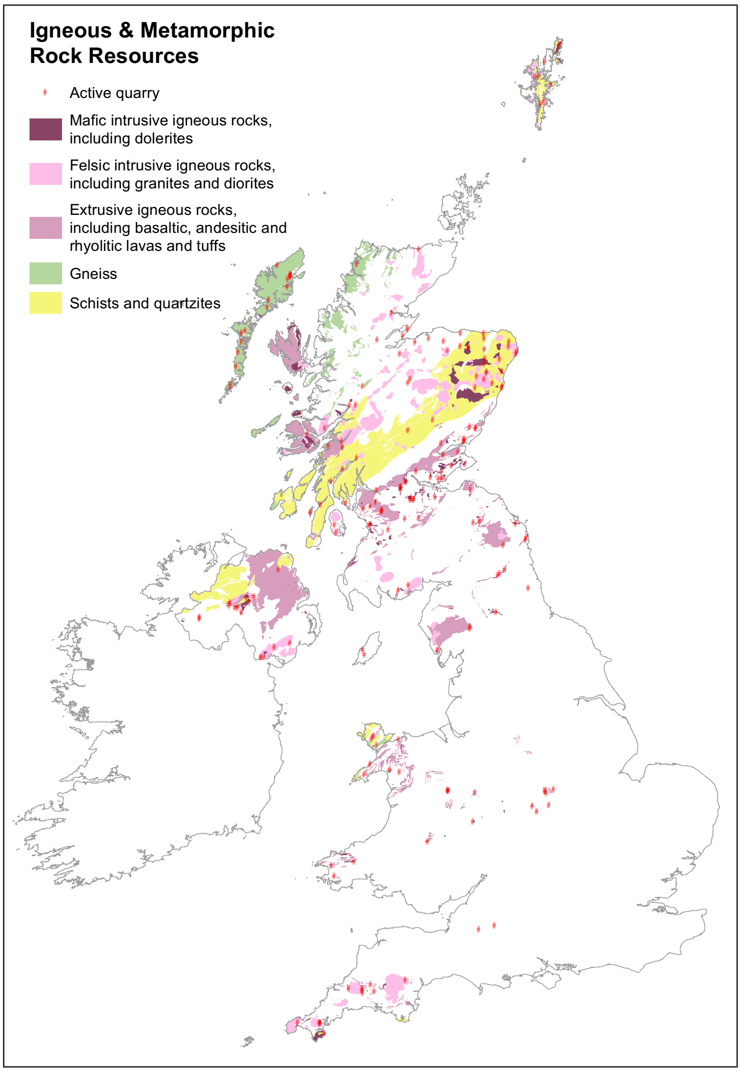

Figure 7 Distribution of igneous rock resources and quarries in the UK.

of dolerite, such as the Whin Sill in northern England, but similar types of bodies occur in the Midland Valley of Scotland, the Welsh Borders and the South West. Volcanic rocks (extrusive lavas or tuffs) are generally more variable in quality. However, Palaeogene basalts are worked in Northern Ireland and Carboniferous volcanics in central Scotland. A very high PSV (skid resistant) stone is produced from the Borrowdale Volcanic Group in the Lake District.

In the western Highlands of Scotland there are large intrusions of granite and these are worked at a few localities for crushed rock aggregates. Of particular importance is the Strontian Granite on the north-west side of Loch Linnhe and here, at Glensanda, the granite is quarried on a large scale for aggregates production, all of which is exported by ship primarily to markets in London, south-east England and north-west Europe. The granite aggregates from Glensanda are high quality materials used for roadstone, rail ballast and concreting aggregates.

Sandstone

Sandstones (Figure 8) are sedimentary rocks consisting of sand-sized particles composed predominantly of quartz but with variable amounts of feldspar and rock fragments set in a fine-grained matrix or cement. Compositional differences, both of the sand grains and the matrix, give rise to different rock names under the general heading of 'sandstone', such as quartzite, greywacke, gritstone, and arkose.

Sandstones of various geological ages occur extensively in Britain and comprise about 15% of the surface outcrops, including a few in the geologically younger surface rocks of south-east England. They differ widely in their thickness and physical properties, and thus resource potential.

Sandstones have traditionally been valued as sources of building stone (see **Building Stone Factsheet**). In 2014 only about 3% of total production was for this purpose and sandstone is now used mainly as crushed rock aggregates, although it only accounted for approximately 10% of the crushed rock aggregates produced in Great Britain in 2014.

The suitability of a sandstone for aggregates use mainly depends on its strength, porosity and durability. These qualities are related to mode of formation and geological history. Thus the mineralogical composition, grain size, degree of grain sorting, nature and degree of cementation, degree of compaction and weathering state are fundamental rock properties which directly affect the end-use performance of the sandstone and its economic potential. Individual sandstone units also vary in thickness and lateral extent.

Many types of sandstone are too porous and weak to be used other than as sources of constructional fill. In general, older more indurated sandstones (subjected to tectonic compression) exhibit higher strengths and are suitable for more demanding aggregates uses.

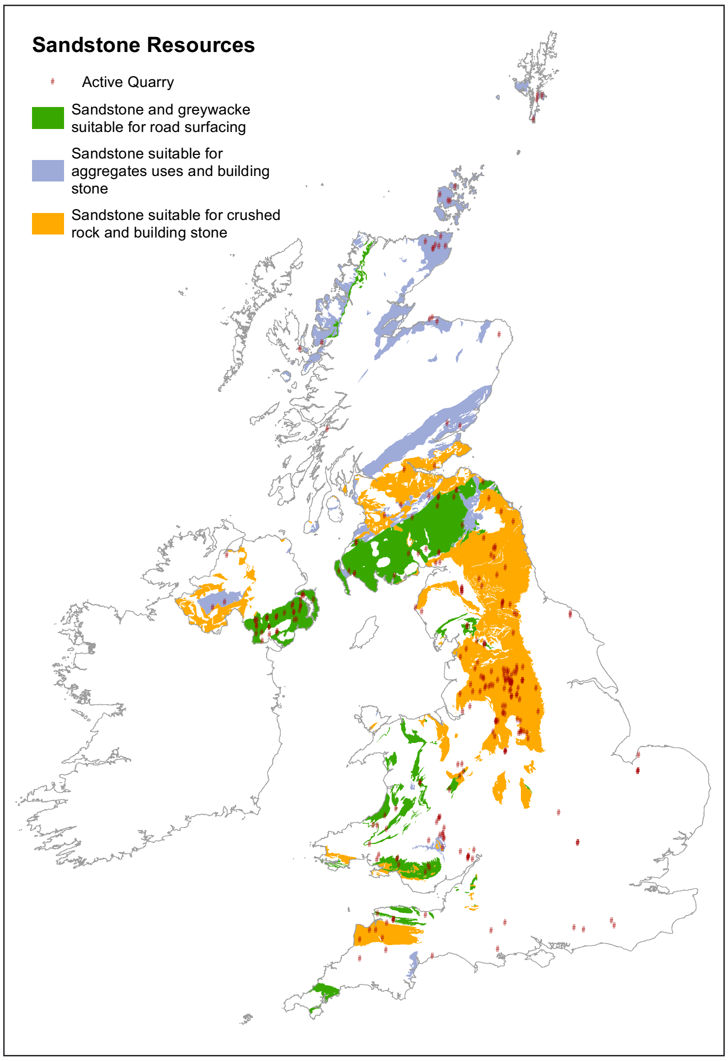

Figure 8 Distribution of sandstone resources and quarries in the UK.

Some sandstones (greywackes) also have a high polishing and abrasion resistance and are particularly valued for road surfacing where they provide resistance to skidding. They are the premium products of the crushed rock quarrying industry.

The Upper Carboniferous Pennant Sandstone of the South Wales Coalfield is one of the best natural road-surfacing materials available in Britain. These sandstones are indurated greywackes, which have been subjected to compression, and are typically highly resistant to polishing (very high PSV)[4] and in most cases they combine durability (low AAVs, low LAAVs) with good strength (low ACV). Despite the considerable thicknesses, lateral variability and widespread distribution of the Pennant sandstones, the aggregates properties of these sandstones are remarkably uniform. The major cause of variation in aggregates properties is the degree of weathering. Weathering weakens the aggregates and reduces durability. All surface exposures of Pennant Sandstone are weathered to some degree and the depth of weathering is controlled by the distribution of joints and other rock discontinuities. Pennant sandstones also occur in the small coalfields of the Forest of Dean, Gloucestershire and Bristol area. The sandstones are similar to those in South Wales but are not as widely exposed and are quarried mainly for building stone.

The Precambrian Longmyndian rocks forming relatively high ground around Shrewsbury are also important resources of road surfacing aggregates. These sandstones are subgreywackes and produce a particularly high quality roadstone which is utilised in high specification applications. In western North Yorkshire, Lower Palaeozoic rocks occur in a series of inliers unconformably overlain by Carboniferous limestones near Settle and Ingleton. These rocks are strongly folded and comprise a mixed sequence of greywackes, siltstones, arkoses and conglomerates. They are quarried for the production of high specification road surfacing aggregates for distribution throughout England.

Many sandstone deposits contain beds of clay, mudstone and siltstone which may make up a significant proportion of the deposit. These materials create difficulties during quarrying and processing and create a substantial amount of waste that may need to be disposed of on site. Processing of hard sandstones to produce the required aggregates sizes may also give rise to large quantities of fines that have to be deposited in tips and settlement lagoons within the site.

Sand and gravel

Sand and gravel (Figure 9) 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 aggregates) is used for general and concrete applications to define particles between 4 and 80 mm and the term 'sand' (or fine aggregates) for material that is finer than 4 mm, but coarser than 0.063 mm. For use in asphalt, 2 mm is now taken as the dividing point between coarse and fine aggregates.

Sand and gravel deposits are accumulations of the more durable rock fragments and mineral grains, which have been derived from the weathering and erosion of hard rocks mainly by glacial and river action, but also by wind. The properties of gravel, and to a lesser extent sand, largely depend on the properties of the rocks from which they were derived. However, water action is an effective mechanism for wearing away weaker particles, as well as separating different size fractions. Most sand and gravel is composed of particles that are durable and rich in silica (quartz, quartzite and flint). Other rock types, mainly limestone, may also occur in some land-won deposits including deleterious impurities such as lignite, mudstone, chalk and coal.

Sand and gravel was the principal source of primary aggregates until 1979, when crushed rock output exceeded it for the first time. Its relative importance has declined since then

[4] PSV- Polished Stone Value; AAV -Aggregates Abrasion Value; LAAV — Los Angeles Abrasion Value; ACV — Aggregates Crushing Value.

Construction aggregates

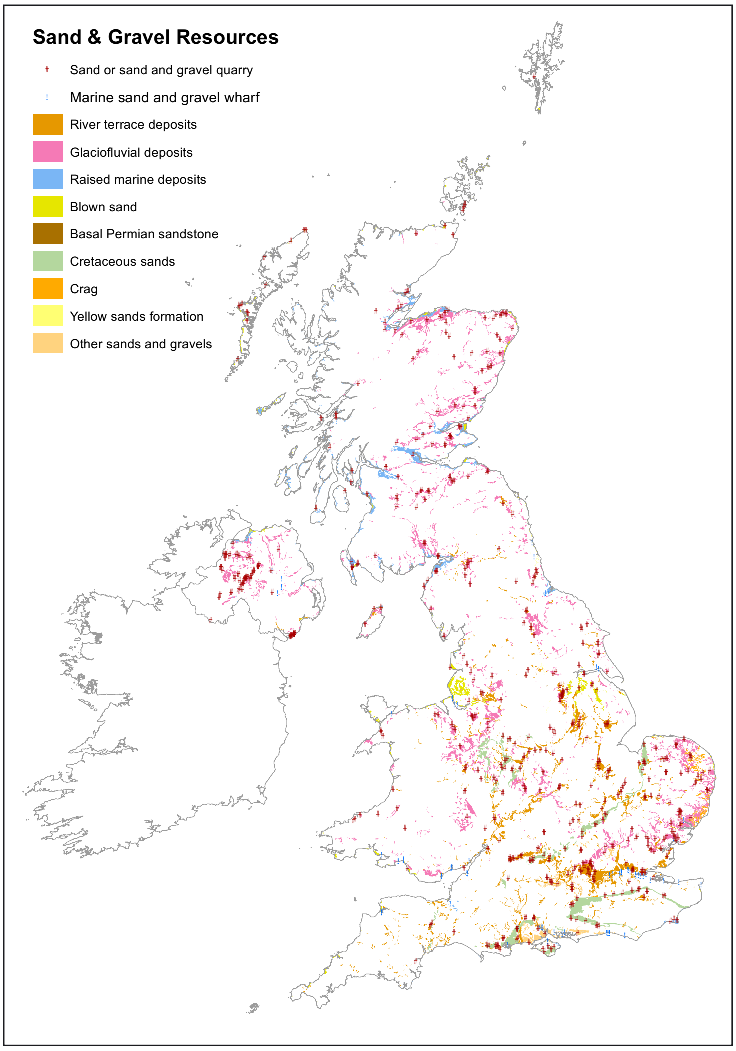

Figure 9 Distribution of sand and gravel resources and quarries in the UK

and in 2017 sand and gravel accounted for 35% of total primary aggregates supply. Sand and gravel is derived from both land-won and marine dredged sources, the latter being particularly important to supply in the South East and London.

Land-won sand and gravel

Sand and gravel resources can be conveniently classified into two major categories depending on their age and geology:

- superficial, or 'drift' deposits, and
- bedrock, or 'solid' deposits.

Superficial deposits comprise all those sediments laid down during the last two million years. They mainly comprise **river sands and gravels** which take the form of extensive spreads that occur along the floors of major river valleys, generally beneath alluvium, and as river terraces flanking the valley sides. River terraces are the dissected, or eroded, remnants of earlier abandoned river floodplains.

Deposit thickness varies from less than 1 m to maximum values of around 10 m. Sand to gravel ratios are variable, but river deposits typically are relatively clean with a lower fines content (silt and clay) than glacial deposits. Important resources are associated with the Thames, Trent and Severn and their tributaries, but many other river deposits are also worked. In general, the composition of the sand and gravel of a river basin reflects that of the rocks in the uplands drained by the river and its tributaries. The River Trent sands and gravels, for example, contain a high proportion of well sorted quartzite pebbles derived from the Triassic Sherwood Sandstone Group of the north Midlands. In contrast, the River Thames gravels are predominantly composed of flint derived from the Chalk uplands of south-east England, except in its upper reaches in Oxfordshire where the gravels are largely derived from the Jurassic limestones of the Cotswolds.

The other major group of resources are **glaciofluvial sands and gravels**. These deposits were associated with glacial action and laid down by the glacial meltwaters issuing from, or flowing on top, within and beneath, ice sheets and glaciers. The deposits are commonly associated with till (boulder clay), and may exhibit complex relationships, occurring as sheet or delta-like layers above till deposits, or as elongate, irregular lenses within the till sequence. As a result, the distribution of glaciofluvial deposits is less predictable in geographical extent than river sand and gravel deposits. They may also exhibit considerable lateral variations in thickness, composition and particle size distribution, generally contain more fines (silt and clay) and frequently contain a larger amount of over-sized materials. Thicknesses of over 30 m have been reported but overburden thicknesses can also be high.

As Britain has been subjected to several periods of glaciation, their distribution is complex. Resources may occur in all parts of the country except southern and southwest England which were not glaciated.

Other onshore resources of sand and gravel include storm beaches, such as on Dungeness in Kent, but deposits are only of local importance. Dune sands are usually too fine grained to be used to make concreting aggregates but they are sometimes used in mortar although their narrow size range is an inhibiting factor.

Bedrock deposits of sand and/or gravel are important sources of supply in some areas. They occur as bedded formations, ranging in age from Permian to Palaeogene, and are relatively unconsolidated and easily worked. Some deposits such as the Lower Cretaceous Folkestone Formation of the Weald and the Permian Yellow Sands of Durham, consist entirely of sand. The sandy pebble beds (conglomerates) of the Triassic Sherwood Sandstone Group in the Midlands and in Devon are important sources of coarse concrete aggregates. Bedrock deposits are generally much thicker than most superficial deposits and thus yields per hectare are much greater.

Marine sand and gravel

Britain has one of the world's most developed marine sand and gravel industries, which makes an important contribution to overall provision of aggregates, notably in London and the South East.

Sand and gravel resources are unevenly distributed on the continental shelf but are similar to their land-based equivalents, occurring as small patches separated or covered by extensive areas of uneconomic deposits. They vary in their thickness, composition and grading, and in their proximity to the shore.

The origins of gravel-bearing sediments offshore are directly comparable to those of terrestrial deposits. They are relict Quaternary deposits formed by fluvial (river) or glaciofluvial processes but modified by the major postglacial sea-level rise (which took place up to 5000 years ago) and subsequently re-worked by tidal currents. They represent a range of former depositional environments, including fluvial channel-fill or terrace deposits, glaciofluvial meltwater plain deposits, sea-bed lag gravels and degraded shingle beach or spit deposits, as well as modern marine tidal sand banks and sandwave deposits. The gravels are generally not replenished after extraction, though some sand deposits may be replenished, depending on the local sediment transport regime.

Sand and gravel deposits occur in many offshore areas around Britain, although gravel-bearing resources are more limited. Traditionally, most dredging has taken place in coastal waters less than 25 km offshore and in water depths of between 18 m and 35 m but in recent years there is a trend towards working further offshore and at potentially greater depths. However, the current dredging fleet is not able to extract material from water depths in excess of 60 m. There is currently no extraction off Scotland and Northern Ireland, the limiting factors being resource availability and market demand.

Extraction is locally constrained by proximity to the shoreline, gas pipelines or cable routes, offshore wind farms, fisheries, or by the navigational requirements of shipping lanes. The multiple use of UK seas means that there is competition for sea space. As marine aggregates extraction is spatially constrained by resource distribution, resources can be sterilised by other activities. The current licensed dredging areas are (in descending order of tonnages removed): the east coast (offshore Great Yarmouth-Southwold), the south coast (around the Isle of Wight), the Humber-Wash area, the east English Channel (off Eastbourne), the south west coast (chiefly the Bristol Channel), the Thames Estuary (including off the east coast as far north as Orford) and the north west coast (chiefly Liverpool Bay — Irish Sea).

There are considerable regional variations in the composition of the sand and gravel deposits. For example, the gravelly deposits offshore Great Yarmouth are mostly flint gravels of fine pebble size, whereas gravels from the Humber area are much coarser, are principally composed of igneous, metamorphic or hard sandstone types, and are derived from former glaciofluvial deposits. Gravels from the south coast area are principally composed of flint and they similarly show regional variations in grain size. The Bristol Channel area and Liverpool Bay-Irish sea area contain large volumes of sand and only relatively small amounts of gravel. Dredging here is for sand for concrete production as there are regional shortages of suitable land-won materials.

Recycled aggregates

Demolition and construction waste is inorganic material, such as concrete and masonry. It is, by far, the largest source of alternative aggregates to natural sources. Major sources include large demolition and construction operations within urban areas (redevelopment or 'brownfield' site clearance) with the advantage of being close to existing markets. Other, more remote, sources are the removal of major infrastructure facilities (runways, old hospitals, old military bases) in the countryside.

There are also substantial cost advantages to disposing of waste on site at construction sites (as hardstanding, beneath 'block and beam' floors, and in landscaping bunds). Much of the potential arisings from old infrastructure is already being utilised and as a result the UK is close to achieving maximum recovery and usage of this material. Stricter guidance on the disposal of contaminated demolition waste may limit future arisings.

Other important sources of recycled aggregates include asphalt road planings, which are removed from the road surface prior to maintenance resurfacing or full reconstruction. Spent railway track ballast is also recycled into lower grade uses. Other minor sources of recycled aggregates are spent foundry sand, waste glass and fired ceramic ware.

Secondary aggregates

The extraction and processing of china clay in south west England involves the production of large quantities of mineral waste. The coarse waste consists of sand (mainly quartz) and rock (unaltered granite). In 2008 the total industry annual arisings were roughly 4 million tonnes of sand and 3 million tonnes of rock but more recent data are not available. The industry 'stockpile' of material that is 'possibly usable' has previously been estimated to be approximately 150 million tonnes but it could be substantially different to this figure. The main problems with expanding sales is the distance to the major markets, inadequate local transport links, limited railway line and wharf capacity and the higher demand for cement when this material is used in concrete. The latter is related to the high surface area of the sand particles.

In the extraction and processing of slate very little of the material extracted is used for quality slate products. The majority of slate waste that is generated each year is in North Wales, with further small quantities arising in north west and south west England. Slate waste is being increasingly used as aggregates mainly in road construction but also as fine aggregates in concrete. Usage is modest and, as with china clay, a major problem is distance to major markets. Particle shape for slate waste can also cause problems in certain uses, e.g. concrete, because flat or 'flaky' particles have a larger surface area.

Although clay and shale would not normally be considered as a source of aggregates they may be used for bulk fill. Colliery spoil is a by-product of mining and processing coal. It consists mainly of mudstones and siltstones, which are only suitable as a source of low value bulk fill. Critical factors in the use of colliery spoil are quality and consistency, the presence of sulphates and location with respect to markets. With a contraction in deep coal mining, the availability is now much reduced and many of the historical spoil heaps are restored and unavailable for extraction. However, lightweight aggregates produced by heating certain clays at high temperature can produce good quality aggregates for concrete block manufacture.

Blastfurnace and steel slags are by-products of iron and steelmaking respectively and both have for many years been used as sources of secondary aggregates. Blastfurnace slag, in particular, can be used directly as an alternative to natural aggregates for more demanding applications.

Ash used as secondary aggregates is derived primarily from burning pulverised coal in coal-fired power stations. Incinerator bottom ash (IBA), produced from burning municipal wastes can be used but it is only produced in small quantities and generally has inconsistent qualities. Most of the ash produced in coal-fired power stations is a fine powder called pulverised fuel ash (PFA), which can be used as a cement making material, as fill and in ground remediation. Furnace bottom ash (FBA) is a coarser agglomerated ash, which is sold as a lightweight aggregates in concrete block manufacture.

Reserves

In UK mineral planning, the term 'reserves' or 'mineral reserves' refers to material that has a valid planning permission for mineral extraction. Without a valid planning permission no mineral working can legally take place. Commonly a 'landbank' is quoted for aggregate minerals, which is the sum of all permitted reserves in active and inactive sites (but not 'dormant' sites) at a specified time, and for a given area. It is usually expressed in terms of years supply at an average rate of output. The area is usually an individual Mineral Planning Authority or groups of Authorities. The minimum length of a landbank reflects the time needed to obtain planning permission and to bring a site into full production.

Information on permitted reserves of aggregate minerals (sand & gravel and crushed rock) in England and Wales is published by the Aggregates Working Parties (AWPs).

For England and Wales, detailed information on permitted reserves of primary aggregates in active and inactive sites, by region and environmental designation is published in four-yearly Aggregate Minerals Surveys. The most recent survey was carried out in 2014 and the results are summarised in Table 7. A similar survey for Scotland was published in 2015, containing 2012 data (Table 8). There has not been an equivalent survey in Northern Ireland.

Of the total permitted reserves of 3906 million tonnes in England and Wales in 2014, crushed rock accounted for 88.3%. The distribution of reserves is very uneven, with 25.0% of all

	Thousand tonnes		
Region	**Sand & gravel**	**Crushed rock**	**Total**
South West	28 924	817 669	846 593
South East	67 214	52 171	119 385
London	702	0	702
East of England	123 588	4 807	128 395
East Midlands	59 687	918 592	978 279
West Midlands	88 822	268 919	357 741
North West	25 480	257 817	283 298
Yorkshire & the Humber	25 209	239 233	264 442
North East	18 198	219 723	237 920
England	**437 823**	**2 778 932**	**3 216 756**
South Wales	3 392	511 814	515 206
North Wales	16 091	157 592	173 683
Wales	**19 483**	**669 406**	**688 889**
England & Wales	**457 306**	**3 448 338**	**3 905 645**

Table 7 Total permitted reserves of land-won aggregate minerals in active and inactive sites in England and Wales, 2014.

Source: *Collation of the results of the 2014 Aggregate Minerals Survey for England and Wales, BGS. (This data excludes non-aggregates uses, and also excludes 'dormant' sites).*

Region	Thousand tonnes		
Region	Sand & gravel	Crushed rock	Total
Argyll & Bute	S	S	S
Forth Valley	S	0	S
Highland & Moray	5 430	23 205	28 635
North East Scotland	4 151	240 792	244 943
Orkney & Shetland Islands	0	S	S
SESplan	16 768	21 809	38 577
TAYplan	10 460	17 193	27 653
West Central Scotland A	18 791	81 627	
West Central Scotland B & Dumfries & Galloway	S	18 131	S
Western Isles	123	2 770	2 893
Total	**60 842**	**410 427**	**471 269**

S = suppressed to preserve confidentiality

Table 8 Estimated consented reserves in active sites in Scotland, 2012

Source: Scottish Aggregates Survey 2012 (published 2015), Scottish Government

Notes: Forth Valley = Stirling, Falkirk and Clackmannanshire areas; North East Scotland = the majority of Aberdeenshire; SESplan = East Central Scotland including West, Mid- and East Lothian and the Scottish Borders; TAYplan = parts of Fife, Angus and Perth and Kinross; West Central Scotland A = Glasgow and the Clyde Valley; West Central Scotland B = North, South and East Ayreshire. See map within the published document for details of the divisons.

reserves being located in the East Midlands and 21.7% in the South West. The South East and East of England have very limited reserves of crushed rock. Sand and gravel reserves are much smaller, in relation to average annual land-won sales (equivalent to about 11 years at 2014 levels of output), than crushed rock reserves, which are usually measured in terms of a few decades (42 years at 2014 levels of output).

In Scotland, of the total permitted reserves of 471 million tonnes in active sites in 2012, crushed rock amounted to 87.1%. As with England and Wales, the distribution of these reserves is very uneven, with 52.0% of all Scottish aggregates reserves being located in North East Scotland. This distribution does not align with levels of production in Scotland because only 7% of output in 2012 came from this area. In contrast 35% of production in 2012 came from Highland & Moray while 26% was produced in the area labelled as 'West Central Scotland A'.

The gross figures for permitted reserves are potentially misleading for a number of reasons. For example, the output of a site is primarily an expression of the demand for aggregates and a function of its production capacity to contribute towards that demand and not the size of reserves. Crushed rock quarries in very rural areas with very large reserves and potentially large production capacity can have low production rates and a large landbank. In contrast sand and gravel quarries near major demand centres may have relatively large outputs but, even with frequent new permissions to replace extracted reserves, may have small landbanks.

Gross figures for aggregates reserves also mask important detail about their suitability for specific applications. Despite overall large reserves there may be deficiencies for specific markets. For example, some 32% of aggregates sales in 2014 were for concrete and in some areas there is a deficiency of material that is suitable for this use.

Construction aggregates

In most years, the quantities associated with new planning permissions are lower than total aggregates sales. In 2017, for example, 24% of sales of sand and gravel were replenished with new planning permissions. Using a 'rolling 10-year average' the replenishment rate was 53%. For crushed rock, the figure for 2017 was 3%, while the rolling 10-year average was 69%. (These figures are taken from the 7th Annual Mineral Planning Survey report, published by the Mineral Products Association).

Relationship to environmental designations

The increasing number and extent of landscape, nature conservation and other designations of international, national and local importance, in conjunction with constraints relating to other factors (groundwater, market location, airports, archaeology), has significantly reduced the choice of potential sites for the extraction of aggregates. Aggregates can, however, only be extracted where the geological resources exist.

The hard and resistant nature of the rocks that are suitable for use as crushed rock aggregates means that they also give rise to some of Britain's most attractive and spectacular upland scenery. Some of these areas are also valued for their nature conservation importance. In particular, Carboniferous limestone is one of the principal sources of crushed rock aggregates in Britain, but more than half of the outcrop in England is covered by National Parks, Areas of Outstanding Natural Beauty (AONBs) and Sites of Special Scientific Interest (SSSIs), some of which are also designated as Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) under EU legislation. Other hard rocks, such as igneous rocks also form highly attractive scenery in the Lake District, Snowdonia and Scotland. The volumes of primary aggregates reserves within the main Environmental Designations is shown in Table 9.

Although sand and gravel is not as heavily constrained by national landscape designations, there are many other constraints on their working, notably in river valleys where issues of archaeology and agricultural land quality are more likely to arise. Much of the river terrace sand and gravel in the Thames Valley is overlain by high quality agricultural land. In contrast, a substantial part of the 'dry' high level terrace gravels and solid sands and gravels in areas such as Dorset, Berkshire and Hampshire are overlain by very poor quality land, but designated as SSSIs, SPAs and SACs because of heathland.

Designation	Sand and Gravel		Crushed rock	
	Thousand Tonnes	% of Total Reserves	Thousand Tonnes	% of Total Reserves
National Park	4 788	0.1%	351 329	10.2%
AONB	21 904	4.8%	259 576	7.5%
SSSI	42 728	9.3%	876 206	25.4%
SPA and SAC	13 914	3.0%	199 861	5.8%
Total Reserves	457 306		3 448 338	

Table 9 Reserves in environmental designations within England and Wales at 31 December 2014
Source: *Collation of the results of the 2014 Aggregate Minerals Survey for England and Wales, BGS*.

Green Belts around the major conurbations cover substantial areas of aggregates reserves, notably sand and gravel (19.4% of sand and gravel reserves and 4.6% of crushed rock reserves in 2014). Working aggregates in such locations near major centres of demand would accord with sustainability principles, but such extraction will only comply with Green Belt policy if it maintains openness.

Local landscape, habitat and archaeological designations provide a further range of constraints. In some areas an almost complete mosaic of overlapping designations exists.

Bird Strike Safeguarding Zones now require 13 km buffers around some airfields in which development that will lead to increased bird movement may be resisted. This has marked implications for river sand and gravel where 'wet' extraction typically leaves water bodies that are attractive to birds. In the past many of these sites would be restored with waste. However, restrictions on landfilling, both in tipping into water and shortfalls in arisings of inert waste, have significantly reduced the potential to restore such shallow workings. Landfill of waste to restore 'dry' deep quarries may also attract birds and if such works are required to restore the site then that also may have implications on extraction in such zones.

Exhausted aggregates quarries are in a unique position to develop recreation, education, and conservation sites through high quality and innovative restoration. A significant number of SSSIs are located close to, or within, past and current aggregates sites and a proportion of these are a direct result of the mineral working.

Extraction and processing

Crushed rock

Crushed rock is produced from quarries that are much larger and deeper than sand and gravel quarries. They typically have outputs in the range 100 000 t/y up to 5 000 000 t/y. Investment in plant and equipment can, therefore, be very large.

Overburden thicknesses vary considerably from almost nil to over 30 m in some operations and is removed by a combination of hydraulic excavators, ripping and blasting. Generally it is used for restoration and landscaping. Blasting is normally required to extract the required rock and this is carried out in one or more benches. After blasting, and any secondary breaking of larger blocks by drop-ball or hydraulic breaker, a mechanical excavator loads the rock into dump trucks for transfer to either a fixed primary crusher or a mobile crusher on the quarry floor.

Processing typically involves screening off clays and fines followed by a series of crushing and screening stages designed to produce material with specified size grades, but with the associated minimum production of fines. Products include both 'single sizes' and material containing a range of sizes. The European specifications that came into force on 1 January 2004 contain standard sizes for aggregates which are typically produced: 28/40 mm (with particle sizes between 28 mm and 40 mm), 20/28 mm, 14/20 mm, 6/10 mm, 4/6 mm and 0/4 mm. Some rock is also sold as mixes of sizes often referred to as 'all in' or crusher run.

The particle size of the crusher product will determine the yield of saleable product. Particle shape may be an important consideration and, together with the type of rock involved, this will affect the type and range of processing plant required. Considerable quantities of crushed rock go to value-added processing, such as the production of coated roadstone.

Processing produces fines which can be difficult to sell. In addition, rock that is contaminated with clay (known as 'scalpings') is screened out and may be sold as a low-grade, low value product. To some extent this has become more difficult because of competition from recycled materials, which have a cost advantage being exempt from the Aggregates Levy. Washing plants are, therefore, being specially built to treat this material and upgrade its quality.

Sand and gravel

Typically sand and gravel operations have outputs in the range 10 000 t/y up to 1 000 000 t/y. However, sites larger than 500 000 t/y are rare and most fall in the range 100 000 to 300 000 t/y. Sand and gravel extraction initially involves the removal of overburden which usually consists of soil, peat and clay (e.g. boulder clay), although, in the case of bedrock sands, these may include mudstone or limestone. Overburden thicknesses range from almost nil to over 10 m, but rarely over 15 m. The thickness of the overburden is very important as this controls what is economically viable to work but other factors also have influence — geological style of deposit, its quality (e.g. gravel content), whether the deposit can be worked dry or requires dewatering, whether the deposit is a new site or an extension and the location of the deposit with respect to markets. Overburden to mineral ratios are also highly variable and although it is commonly quoted that they should not exceed 2:1, higher ratios are worked even down to sand and gravel thicknesses of 1 m. Careful removal of overburden is important so that topsoil, subsoil and other overburden are kept separate for eventual use in restoration.

River gravel deposits, by their nature, are often below the ground water table. Extraction therefore usually involves dewatering the site by pumping, although sometimes it is feasible to work the site wet. Dry working has the advantage that it allows more selective extraction. Some bedrock sands may also be worked below the water table.

Processing of sand and gravel for concrete aggregates consists of washing and scrubbing to remove clay, separation of the sand fraction, grading the gravel into different sizes, sand classification and dewatering, and crushing of oversize gravel to produce smaller more saleable material. Crushing is now a common feature at many sand and gravel operations and is necessary to maximise saleable product. The washing process removes fines (silt and clay) defined as $< 63\ \mu m$ adhering to the particles or present as clay bound agglomerates that need breaking down. The 'fines' content of a sand and gravel deposit is an important parameter in determining the viability of a deposit. Fines should not be greater than 25% for silt but less for clay as it is more difficult to remove. Gravel containing clay (hoggin), used for constructional fill, may be produced 'as dug'.

Most sand washing plants for the production of concreting, asphalting and building sand involves the dispersion of sand in water and the separation of fines in a cyclone, which delivers a partially dewatered coarser product. The unwanted fines are allowed to settle out in lagoons, from which process water is recirculated, or may be dewatered further using various types of filter-press. Building sand can also be produced by passing the excavated sand over a screen to remove oversize material, without the use of water (dry screening).

Processing provides scope for adjusting the grain-size distribution of the 'as-dug' material to match market requirements for the final saleable product. Blending of material from the same and different sites is becoming increasingly common in order to adjust grain size to meet user requirements and to maximise the use of resources. The greatest demand is for sand and 4/10 mm, 10/20 mm and 20/40 mm gravel.

Sand and gravel stockpiles.

Construction aggregates

Sand and gravel processing plant.

Marine sand and gravel

Marine sand and gravel deposits are essentially similar in origin to those on land but became submerged due to rising sea levels after the most recent 'ice age'. The UK's sand and gravel dredging fleet has an average age of 22 years, a capacity of between 1250 to 10 000 tonnes per vessel and operating cycles of between 12 and 48 hours. Most extraction in UK waters is by trailer suction dredging, where a suction pipe is pulled across the seabed at slow speed. The total area actually dredged in any one year is always significantly less than the area licensed. For example in 2017: 1057.37 km^2 of the sea bed was licensed for marine sand and gravel dredging and of that only 90.94 km^2 was actually dredged (or 8.6% of the area licensed).

If environmentally acceptable in a particular location, primary screening takes place on board the dredger but the main processing takes place after it is discharged at the wharf. A major advantage of marine deposits is that high quality sand and gravel can be landed directly into areas of high demand. Marine aggregates tend to have a low fines content, but processing is comparable to land won sand gravel. Gravels are initially washed with fresh water to reduce the sodium chloride content.

Arisings from extraction and processing

Aggregates extraction and processing will usually generate material that is not suitable for sale. Historically this material would have been classified as 'waste' because it was not sold as a 'product', but since the enactment of the European Mine Waste Directive this material is no longer strictly considered to be a 'waste'. This is because the definition of that term implies the material has no use, when actually this material is very important for the restoration of aggregates quarries. The proportion of material generated will depend on the geology of the specific deposit. These materials are produced from:

- Overburden and interburden removal (soils and clays that overlie the aggregates or form bands between layers of rock required for aggregates);

- Washing of sand and gravel to remove fines (generally <63 µm) and disposed of in lagoons;
- Scalping of rock to remove fines and clay;
- Crushing, where fines result from crushing for the production of specific sizes of aggregates; and
- Dry screening of sand, segregating clay and rock.

These materials generated by aggregates extraction are inert and non-hazardous. There has been no systematic quantification of the amount of these materials generated as a result of primary aggregates production. In some circumstances, this material may be considered as a resource (e.g. some scalpings are clean enough to meet specifications for Type 1 sub-base, or the material will have potential to be used as fill). However, some can only be marketed following additional processing, the economic viability of which will depend on a number of factors, but mainly the availability of local markets. Other materials can only be used on-site, for example as screening bunds or as part of restoration.

Co- and by-products

With the major exception of limestone and dolomite, crushed rock aggregates producers have limited opportunities for producing co-products or by-products. However, almost all crushed rock quarries are capable of producing building stone to a greater or lesser extent, and small amounts of basalt are used to produce rock wool insulation. However, a significant number of limestone and dolomite quarries also produce material for industrial and agricultural applications. About 13% of total Great Britain production of limestone and dolomite in 2014, or 7.8 million tonnes, was sold for a range of industrial applications and for agricultural lime (excluding for cement manufacture). Almost all of this will be associated with aggregates production as a co-product.

Many silica sand quarries also produce construction sand from specific beds, including overburden, and from oversize material that cannot be processed to produce marketable silica sand. Aggregates can also be a co- or by-product at sites where building and dimension stones are extracted.

As securing planning permission for new mineral extraction becomes increasingly difficult, it is important that the use of all resources are maximised. Some deposits that would not be viable on their own may be workable in association with other minerals.

Alternatives/recycling

The principles of sustainable development require that suitable alternative materials of all sorts should be considered as resources in the same way as primary minerals. Encouraging the efficient use of materials through construction practices and methods that consume less material is an important element of this strategy. For example, *in-situ* soil stabilisation techniques using cement/lime hydraulic binders may replace capping layers in road construction. However, the issues are complex and alternative construction materials, such as cement, lime, steel and glass are all energy intensive to produce and transport.

The extent to which changing construction practice is currently influencing aggregates demand is not fully understood. However, changes in materials used (use of steel and glass instead of concrete) seem to primarily reflect fashion and architectural/engineering design considerations rather than sustainable development considerations. Similarly the use of plasterboard instead of concrete block for internal walling is driven by cost, speed of construction and cleaner working conditions and not by a desire to reduce consumption of aggregates.

The availability and production of recycled and secondary aggregates has been covered elsewhere in this factsheet. With aggregate minerals, physical properties such as strength and abrasion resistance are not changed irreversibly in use, except for an element of decay. Aggregates can, therefore, be recovered, for example, from construction and demolition waste or asphalt planings, and reused at least for less demanding applications.

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Limestone quarry extracting material for both industrial minerals and aggregates.

However, it should be recognised that potentially recyclable materials are relatively limited in their arisings (production) from a single source. They also need to be sourced carefully if consistent properties are to be assured to users. Moreover, it is increasingly recognised that their use is fast approaching their ceiling. Further, resources such as crushed concrete from old runways represent a diminishing resource that cannot be replaced once broken up. The availability of construction and demolition waste, the main source of recycled aggregates, depends on the quantity of buildings or other structures that are being demolished.

Transport issues

Aggregates are low value high weight/volume products. Most aggregates are transported by road, the average delivered distance being about 43 km (27 miles). In 2017 approximately 17% of primary aggregates were moved by non-road means for part of their delivery journey, although local deliveries from rail depots or wharves are also carried out by road. The non-road movement of aggregates includes: rail (11%) and coastal or inland waters (6%).

Primary aggregates are, where possible, produced close to major centres of demand so as to minimise costs. Large aggregates resources that are distant from major markets and with poor transport links may be only worked on a small scale. However, good transport links, notably by rail and sea, and economies of scale may support the development of resources located considerable distances from demand centres.

Transport is a key element of the supply process. There are two main issues associated with the transport of aggregates. First are the environmental impacts of the supply of aggregates in the immediate vicinity of the quarry (the environmental impacts of more distant transport movements are generally dissipated within the whole transport system). Second, since aggregates are probably the lowest value materials that are transported by road, rail and sea, the cost of transport is an important element of the final delivered cost of the aggregates.

The uneven distribution of aggregates resources means that there is substantial movement of aggregates within the UK. Although most of this is by road, many large quarries are rail linked and large quantities are moved by rail, including from the Mendips and Leicestershire to London and the South East.

Marine dredged sand and gravel is commonly landed within major centres of demand, notably in London and the South East. Crushed rock is also transported by ship from a few coastal quarries principally to destinations in England, but again mainly to London and the South East. The precise quantity is not known. Significant tonnages are shipped from Britain's only large coastal quarry at Glensanda on Loch Linnhe in western Scotland, principally to the Isle of Grain in Kent (although it is believed that this represents less than one quarter of the total output from the quarry in most years). From the Isle of Grain some aggregates are transhipped onto barges for movement up the Thames to Tilbury as well as to other ports in southern and eastern England. Shipments from Glensanda are also made to other UK terminals. Domestic shipments of rock are also made from Northern Ireland and in smaller quantities from other regions.

Seaborne imports of aggregates, including sand, gravel or armourstone as well as crushed rock, are principally from Denmark, Ireland, Netherlands, Spain, Belgium and Norway and are mainly landed in the South East. Aggregates are also transported by barge on the Trent, Severn and Thames. Wharves for handling aggregates may well be underutilised in comparison with income from general cargo, other quayside industry and marinas. They may be incompatible with adjoining uses and there is a significant danger that they may be lost.

The supply of recycled aggregates generally has the advantage of being closer to the market, indeed some recycled aggregates are generated and used on the same construction site. However, some secondary aggregates, notably china clay and slate wastes, are remote from major centres of demand. This is a major disincentive to their greater use. Modest quantities of china clay aggregates are moved by sea.

Although alternative methods to road transport have clear advantages they are not without environmental impacts. Rail depots (where aggregates are delivered by rail) and wharves (for landing marine dredged sand and gravel and/or crushed rock) also create visual impact, noise and dust. Moreover, although some wharves are rail connected, or can tranship aggregates to barges for movement closer to the market, this is the exception and most aggregates will still have to be finally distributed by road. Often there are rail network capacity constraints (e.g. line capacity limitations, weight limits) to increased rail movement of aggregates and the future availability of wharves may be a constraint on increased coastal shipments.

Transport issues are likely to increase in importance in the future: for example (1) as rail borne traffic competes with passenger traffic on congested rail routes, and (2) where there are concerns about the adequacies of port and wharf infrastructure that are both capable of taking seaborne shipments and have associated transport links to move the material to the market.

Economic instruments

Two economic instruments affect the supply of aggregates; the Landfill Tax and the Aggregates Levy.

The Landfill Tax was introduced on 1 October 1996 as a tax on waste disposal at landfill sites. The purpose of the tax is to encourage business and consumers to produce less waste, to discourage landfill and encourage waste minimisation and investment in other forms of material recycling and/or resource recovery. There are two rates of tax:

- £2.90 per tonne (from 1st April 2019) for inactive or inert waste listed in the Landfill Tax (Qualifying Material) Order 1996. These are wastes which do not give rise to gases and have no potential for polluting groundwater;
- £91.35 per tonne (from 1st April 2019) applying to all other taxable waste.

These rates are subject to an escalator and increase every year.

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Some types of waste are exempt from the Landfill Tax, including mine and quarry wastes. Inert waste used in the restoration of active mineral workings and landfill sites was also given an exemption from the Landfill Tax in 1999.

The Aggregates Levy was introduced in April 2002 and is currently £2 per tonne. It applies to sand, gravel and crushed rock subjected to commercial extraction in the UK, including aggregates dredged from the seabed and also to aggregates imported from overseas. It is intended to address the environmental costs associated with quarrying operations (noise, dust, visual intrusion, loss of amenity and damage to biodiversity) in line with the Government's statement of intent on environmental taxation. Its objective is to reduce demand for virgin aggregates and encourage the use of recycled materials and secondary aggregates such as china clay waste, slate waste and colliery spoil, which are exempt. There are other exemptions such as arisings from navigation dredging or material arising from the ground during the construction of highways, railways or building foundations.

Aggregates that are exported from the UK are entitled to relief from the Levy, as is material that is not used for construction (e.g. material used for beach replenishment or removed to landfill).

The imposition of the Levy resulted in a number of market 'distortions' (some of which were partially addressed by the exemptions noted above) and it led to challenges in the European courts, principally by the British Aggregates Association. In March 2019, the Government announced a comprehensive review of the Levy including its current design, its effectiveness in meeting its objectives and the impact it has on business. The review will consider potential reforms that could be made. The UK Government is also committed to devolving the Levy to the Scottish Parliament.

Planning issues

National policy

Government planning policy on the provision of construction aggregates in England is set out in the *National Planning Policy Framework* issued in 2012 and revised in 2018. Additional guidance is provided in *National and regional guidelines for aggregates provision in England 2005–2020* and in online guidance.

Comparable planning policy for Wales is set out in Section 5.14 of *Planning Policy Wales* and supplemented by *Minerals Technical Advice Notes*. In Scotland minerals planning policy is set out in the *Scottish Planning Policy and Supplemental Planning Guidance* documents published by individual regions of Scotland. Northern Ireland has a *Strategic Planning Policy Statement,* with specific mineral related policies contained within *Regional Planning Policies.*

All these documents recognise that an adequate and steady supply of aggregates is essential to support sustainable economic growth and quality of life. Policy aims to ensure this steady and adequate supply of aggregates with minimum impact on the environment.

Managed Aggregates Supply System in England

Although there are a number of supply sources for aggregates, including marine dredged, secondary and recycled materials, the majority of aggregates demand is met from land-based extraction. However, in the UK there are significant geographical imbalances in the occurrence of suitable resources for natural aggregates, particularly for crushed rock, and the areas where they are most needed.

For over 35 years, these imbalances in supply and demand have been met through the Managed Aggregates Supply System. The underpinning concept of this System is that Mineral Planning Authorities which have adequate resources make an appropriate contribution to national as well as local supply, although this must be balanced with the need to minimise environmental impacts of extraction. Mineral Planning Authorities that are comparatively resource-poor are expected to continue to contribute to meeting supply needs in their areas, where this can be done sustainably. However, ultimately these areas will receive significant quantities of aggregates imported from other areas.

The System comprises a number of elements:

- A Local Aggregates Assessment, prepared for each Mineral Planning Authority containing details of demand and supply options for aggregates in its area. These assessments should be evidence-based, linked to Local Plans and reviewed on an annual basis.
- Aggregates Working Parties comprising groups of Mineral Planning Authorities together with representatives from industry and other organisations if appropriate. The role of these Working Parties is to monitor the operation of the System and provide technical advice.
- National and Sub-National Guidelines for Aggregates Provision published by the Government in 2009 to provide an indication of the total amount of aggregates provision that the Mineral Planning Authorities, collectively within each Aggregates Working Party, should aim to provide to 2020.
- National Aggregates Co-ordinating Group convened by the Ministry of Housing, Communities and Local Government (MHCLG) to provide guidance to the Aggregates Working Parties, to monitor the overall provision of aggregates in England and to provide advice to Government.
- Aggregates landbanks which are a monitoring tool to alert Mineral Planning Authorities to the possibility of disruption to the provision of land-won aggregates. The landbank is the sum of all permitted reserves divided by the average sales over a 10 year period. Landbanks of at least 7 years should be maintained for sand and gravel and at least 10 years for crushed rock, although longer periods may be appropriate in certain circumstances.

A more detailed description of the System is included in the BGS report *Managing aggregates supply in England: A review of the current system and future options* (BGS Open Report OR/08/042).

Transport and locational considerations

The planning system and sustainable development objectives relate to aggregates extraction and supply in a number of ways. In considering the overall use of resources, the extent to which aggregates can be sourced locally to demand centres is a significant issue because of the direct implications on fuel consumption and greenhouse gas production if aggregates are transported over greater distances by road. There are also the indirect effects related to vehicle life, amenity, accidents and the degradation of the road system. Other modes of transport such as rail and sea are more sustainable over long distances, but such options are limited. At present, it is unlikely that any new coastal quarry will be developed in the UK. Rail linked quarries are few and potential rail connections are constrained by limited rail capacity.

The minimisation of harm to landscape and habitats is an important sustainable development consideration. This can be done through the location of quarries and good environmental management of sites. Since aggregates extraction is a temporary use of land, albeit a sometimes protracted use, effective and imaginative restoration will bring the site back into beneficial use. It is now widely accepted that this has the capacity to create new opportunities for habitats, biodiversity and geodiversity.

Relationship between primary and secondary aggregates resources

Sustainability and resource efficiency considerations require that the use of recycled and secondary aggregates is maximised before primary aggregates are utilised. Currently some 30% of total aggregates demand is supplied by alternative materials, mainly construction and demolition waste, and Britain is one of the leading countries in Europe in this regard. However, it is thought that most of the material that is suitable for aggregates use is being recovered and used. There are large resources of some secondary materials, such as china clay sand and slate waste, but these are remote from major markets and there are significant economic obstacles to creating the transport infrastructure to overcome this problem. Consequently primary aggregates will continue to be required to supply a major proportion of UK demand.

Safeguarding

Ensuring that sufficient reserves of the right quality are permitted to meet demand will

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continue to be a real challenge for the planning system. Part of that process is the application of effective safeguarding mechanisms to prevent the unnecessary sterilisation of aggregates resources so that they may be available in the future. These mechanisms include the definition of 'Mineral Safeguarding Areas' in local plans, together with associated local policies. Prior extraction may be an option to avoid sterilisation of resources by non-mineral development. The safeguarding of key minerals infrastructure, such as rail depots and wharves, is also essential to ensure options for reducing road transport remain available. Further information on safeguarding can be found in *Mineral safeguarding in England: good practice advice* (BGS Open Report OR/11/046) and in *Mineral safeguarding practice guidance* (published by the Mineral Products Associations and Planning Officers' Society in April 2019).

Landbanks

Landbank policies have been an important element of aggregates planning for many years at both national and local level. Landbanks relate to both years of supply and tonnage of supply in permitted reserves over that specified period. The purpose of these policies is twofold. First they set out a provision that is considered the minimum amount required to maintain supply to the construction industry. Secondly they can provide a guide against which planning applications for extraction may be determined subject to detailed considerations. Separate landbanks are maintained for crushed rock and for sand and gravel. These may be further divided, where practical and necessary, to deal with different materials within those two groups. For example, reserves of sand and gravel in a Mineral Planning Authority area might be dominated by sand with an extreme shortage of gravel. It would not be desirable to ignore that shortage of gravel in landbank calculations as that could lead to supply problems for that specific commodity.

Environment and amenity impacts

The relationship and constraints flowing from designations have been described above. In considering aggregates extraction proposals a range of detailed external amenity impacts are also assessed by the planning process. These include noise, mud and dust from the operations and transport, vibration and flyrock from blasting, pollution, visual impact, effect on groundwater including the impact of dewatering and discharge, stability, lighting associated with night-time operations, and adequacy of the highway network.

Restoration

The extraction of aggregates can provide valued assets during and after extraction, and in conservation terms the UK would be poorer without such assets. Many SSSIs, and some SPAs and SACs, have their origins in quarrying because the quarry restoration has provided a range of habitats and ecological niches (ponds, rock faces, reed beds, etc.) that are either rare in the UK or lost by other development. Even during working, quarries can provide valuable nesting sites for birds on rock faces or in sand faces and a range of habitats and associated flora and fauna on silt and clean water ponds. Bare mineral surfaces in many quarries provide ideal conditions for ground nesting birds or rare colonising plant species that can only survive when not overwhelmed by more vigorous species that grow on more productive land. A continuity of such surfaces is, therefore, desirable. It is now recognised that restored mineral workings can make a major contribution to both biodiversity and geodiversity.

Restoration of agricultural land, either with or without importation of waste, can achieve high standards. As the restoration works will remove any major variation in substrate it is possible to increase the quality of the restored land compared to that before working. Restored aggregates quarries also provide a range of recreation facilities that would otherwise be unavailable.

Licensing of marine dredging of aggregates

The Crown Estate owns virtually all the seabed within the UK's territorial waters (12 nautical mile limit), but has the rights to explore for and extract sand and gravel in the whole of the UK Continental Shelf. It also owns about 55% of the foreshore (between mean high and mean low water) and approximately half of the beds of estuaries and tidal rivers in the UK.

Almost all marine extraction, therefore, takes place from licences on seabed owned by The Crown Estate. These properties and rights are managed by the Crown Estate Commissioners (for areas offshore of England, Wales and Northern Ireland) or Crown Estate Scotland (for areas offshore of Scotland).

The Marine and Coastal Access Act (2009) established a new system of marine planning in the UK which is devolved to the four countries. All public authorities taking decisions related to the UK marine area are required by this Act to do so in accordance with the *UK Marine Policy Statement*. Each country has developed, or is developing, a Marine Plan to manage all marine activities for its part of UK's waters.

Applications for the extraction of marine minerals are administered by the Marine Management Organisation for England; the Marine and Fisheries Division of the Department of Agriculture, Environment and Rural Affairs for Northern Ireland; Marine Scotland; or the Marine Licensing Team at Natural Resources Wales; as appropriate. Each application will require an environmental impact assessment and extensive consultation with stakeholders, including the fishing industry. In some cases a coastal impact study may also be required. Once the appropriate organisation has issued a Marine Licence, the Crown Estate will then issue a Production Agreement.

Environmental impacts associated with marine dredged sand and gravel relate to habitats, archaeological and heritage assets including wrecks, and potential effects on other uses of the sea including fisheries, navigation, wind farms and recreation. Coastal impact assessments assess whether the rates of coastal erosion and deposition are likely to be adversely affected. Licences are subject to conditions and monitoring arrangements to ensure that the environmental impacts are minimised.

Further information

UK Industrial Strategy, published 2017, with an associated progress report, published 2018. Department for Business, Energy and Industrial Strategy. https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

UK Construction Sector Deal, published 2018. Department for Business, Energy and Industrial Strategy. https://www.gov.uk/government/publications/construction-sector-deal

UK Minerals Strategy, published 2018. UK minerals and mineral products industry. https://mineralproducts.org/documents/UK_Minerals_Strategy.pdf

National and Regional Guidelines for Aggregates provision in England for the period 2005–2020. Department for Communities and Local Government, published in 2009. https://www.gov.uk/government/publications/national-and-regional-guidelines-for-aggregates-provision-in-england-2005-to-2020

National Planning Policy Framework. Ministry of Housing, Communities and Local Government. 2019. https://www.gov.uk/government/publications/national-planning-policy-framework--2

Other guidance on mineral planning in England can be found here: https://www.gov.uk/government/collections/planning-practice-guidance

Planning Policy Wales. Welsh Government. 2018. https://gov.wales/planning-policy-wales

Minerals Technical Advice Note (Wales). 1: Aggregates. Welsh Government, 2004. https://gov.wales/minerals-technical-advice-note-mtan-wales-1-aggregates

Scottish Planning Policy. The Scottish Government, 2014. https://www.gov.scot/publications/scottish-planning-policy/

Strategic Planning Policy Statement for Northern Ireland (SPPS). Department of the Environment, 2015. https://www.planningni.gov.uk/index/policy/spps.htm

Regional Planning Policies: Minerals, Northern Ireland Planning Portal. https://www.

planningni.gov.uk/index/policy/rural_strategy/psrni_regional_policies/psrni_minerals.htm

UK Marine Policy Statement. HM Government, Northern Ireland Executive, Scottish Government, Welsh Assembly Government. 2011. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf

Further details about the Aggregates Levy can be obtained from: https://www.gov.uk/government/publications/excise-notice-agl1-aggregates-levy/excise-notice-agl1-aggregates-levy#scope-of-the-levy

Information about the review of the Aggregates Levy can be obtained from: https://www.gov.uk/government/publications/review-of-the-aggregates-levy

Aggregates Working Parties (AWPS) were established in the English Regions and Wales in January 1976 with membership drawn from Mineral Planning Authorities, the aggregates industry and Government. The remit of the Working Parties is to provide information and guidance on planning and related issues concerned with the provision of aggregates in their region. The AWPS carry out annual monitoring of the supply of aggregates in their region and permitted reserves of aggregates. The results are published as monitoring reports.

United Kingdom Minerals Yearbook. 2019. BGS Open Report OR/19/018. http://www.bgs.ac.uk/mineralsuk/statistics/ukStatistics.html

Collation of the results of the 2014 Aggregate Minerals Survey for England and Wales. Produced by the BGS on behalf of Department for Communities and Local Government and the Welsh Government. https://www.gov.uk/government/publications/aggregate-minerals-survey-for-england-and-wales-2014

Mineral Safeguarding in England: good practice advice, 2011. BGS Open Report CR/11/046. https://www.bgs.ac.uk/downloads/start.cfm?id=2069

Mineral Safeguarding Practice Guidance, 2019. Mineral Products Association and Planning Officers' Society. https://mineralproducts.org/documents/MPA_POS_Minerals_Safeguarding_Guidance_Document.pdf

Managing aggregates supply in England: A review of the current system and future options, 2008. BGS Open Report OR/08/042. http://www.bgs.ac.uk/downloads/start.cfm?id=1372

The strategic importance of the marine aggregate industry to the UK. 2007. BGS Open Report OR/07/019. https://bmapa.org/documents/BMAPA_download.pdf

Primary Aggregates Reserves in England 1990-2004, published 2006. BGS Commissioned Report CR/06/168. http://www.bgs.ac.uk/downloads/start.cfm?id=1298

The role of imports to UK aggregates supply, 2005. BGS Commissioned Report CR/05/041N. www.bgs.ac.uk/downloads/start.cfm?id=1300

The Economic Importance of Minerals to the UK, 2004. BGS Commissioned Report CR04/070N. http://www.bgs.ac.uk/downloads/start.cfm?id=1301

Mineral Products Association https://mineralproducts.org/ /

British Aggregates Association http://www.british-aggregates.com/

British Marine Aggregates Producers Association. http://www.bmapa.org/

The Crown Estate http://www.thecrownestate.co.uk/

Crown Estate Scotland https://www.crownestatescotland.com/

Ministry of Housing, Communities and Local Government. https://www.gov.uk/government/organisations/ministry-of-housing-communities-and-local-government

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Mineral Planning Factsheets for a range of other minerals produced in Britain are available for download free of charge from http://www.bgs.ac.uk/mineralsUK/

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