

Construction aggregates

*This factsheet provides an overview of **aggregate** 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 2013

Gravel aggregate.

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, granular¹, 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: 2002) defines aggregates as 'granular material used in construction. Aggregate may be natural, manufactured or recycled.' These are further defined as:

Natural aggregate — aggregate from mineral sources which has been subject to nothing more than physical processing (crushing and sizing);

¹ However, a proportion of aggregate sales is for constructional fill or other uses where, according to the particular works, soft and non-granular material may be acceptable or even specified.

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

Recycled aggregate — aggregate 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 aggregate and used for the first time. Most construction aggregates are produced from hard, strong rock formations by crushing to produce **crushed rock aggregate** 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 aggregate**. The term **aggregate mineral** is also used for any naturally occurring material that is suitable for aggregate use. Some rock types, notably limestone/dolomite, are suitable for both aggregate and non-aggregate 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 aggregate is classified as a **natural aggregate**, and by-product aggregate derived from industrial processes is classed as **manufactured aggregate**.

Recycled aggregates are now an important source of aggregate in Britain. They arise from various sources including demolition or construction of buildings and structures, or



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from civil engineering works. Other forms of recycled aggregate are asphalt plantings 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 therefore it is important that estimates should be 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 the demand for aggregates will continue. Despite a substantial increase in the use of recycled aggregates, it is likely that the major proportion of future aggregate demand will be

supplied from primary sources because there are limitations on the availability of material to be recycled into aggregates and technical limitations in their use.

Aggregates have a wide range of uses in construction. Table 1 shows sales of primary aggregates by major end-use. Most aggregate is used in the production of concrete for buildings and civil engineering structures, or as roadstone in new road building and repair and maintenance. Smaller amounts are used in mortars and finishes in construction, as railway track ballast, and, in substantial amounts, as constructional fill.

The main use of sand and gravel is for concrete (67% 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 (41% of the total crushed rock sold), where it is either coated with bitumen in asphalt or used uncoated. A further 18% of crushed rock is used in concrete.

Concrete is made from a mixture of water, cement, coarse aggregate (natural gravel, crushed limestone or other hard rock) and fine aggregate (generally quartz sand, but limestone sand and other crushed rock fines are also used). The water and cement form the paste binder, whilst the aggregate forms

Principal uses	Thousand tonnes			
	Sand & gravel*	Crushed rock	Total	%
Concrete aggregate	36 694	16 799	53 493	36.7
Screened, graded aggregates, including surface dressings	4 609	18 543	23 152	15.9
Roadstone and gravel, coated	504	19 360	19 864	13.6
Roadstone uncoated	–	18 199	18 199	12.5
Building and asphaltting sand	7 549	–	7 549	5.2
Railway ballast	–	1 421	1 421	1.0
Armourstone/gabion	–	1 620	1 620	1.1
Constructional fill and other constructional uses	5 659	14 988	20 647	14.1
Total sales	55 015	90 930	145 945	100

Table 1 Great Britain: Sales of primary aggregates by major end-use, 2011.

Source: Annual Minerals Raised Inquiry, ONS

*including marine dredged

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an inert filler. Fine and coarse aggregate are added either separately or as a combined 'all-in' aggregate. The properties of the aggregate 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 as 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, in the case of minor roads, for the whole structure. 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), hard core used for hard standings and tracks; and for drainage materials in pipe bedding and drains. Substantial amounts of coarse aggregate (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 aggregate (generally fine-grained sand) is used in mortar, to bond masonry or as a surface plastering and rendering material.

Some rocks suitable for use as aggregate minerals, notably limestone/dolomite, also 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 aggregate from material that is unsuitable for high quality industrial use (see Factsheets on **Industrial Limestone** and **Industrial Dolomite**). Many crushed rock aggregate quarries also produce small amounts of building stone and conversely some building stone quarries supply quantities of aggregate as by-product of quarrying and processing building stone (see Factsheet on **Building Stone**).

Specifications

The suitability of an aggregate for a particular purpose depends principally on its physical and mechanical properties, although in some applications mineralogical or chemical properties are also important. For general purpose applications an aggregate of high strength and durability with low porosity is required. There is a reasonable correlation between aggregate quality and porosity. Crushed rock with water absorptions of less than 2% will generally produce a good quality aggregate, although for concrete it should be less than 1%. The assessment of aggregate properties is carried out, by using a range of standard test methods (e.g. BS EN 1097), to determine the aggregate's 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 which 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

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essential, a characteristic which is affected by the grading, by the pore size distribution within the aggregate, 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 aggregate must maintain adhesion with the binder). Specifications for materials used in road making in Britain are given in the Highways Agency 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 aggregate

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 aggregate affect concrete characteristics such as density, strength, durability, thermal conductivity and shrinkage. The shape and surface texture of the aggregate 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 (in order to ensure adequate coating of the aggregate). Provided that is recognised in the mix characteristics, high strength concrete can be produced from porous aggregate. Concrete aggregate 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 and therefore the majority of railway ballast is sourced from igneous rocks. In common with many aggregate 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 aggregate types contribute to overall supply. There is a significant variation in aggregate resource types across the UK and local resources may have particular properties that affect use. Although the implications of this will be understood near the source of supply, it may not be appreciated elsewhere leading to resources being discounted or poorly utilised because of concerns about compliance and also competition from higher quality materials.

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

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Britain in 2011, broadly 65% is obtained from natural deposits on land (sand and gravel, and crushed rock), 5% from marine sources and 30% from recycled and secondary sources.

Primary (natural) aggregates	Thousand tonnes	%
Sand & gravel	55 015	27
Land-won sand & gravel	43 826	
Marine-dredged sand & gravel (1)	11 189	
Crushed rock (2)	90 928	44
Limestone/dolomite	43 032	
Igneous rock	38 869	
Sandstone	9 144	
Total primary aggregates	145 943	71
Recycled and secondary aggregates (3)	60 000	29
GRAND TOTAL	205 943	100

Table 2 Great Britain: Summary of aggregates supply, 2011.

Sources: Data for primary aggregates are from the Annual Minerals Raised Inquiry 2011, ONS. Estimates for recycled and secondary aggregates are from the Summary Sustainable Development Report 2012, Mineral Products Association.

The supply of aggregate in Great Britain is summarised in Table 2, where data are available. This table does not include aggregates imported from, or exported to, Europe.

Notes:

1. Landed at GB ports, excluding for beach nourishment. Source AMRI. Crown Estate figures for 'landings' are slightly larger at 11.5 million tonnes in 2011. In addition, just under 1.5 million tonnes were used for beach nourishment.
2. Sum of Limestone/Dolomite, Igneous rock and Sandstone does not add to total for Crushed rock because the figures shown may include material for industrial uses and building stone. These non-aggregate uses have been removed from the total for Crushed rock.
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.

Primary aggregate supply by region and country is summarised in Table 3. Sales of

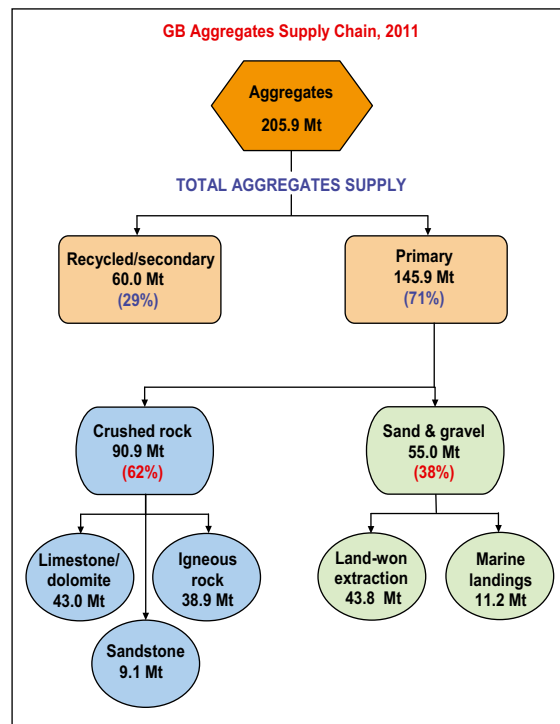


Figure 1 Great Britain: Aggregates supply chain, 2010. See also note 2 for Table 2.

primary aggregate in Great Britain peaked at 300 million tonnes in 1989 but have since declined considerably. In 2011 primary aggregates sales for Great Britain were 145.9 million tonnes, comprising 90.9 million tonnes of crushed rock and 55 million tonnes of sand and gravel, including marine dredged.

Sales of primary aggregate, including marine-dredged landings, for the period 1972–2011 in England, Wales and Scotland are shown in Figures 2 to 4. Crushed rock aggregates accounts for about 62% of the total. 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 22% and 46% 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

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	Land-won sand & gravel	Marine sand & gravel	Total sand & gravel	Crushed rock	Total primary aggregates
Thousand tonnes					
North East	na	na	1 150	3 354	4 504
North West	1 744	97	1 841	4 329	6 170
Yorks & the Humber	3 139	56	3 195	6 681	9 876
East Midlands	5 503	0	5 503	17 036	23 110
West Midlands	6 074	0	6 074	2 927	8 430
East of England	na	na	9 711	274	9 985
South East	5 351	4 194	9 545	800	10 345
London	545	3 055	3 600	0	3 600
South West	4 261	453	4 714	14 715	19 429
England	36 723	8 609	45 332	50 115	95 447
Wales	901	732	1 633	11 001	12 634
Scotland	7 365	0	7 365	21 193	28 558
Great Britain	44 989	9 341	54 330	82 309	136 639
Northern Ireland	2 178	0	2 178	11 895	14 073
UNITED KINGDOM	47 167	9 341	56 508	94 204	150 712

Table 3 UK: Sales of primary aggregates by English Region and country, 2010.

Sources: AMRI, ONS for Great Britain. Department of Enterprise, Trade and Investment, Northern Ireland. (The figures for crushed rock in Northern Ireland are somewhat overstated because sales for non-aggregates use are not separately disclosed). Regional breakdown not available for 2011.

significant drops in aggregate sales. Sales in England fell by 36% between 2007 and 2010. In Wales sales fell by 39%, and in Scotland they fell by 23% over the same period. For comparison, the late 1980s/early 1990s decline in aggregates sales amounted to 27% in England and 12% in Wales, while Scotland actually grew by two per cent.

In *National and Regional Guidelines for Aggregates Provision in England for 2005 to 2020*, published in 2009, the Department for Communities and Local Government (DCLG) forecast that total aggregates provision during this period will 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 3 908 million tonnes, the DCLG assumed that 36% will 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 reviewed annually and will be revised when necessary.

Trade

The UK has large resources of rocks that can be profitably worked for use as aggregate. 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 and France. Export landings were 5.4 million tonnes in 2011, about one third of total marine production.

Both exports and imports of crushed rock increased steadily between 2002 and 2006 or 2007 but have since declined (Table 4). Official trade statistics indicate that the UK is still a net

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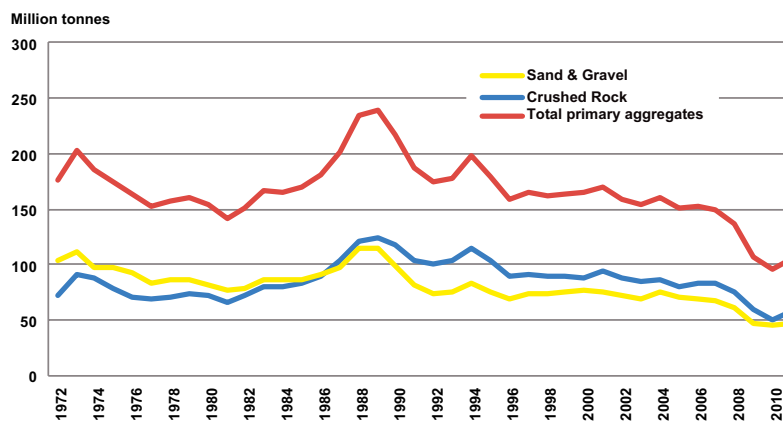


Figure 2 England: Sales of natural aggregate, 1972-2011.

Source: Annual Minerals Raised Inquiry, ONS

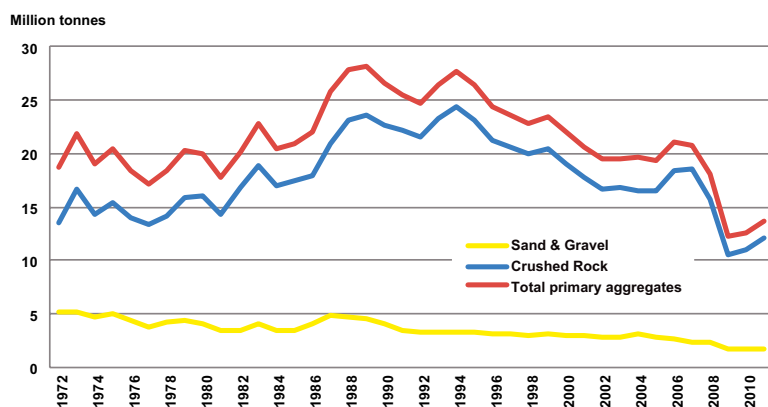


Figure 3 Wales: Sales of natural aggregate, 1972-2011.

Source: Annual Minerals Raised Inquiry, ONS

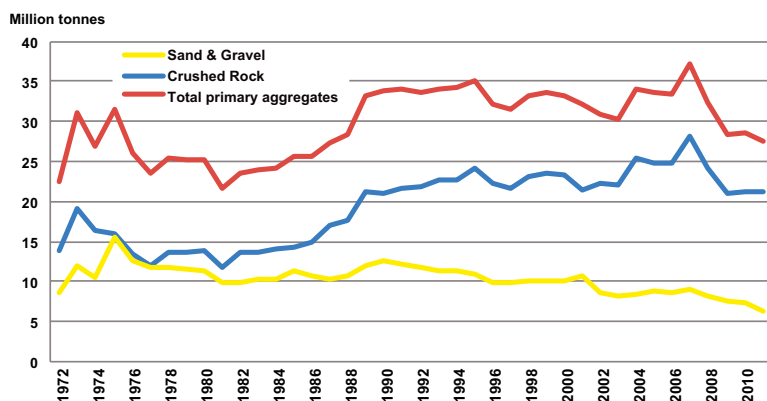


Figure 4 Scotland: Sales of natural aggregate, 1972-2011.

Source: Annual Minerals Raised Inquiry, ONS.

exporter of crushed rock, with exports being 5.4 million tonnes against apparent imports of 1.9 million tonnes in 2011. However, in the past there has been some uncertainty about the accuracy of the data². Imports, comprising crushed rock aggregate and armourstone, are mainly from Norway, but also France and Ireland. 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. The Aggregate Minerals Survey for 2009 shows imports of crushed rock from outside the UK, landed in England and Wales, as approximately 905 000 tonnes. This figure excludes armourstone.

Currently imports account for only about 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 Office for National Statistics, of the 357 million tonnes of minerals extracted in the UK in 2009, primary aggregates accounted for about 55%. For comparison the extraction of fossil fuels (coal, oil and gas combined) amounted to 41% of the total.

Apparent consumption of primary aggregates (production plus imports less exports) in the UK was about 186 million tonnes in 2009 with a per capita consumption of approximately three tonnes. This is low by international standards and just over half the European average of 5.5 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 been declining for several years and is very substantially down on peak consumption of about 300 million tonnes in 1989. A measure of the intensity of use of primary aggregates is provided in Figure 5,

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

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	Thousand tonnes									
Exports	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Sand & gravel	8 881	8 420	8 174	8 454	9 309	8 089	7 748	6 237	6 082	5 413
(of which Marine S&G)	8 881	6 096	6 192	6 471	6 715	6 649	6 212	5 661	5 192	5 413
Crushed rock	3 594	3 188	4 528	4 851	5 322	5 959	5 261	4 917	4 911	5 387
Total Exports	12 475	11 608	12 702	13 305	14 631	14 048	13 009	11 153	10 992	10 800
Imports										
Sand & gravel	414	861	924	644	635	897	648	445	344	358
Crushed rock	573	633	619	1 517	2 270	1 910	1 984	1 610	1 896	1 705
Total Imports	987	1 494	1 543	2 161	2 905	2 806	2 632	2 054	2 240	2 063
Crude granite	1 012	1 090	1 558	1 235	641	326	954	259	163	163

Table 4 UK: Imports and exports of natural aggregates (and imports of crude granite), 1998–2011.

Source: HM Revenue & Customs and The Crown Estate Commissioners.

which shows aggregate consumption per £1000 of construction output in 2005 constant values. In the last 16 years there has been an almost continuous decline in the quantity of primary aggregate consumed per unit of construction output, from 3.1 t/£1000 output in 1994 to 1.3 t/£1000 in 2010. The reasons for the decline may be several fold:

- 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.

The decline in the intensity of use of primary aggregates cannot continue indefinitely. It will ultimately stabilise, and could perhaps rise if

more investment is put into transport infrastructure, flood prevention and 'brownfield' site development. However, there is no basis for judging when that might happen. The trend in intensity of use is, therefore, monitored annually.

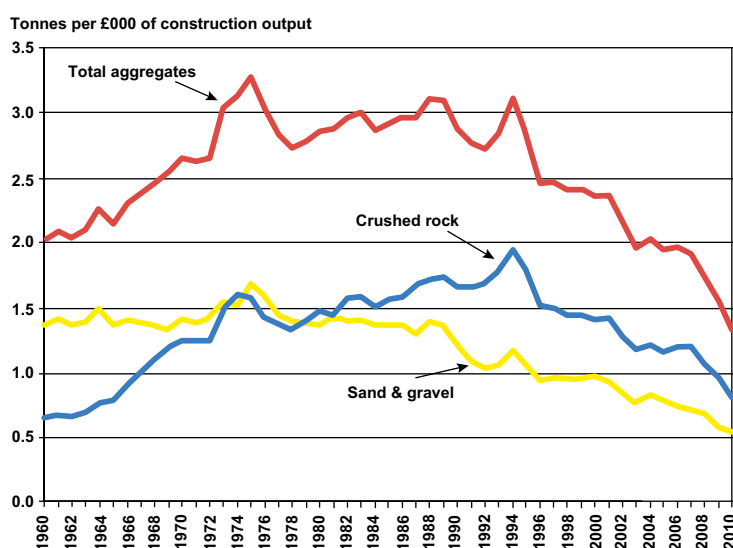


Figure 5 Great Britain: Intensity of use of primary aggregates per unit (£1000) of construction output in constant values, 1960–2010.

Source: UK Minerals Yearbook, BGS.

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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 the South East and London, where consumption was 25.1 million tonnes in 2009 but land-won sales from sources within the two regions were only 5.4 million tonnes. The balance was made up from landings of marine sand and gravel (7.8 Mt), imports (mainly crushed rock) from the South West (5.1 Mt) and the East Midlands (1.6 Mt) and seaborne landings notably from Scotland and Europe (1.8 Mt).

Other major flows of aggregates were from the East Midlands to the East of England (3.3 Mt), the North West (2.5 Mt), to the West Midlands (2.2 Mt) and to Yorkshire and the Humber (2.1 Mt); from the South West to the South East (3.2 Mt), and from North Wales to the North West (1.1 Mt). All these figures are from the 2009 Aggregates Minerals Survey.

Economic importance

Sales of primary aggregates in the UK were some 148.8 million tonnes in 2009 with an estimated value of £1 239 million based on an 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 key element of the supply process and of the delivered price of aggregates, and a substantial industry is required to move aggregate 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 5 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

Industry	Total sales of the principal products of the industry
	£ Million
Ready-mix concrete	1 207
Mortars	104
Coated roadstone	560
Concrete products for construction purposes	1 375
Total	3 246

Table 5 UK: Total manufacturing sales of selected mineral-based industries, 2009

Source: ProdCom, ONS.

(GVA) of the construction industry in 2009 was £87.4 billion, accounting for 7.0% of total GVA. The GVA for construction in 2009 declined by 10.7% compared to 2008, as a result of the recession, but this followed a period of continuous growth which amounted to 46.2% between 2002 and 2008. At its peak in 2008 the GVA of the construction industry was £97.9 billion, 7.6% of the UK's total GVA.

In Great Britain, in 2010, the total value of construction work was £101.8 billion, of which £67.7 billion was new work and £34.1 billion was repair and maintenance. There was an additional £6.5 billion of work done in Northern Ireland.

Structure of the industry

There are about 1 100 aggregate quarries in the UK, roughly split 45:55 between sand and gravel sites and crushed rock. There are also a large number of aggregate producers, which range from single quarry owners to multi-national companies operating many sites throughout the country. In mid-2011, five multi-national companies accounted for just over 70% of total output, they are: Tarmac (owned by Anglo American), Hanson (owned by Heidelberg Cement), Aggregate Industries (owned by Holcim), Cemex and Lafarge. Other important producers are Breedon and Brett.

In February 2011, Anglo American and Lafarge SA announced they had agreed to form a Joint

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Venture which would combine their respective cement, aggregates, ready mix concrete and asphalt operations in the UK. The Office for Fair Trading subsequently referred the proposal to the Competition Commission. A decision was reached in May 2012 and final undertakings agreed in July 2012. In order for the proposal to proceed, both Lafarge and Anglo American needed to divest several quarries and rail depots along with numerous ready mix concrete plants. Anglo American was also required to divest its 50% interest in Midland Quarry Products. The divested assets were purchased by Mittal Investments and established as a new company, Hope Construction Materials in 2013.

The Mineral Products Association (MPA) is the principal trade association representing the aggregates industry and its members account for some 90% of total output. This trade association also represents the cement, asphalt, concrete, lime, mortar and silica sand industries, as well as aggregates. The British Marine Aggregates Producers Association, a constituent body of the Mineral Products Association, represents the marine dredging industry. The British Aggregates Association (BAA) represents independent and privately-owned quarry companies throughout the UK, accounting for 10% of national output.

Resources

The UK has large resources of material suitable for use as aggregate 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 aggregate resources is uneven. In particular, there is an almost total absence of hard rock suitable for crushed rock aggregate in southern, eastern and parts of central England, where demand represents a significant proportion of the total.

With ever tighter limitations on what might be given permission for extraction, the industry has sought to maximise recovery rates from existing reserves by upgrading previously uneconomic deposits. For example, processing

clayey gravels in plant which is more effective at removing clay and upgrading rock scalplings.

Crushed rock aggregate

A variety of rocks are, when crushed, suitable for use as aggregates. Their technical suitability for different aggregate 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 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 aggregate. However, 'high quality' crushed rock aggregate, to meet demanding specifications, is commonly derived from hard, dense and cemented sedimentary rock (most limestones and certain sandstones) and the tougher, crystalline igneous rocks. Their distribution is shown in Figures 6–9.

Limestone

Limestones are sedimentary rocks composed mainly of calcium carbonate (CaCO_3). With an increase in magnesium carbonate (MgCO_3) content they grade into dolomite ($\text{CaMg}(\text{CO}_3)_2$). Most limestones and dolomites are hard and durable and useful for aggregate. They are common rock types and consequently widely extracted for aggregate materials. 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 aggregate use.

In Great Britain, limestone (including dolomite) provides 49% of the crushed rock aggregate produced. Limestones of Carboniferous age are the major source of limestone aggregate and it represents one of the largest resources of good-quality aggregate in Britain. These limestones are commonly thickly bedded and consistent

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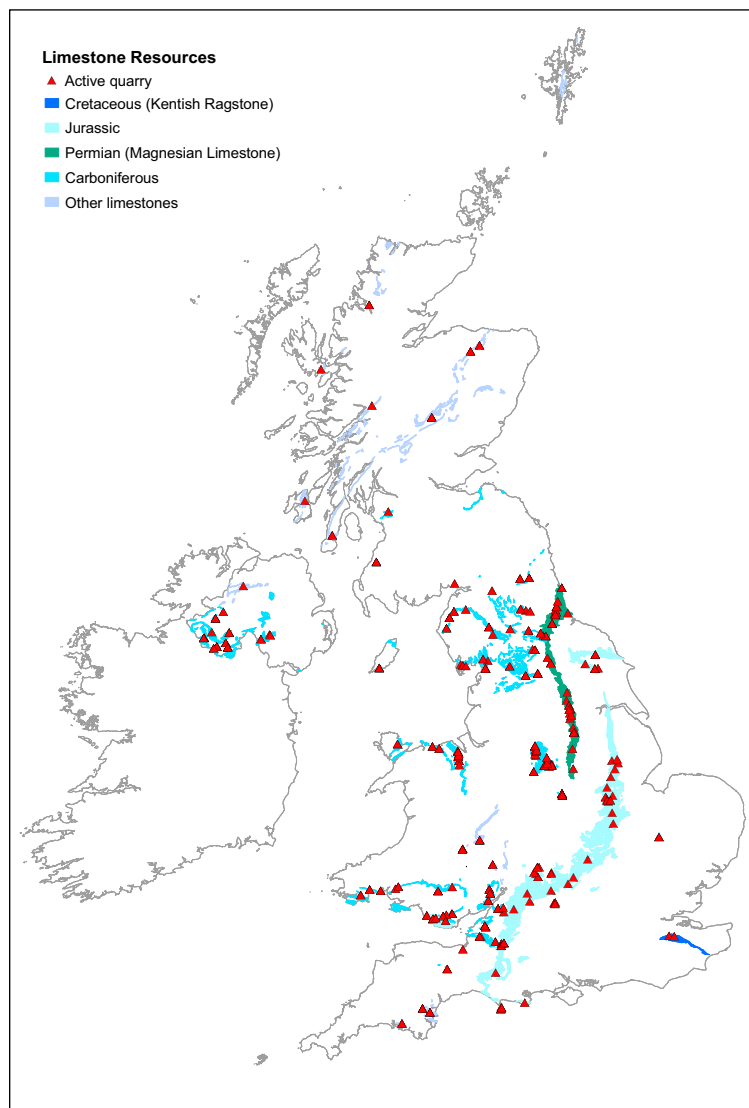


Figure 6 Distribution of limestone resources and quarries in the UK.

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 aggregate. 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 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 aggregate 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 aggregate. A significant proportion of Mendip limestone output is exported to south-east England, mostly by rail, 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 Jurassic and Cretaceous (the Chalk) limestones are hard enough to be quarried for less demanding aggregate 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 and are much softer than typical Carboniferous limestone with higher porosity. Hence, they are generally quarried for their industrial uses or for low-grade aggregate applications, such as sub-base roadstone and fill. However, some beds are sufficiently strong, sound and durable to be used as concreting aggregate and several quarries near Maltby, South Yorkshire and near Durham produce high-quality aggregate materials.

Igneous and metamorphic rock

Igneous rocks 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, usually produced from sandstones. The high strength and attrition

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resistance of certain igneous rocks results in their use as railway ballast. In Great Britain igneous and metamorphic rock account for 42% of the crushed rock aggregates produced.

Resources of igneous and metamorphic rocks are predominantly concentrated in Northern Ireland and Scotland, 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, and are well placed to serve markets in the South East. The deposits are of economic importance out of proportion to their relatively small size and account for 28% of total igneous rock production in Great Britain. 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 of dolerite, such as the Whin Sill in northern England. 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 aggregate production, all of which is exported by ship to markets in London, south-east England and north-west Europe. The gran-

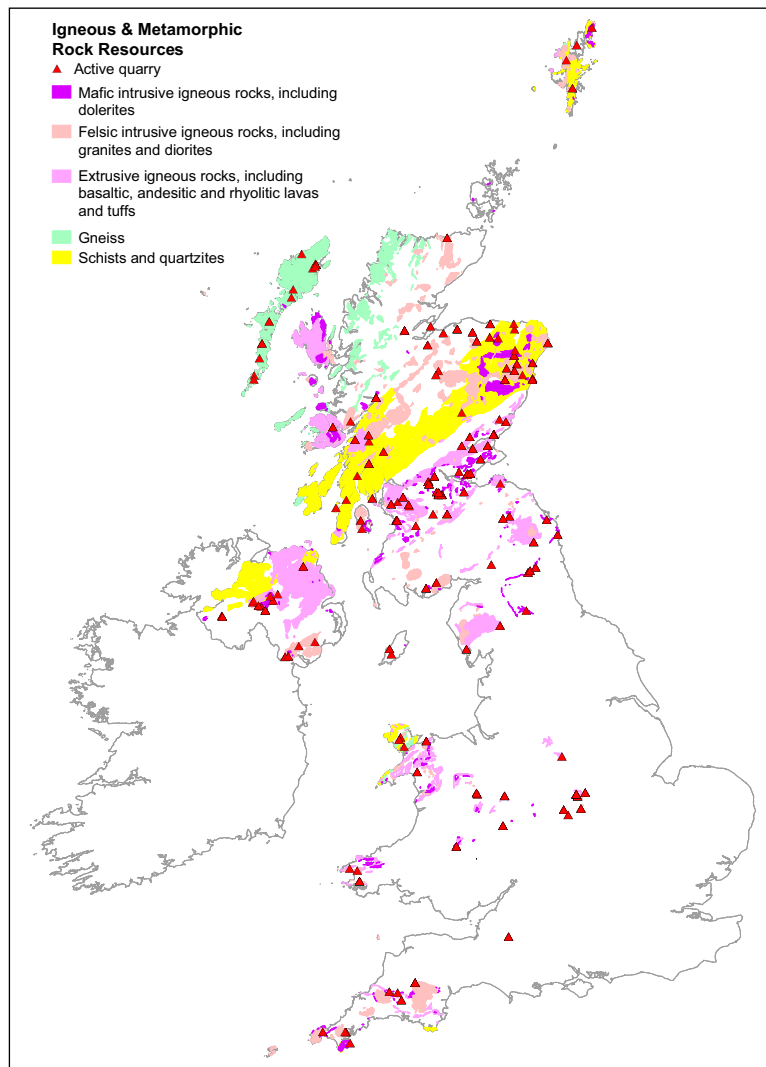


Figure 7 Distribution of igneous rock resources and quarries in the UK.

ite aggregates from Glensanda are high quality materials used for roadstone, rail ballast and concreting aggregate.

Sandstone

Sandstones 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 quartzites, greywackes, gritstones, and arkoses.

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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**). Today only about 8% of total production is for this purpose and sandstone is now used mainly as crushed rock aggregate, although it only accounts for approximately 9% of the crushed rock aggregates produced in Great Britain.

The suitability of a sandstone for aggregate 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 aggregate uses. 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 Sandstones of the South Wales Coalfield are 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 LAAs) with good strength (low ACV). Despite the considerable thicknesses, lateral variability and widespread distribution of the Pennant sandstones, the aggregate properties of these sandstones are remarkably uniform. The major cause of variation in aggregate properties is the degree of weathering. Weathering weakens the aggregate and reduces its durability. All

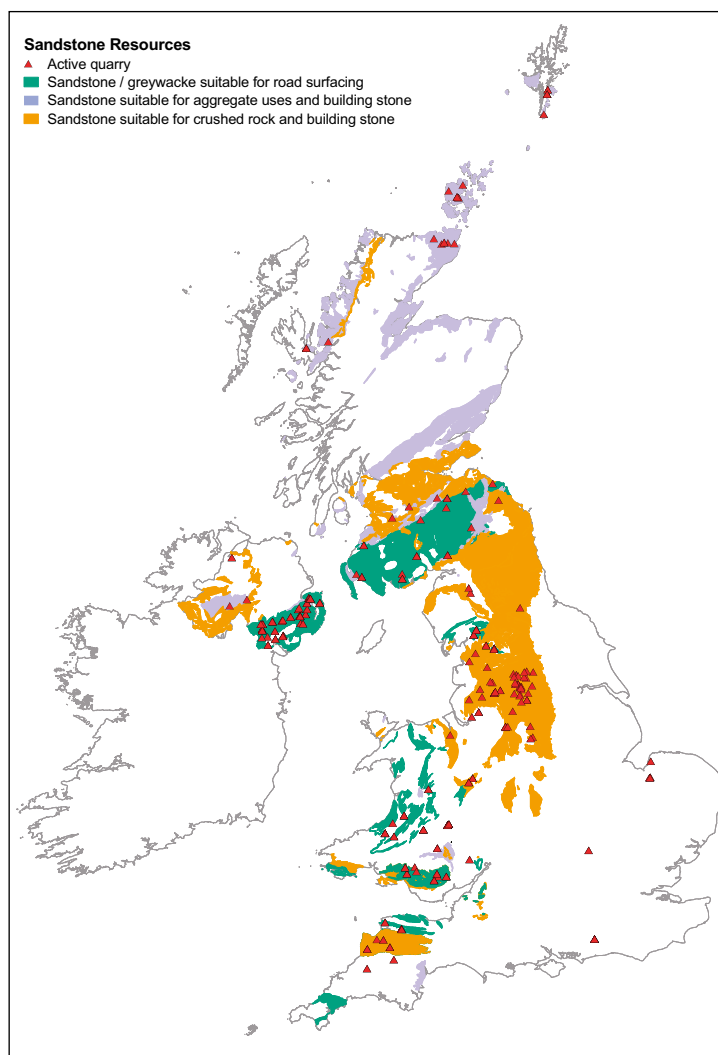


Figure 8 Distribution of sandstone resources and quarries in the UK.

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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 aggregate. These sandstones are sub-greywackes 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 Ingletton. These rocks are strongly folded and comprise a mixed sequence of greywackes, siltstones, arkoses and conglomerates. They are quarried at several sites 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 aggregate sizes may also

⁴ PSV–Polished Stone Value; AAV–Aggregate Abrasion; LAAV–Los Angeles Abrasion Value; ACV–Aggregate Crushing Value.

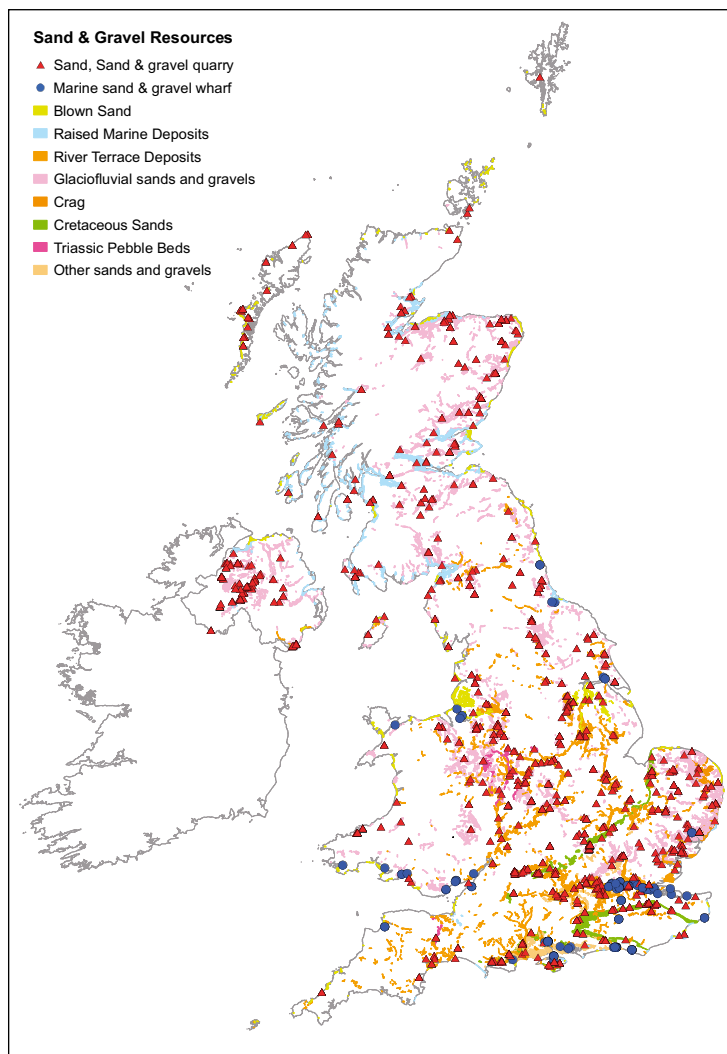


Figure 9 Distribution of sand and gravel resources and quarries in the UK.

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 are defined on the basis of particle size rather than composition. In current commercial practice, following the introduction of new European standards from 1st January 2004, the term 'gravel' (or more correctly coarse aggregate) is used for general and concrete applications to define particles between 4 and 80 mm and the term 'sand' (or

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fine aggregate) 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 aggregate.

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 aggregate until 1979, when crushed rock output exceeded it for the first time. Its relative importance has declined since then and in 2011 sand and gravel accounted for 38% of total primary aggregate 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 (Figure 9). 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

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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 aggregate. Bedrock deposits are generally much thicker than most superficial deposits and thus yields per hectare are much greater.

Marine sand and gravel

Britain is one of the world's leading producers of marine sand and gravel, which makes an important contribution to overall provision of aggregate materials, notably in 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, seabed 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 the more limited. Most dredging takes place in coastal waters less than 25 km offshore and in water depths of between 18 m and 35 m. Current dredging plant does not allow working in water depths in excess of 50 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, off 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 are sterilised by other activities. The most important resource areas are the east coast (offshore Great Yarmouth-Southwold), the south coast, the Humber-Wash area, the south west coast area (chiefly the Bristol Channel) and the north west coast area (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, and are principally composed of igneous, metamorphic or hard sandstone types, 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

Construction and demolition waste material, such as concrete and masonry, is, by far, the largest source of alternative aggregate to natural sources. Major sources include large demolition and construction operations within urban areas (redevelopment or 'brownfield' site

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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 has already been utilised and as a result there is a view that we are 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 aggregate 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 2005 the total industry annual arisings were roughly 9 million tonnes of sand and 6.5 million tonnes of rock but more recent data is not available. The industry 'stockpile' of material that is 'possibly usable' is estimated to be approximately 150 million tonnes. 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 and water when this material is used in concrete. The latter are 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 aggregate mainly in road construction but also as fine aggregate in concrete. Usage is modest and, as with china clay, a major problem is distance to major markets.

Although clay and shale would not normally be considered as a source of aggregate 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 now restored and as such are unavailable for extraction. However, lightweight aggregates produced by heating certain clays at high temperature can produce a good quality aggregate for concrete block manufacture.

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

Ash used as secondary aggregate 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 aggregate in concrete block manufacture.

Reserves

In mineral planning, the term 'reserves' or 'mineral reserves' refers to a mineral resource 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

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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 (MPA) or groups of MPAs. The minimum length of a landbank reflects the time needed to obtain planning permission and to bring a site into full production. In Scotland current guidance indicates that this should be 10 years and in both England and Wales this is 7 years for sand and gravel and 10 years for crushed rock.

Information on permitted reserves of aggregate minerals (sand and gravel and crushed rock) in England and Wales is published annually by the Aggregates Working Parties (AWPs). The most recent complete information is for 2009, when total aggregate reserves were approximately 3 935 million tonnes.

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 2009 and the results are summarised in Table 6. A similar survey for Scotland was carried out in 2007 (containing 2005 data, although with less detail) but this has not been repeated. There has not been an equivalent survey in Northern Ireland.

Of the total permitted reserves of 4 547 million tonnes in England and Wales in 2009, crushed rock accounted for 87.6%. The distribution of reserves is very uneven, with 30.4% of all reserves being located in the East Midlands and 20.0% 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 10 years at 2010 levels of output), than crushed rock reserves, which are usually measured in terms of a few decades (48 years at 2010 levels of output).

A study was conducted by the BGS in 2006 into the aggregate reserve trends for England dur-

Region	Thousand tonnes		
	Sand & gravel	Crushed rock	Total
South West	40 508	868 359	908 866
South East	79 046	58 804	137 850
London	1 952	0	1 952
East of England	147 372	3 343	150 715
East Midlands	80 594	1 303 457	1 384 052
West Midlands	103 694	311 781	415 476
North West	41 765	327 380	369 146
Yorkshire & the Humber	34 000	301 097	335 096
North East	15 337	216 561	231 898
England	544 267	3 390 782	3 935 049
South Wales	1 672	418 962	420 634
North Wales	19 274	172 428	191 701
Wales	20 945	591 390	612 335
England & Wales	565 212	3 982 172	4 547 384

Table 6 Total permitted reserves of land-won aggregate minerals in active and inactive sites in England and Wales, 2009.

Source: Collation of the results of the 2009 Aggregate Minerals Survey for England and Wales, BGS. (This data excludes non-aggregate uses, and also excludes 'dormant' sites).

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ing the period 1990 to 2004, using the annual reports of the Aggregate Working Parties. This study shows that the national landbank is declining as extraction exceeds new planning consents. In particular, sand and gravel reserves declined by 28% between 1995 and 2004, as a result of planning permissions being 27% less than sales. The full report is available as a free download on www.mineralsuk.com. This trend has continued with sand and gravel reserves over the 10-year period of 2000–2009 declining by 29%. Tonnages associated with new planning permissions over the same period were 35% less than sales (see Table 7). Figures 10 and 11 illustrate the differences between sales and planning permissions for the 20-year period from 1990–2009. Similar information is not currently available for other parts of the UK.

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 aggregate 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

gravel quarries near major demand areas may have relatively large outputs but, even with frequent new permissions to replace reserves lost by production, may have small landbanks.

Gross figures for aggregate 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 36.7% of aggregates sales are for concrete and in some areas there is a deficiency of material that is suitable for this use.

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, 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 aggregate means that they also give rise to some of Britain's most attractive and spectacular upland scenery.

	Land-won Sand and Gravel			Crushed Rock		
	Sales	Planning Permissions	Difference	Sales	Planning Permissions	Difference
Region	Thousand Tonnes		%	Thousand Tonnes		%
North East	12 371	5 121	-59	53 306	12 264	-77
North West	30 200	37 730	25	90 191	62 483	-31
Yorkshire & the Humber	42 671	29 706	-30	113 782	31 109	-73
East Midlands	93 975	71 433	-24	284 710	133 336	-53
West Midlands	91 840	34 576	-62	46 208	39 390	-15
East of England	133 687	102 850	-23	4 561	395	-91
South East	97 931	58 412	-40	15 360	7 063	-54
London	9 819	3 686	-62	0	0	0
South West	44 700	18 183	-59	222 032	67 779	-69
England	557 194	361 697	-35	830 150	353 819	-57

Table 7 Shortfall between planning permissions and sales 2000–2009

Source: Primary Aggregate Reserves in England 2000–2009, BGS commissioned report number CR/06/168 and Aggregates Working Parties' annual monitoring reports.

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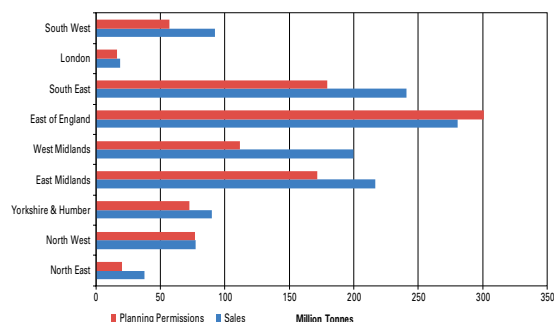


Figure 10 Land-won sand and gravel by region—sales tonnes compared to planning permission tonnes. Source: Primary Aggregate Reserves in England 1990–2009, BGS commissioned report number CR/06/168 and Aggregates Working Parties' annual monitoring reports.

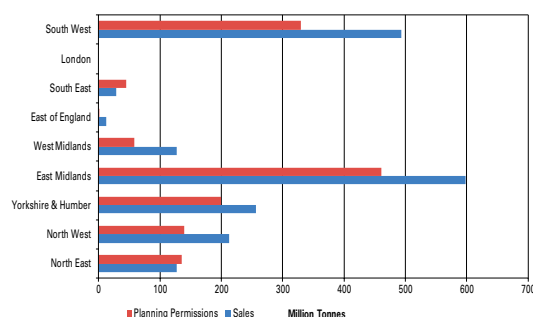


Figure 11 Crushed rock by region—sales tonnes compared to planning permission tonnes. Source: Primary Aggregate Reserves in England 1990–2009, BGS commissioned report number CR/06/168 and Aggregates Working Parties' annual monitoring reports.

Some of these areas are also valued for their nature conservation importance. In particular, Carboniferous limestone is the principal source of crushed rock aggregate 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 aggregate reserves within the main Environmental Designations is shown in Table 8.

Designation	Sand and Gravel		Crushed rock	
	Thousand Tonnes	% of Total Reserves	Thousand Tonnes	% of Total Reserves
National Park	1 236	0.2%	383 235	9.6%
AONB	42 522	7.5%	276 662	6.9%
SSSI	60 504	10.7%	1 029 591	25.9%
SPA and SAC	22 852	4.0%	166 852	4.2%
Total	127 114	22.5%	1 856 340	46.6%
Total Reserves	565 212		3 982 172	

Table 8 Reserves in environmental designations within England and Wales. Source: Collation of the results of the 2009 Aggregate Minerals Survey for England and Wales, DCLG.

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.

Green Belts around the major conurbations cover substantial areas of aggregate resources, notably sand and gravel. Working aggregates in such locations near major centres of demand would accord with sustainability, 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

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'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 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 aggregate quarries are in a unique position to develop recreation, education, and conservation sites through high quality and innovative restoration. A significant number of SSSIs have some relationship with the mineral workings, past or current, and most of these are aggregate sites.

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 about 5 Mt/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: 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 are typically produced. 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 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. However, 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 up to 1 million 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 (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 (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,

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subsoil and other overburden are kept separate for eventual use in restoration.

River gravels 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 aggregate 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 $< 63 \mu\text{m}$ 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), for constructional fill, may be produced 'as dug'.

Most sand washing plants for the production of concreting, asphaltting 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.



Limestone processing.

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Washing and screening sand and gravel.

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'. Modern sand and gravel dredgers have capacities in the range 1 200 to 8 500 tonnes and have operating cycles of between 12 and 36 hours. Most extraction in UK waters is by trailer suction dredging, where a suction pipe is pulled across the seabed at slow speed. The passage of the pipe across the seabed leaves a groove about 2.5 m wide and 0.25 m deep and allows relatively thin deposits to be worked. 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 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

Aggregate 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 this material has no use, when actually it 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

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- Dry screening of sand, segregating clay and rock.

These materials generated by aggregate extraction are inert and non-hazardous. There has been no systematic quantification of the amount of these materials generated as a result of primary aggregate production. In some circumstances, this material may be considered as a resource (some scalplings are clean enough to meet Type 1 sub-base, or the material will have potential to be used as fill), although some can only be marketed with additional processing, the economic viability of which will depend on a number of factors, 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 aggregate 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, with aggregate being produced from lower quality rock that would be unsuitable for these uses. About 15% of total Great Britain production of limestone and dolomite (excluding that for cement manufacture), or 9.5 million tonnes, is sold for a range of industrial applications and for agricultural lime. Almost all of this will be associated with aggregate 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.

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 now 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 that changing construction practice is currently having on 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 are not changed irreversibly in use, except for an element of decay. They can, therefore, be recovered, for example, from construction and demolition waste, and asphalt plantings and used, at least for less demanding applications.

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

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Processing china clay aggregate.

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 aggregate is transported by road, the average delivered distance being about 40 km. In 2010 approximately 10% 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 (1%).

Primary aggregates are, where possible, produced close to major centres of demand so as to minimise costs. Large aggregate 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 aggregate. First are the environmental effects of the supply of aggregates immediately around the quarry (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 aggregate.

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 increasing quantities are being moved by rail, mainly from the Mendips and Leicestershire to London and the South East. Road haulage of aggregates can be part of the general haulage of goods within the country and transport of aggregate can, therefore, be on the back of the transport of other products (e.g. grain or animal feed

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from South East to the South West) producing long distance movements which might otherwise be uneconomic.

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. Large 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 represented less than one quarter of the total output from the quarry in 2011, with the remainder being exported). From the Isle of Grain some aggregates are transhipped onto barges for movement up the Thames to Tilbury as well as other ports in southern and eastern England. Shipments from Glensanda are also made to other terminals, including Northfleet on the Thames, Liverpool, Greenock and Southampton. Coastal shipments of rock are also made from Cornwall, North Wales, the Shetlands and Northern Ireland. Seaborne imports of aggregates, including armourstone, are principally from Norway, France and Ireland and mainly landed in the South East. Aggregates are also transported by barge on the Trent, Severn and Thames. Wharves for handling aggregate 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 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 aggregate are moved by sea.

Although alternative methods to road transport have clear advantages they are not without environmental impacts. Rail depots (where aggregate is 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 aggregate to barges for movement closer to the market, this is the exception and most aggregate will still have to be finally distributed by road. Often there are rail network capacity constraints (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 as rail-borne traffic competes with passenger traffic on congested rail routes. There are also concerns about availability of port and wharf infrastructures that are both capable of taking seaborne shipments (few ports can accommodate shipments of 90 000 tonnes) and, importantly, have adequate 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:

- £2.50 per tonne 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;
- £64 per tonne (from 1st April 2012) applying to all other taxable waste. This rate is subject to an escalator and increases every year.

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

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1999. This tax stimulated greater recycling of aggregates, prior to the introduction of the Aggregates Levy. However, there are concerns that insufficient inert waste is now available to restore mineral workings.

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 aggregate 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 aggregate and encourage the use of recycled materials and secondary aggregates such as china clay waste, slate waste and colliery spoil, which are exempt. 'Clay' and 'shale' are also exempt. Whilst not normally considered as being suitable for aggregate use, except as fill, some 'shales' may be quite hard and increasing quantities appear to be entering the market place. There are problems about the definitions of these materials.

The Levy led to some distortions in the market, notably in Northern Ireland with increased imports from the Republic of Ireland. The Government recognised the problem and extended relief to virgin aggregates at 80% of the full rate. However, this was challenged in the European General Court by the British Aggregates Association and the relief was found to be illegal. The Northern Ireland Aggregates Levy Credit Scheme was therefore suspended with effect from 1 December 2010 and producers in Northern Ireland are consequently required to pay the Levy at the same rate as producers in other parts of the UK.

The growth in the market share of recycled and secondary aggregates, which are mainly used for less demanding applications, has displaced some low-quality primary aggregates in applications such as fill because they are no longer competitive with non-taxed materials. Consequently it is reported that the build up of substantial stockpiles of fines or low-quality

materials at some crushed rock quarries is creating disposal problems and sterilising reserves, as well as a loss of revenues.

Planning issues

National policy

Government planning policy on the provision of construction aggregates in England is set out in the National Planning Policy Framework. Additional guidance is provided in *Guidance on the Managed Aggregate Supply System and in National and regional guidelines for aggregates provision in England 2005–2020*.

Comparable planning policy for Wales is set out in *Minerals Planning Policy Wales* (as amended by any Ministerial Interim Planning Policy Statements) and supplemented by *Minerals Technical Advice Notes*. In Scotland minerals planning policy is set out in the *Scottish Planning Policy*.

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 a steady and adequate supply of aggregate with minimum impact on the environment.

Managed Aggregate Supply System in England

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

For over 35 years, these imbalances in supply and demand have been met through the Managed Aggregate Supply System. The underpinning concept of this System is that Mineral Planning Authorities with adequate resources make an appropriate contribution to national, as well as local, supply. This must be balanced with the need to minimise environmental impacts of extraction. Mineral Planning Authorities which are comparatively resource-poor are expected to continue to

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make a contribution to meeting supply needs, where this can be done sustainably, but will also receive significant quantities of aggregates imported from other areas.

The System aims to ensure a steady and adequate provision of aggregates in England and comprises a number of elements:

- A Local Aggregate Assessment is prepared for each Mineral Planning Authority. These contain details of demand and supply options for aggregates in the authority 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 at regular intervals to provide an indication of the total amount of aggregate provision that each Aggregate Working Party area should aim to supply.
- A National Aggregate Co-ordinating Group is convened by the Department for Communities and Local Government to provide guidance to the Aggregates Working Parties, to monitor the overall provision of aggregates in England and to provide strategic advice to Government.
- Aggregates landbanks are a monitoring tool to alert Mineral Planning Authorities to the possibility of disruption to the provision of land-won aggregates (for further description see section on 'Landbanks' below). The landbank is the sum of all 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.

Further guidance relating to the Managed Aggregates Supply System is contained in the document *Guidance on the Managed Aggregates Supply System* published by DCLG in October 2012. 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 aggregate extraction and supply in a number of ways. In considering the overall use of resources, the extent to which aggregate can be sourced locally to demand centres is a significant issue because of the direct implications on fuel consumption and greenhouse gas production if aggregate is 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 few. 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.

Reduction of harm to landscape and habitats is an important sustainable development consideration. This can be minimised by proper location of quarries and good environmental management of sites. Since aggregate extraction is a temporary use of land, albeit a sometimes protracted use, effective restoration can bring the site back into appropriate use and has been used to create new opportunities for habitats, biodiversity and geodiversity.

Relationship between primary and secondary aggregate 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 aggregate demand is supplied by alternative materials, mainly construction and demolition waste, and Britain leads the rest of Europe in this regard.

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However, it is thought that most of the material that is suitable for aggregate 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 continue to be a real challenge to the planning system. Part of that process is the application of effective safeguarding mechanisms to prevent the unnecessary sterilisation of aggregate resources so that they may be available for the future. Prior extraction may be an option to avoid sterilisation of resources by non-mineral development.

Landbanks

Landbank policies have been an important element of aggregate planning for many years at both national and local level. They form a vital component of the Managed Aggregate Supply System in England (see above). Landbanks relate to both years of supply and tonnage of supply in reserves over that specified period. The purpose of these policies is twofold. First they set out a minimum provision that is considered the least amount required to maintain supply to the construction industry. Secondly they are used to assess the level of provision that needs to be made in mineral plans. 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.

Environmental and amenity impacts

The relationship and constraints flowing from designations have been described above. In considering aggregate 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 on restoration has provided a range of habitats and ecological niches (ponds, rock faces, reed beds, etc) 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 quarries provide ideal conditions for rare colonising species that can only survive when not overwhelmed by more vigorous species that grow on more productive land and a continuity of such surfaces is 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 aggregate 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

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mile limit), but has the rights to explore for and exploit sand and gravel in the remainder 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. These properties and rights are managed by the Crown Estate Commissioners. Almost all marine extraction, therefore, takes place from licences on seabed owned by The Crown Estate. In 2011 the total area licensed for dredging was 1274 km² of which only 114 km² was actually dredged.

Historically marine dredging for aggregates has been controlled by a system of licenses issued by the Crown Estate following a favourable 'Government View' from the DCLG for England or from the devolved administrations in the other parts of the UK. This 'View' was based on the results of consultation and a detailed environmental statement.

This system was replaced in April 2011 by a unified system of marine licensing established under the Marine and Coastal Access Act (2009). Applications for the extraction of marine minerals are now administered by the Marine Management Organisation for England, the Northern Ireland Environment Agency, Marine Scotland or the Marine Consents Unit in 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 licence.

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 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

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Aggregates Working Parties (AWPS) were established in the English Regions and Wales in January 1976 with membership drawn from MPAs, the aggregates industry and the DCLG. 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

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annual monitoring of the supply of aggregates in their region and permitted reserves of aggregates. The results are published as Annual Monitoring reports.

Collation of the results of the 2009 Aggregate Minerals Survey for England and Wales. Produced by the BGS on behalf of Department for Communities and Local Government and the Welsh Assembly Government.

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Mineral Products Association
<http://www.mpa.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/>

Department for Communities and Local Government
<http://www.communities.gov.uk>

University of Leeds – Mineral Industry Research Organisation
<http://www.goodquarry.com>

Waste and Resources Action Programme (WRAP)
<http://www.aggregain.org.uk>

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