



Historic England

Strategic Stone Study

A Building Stone Atlas of

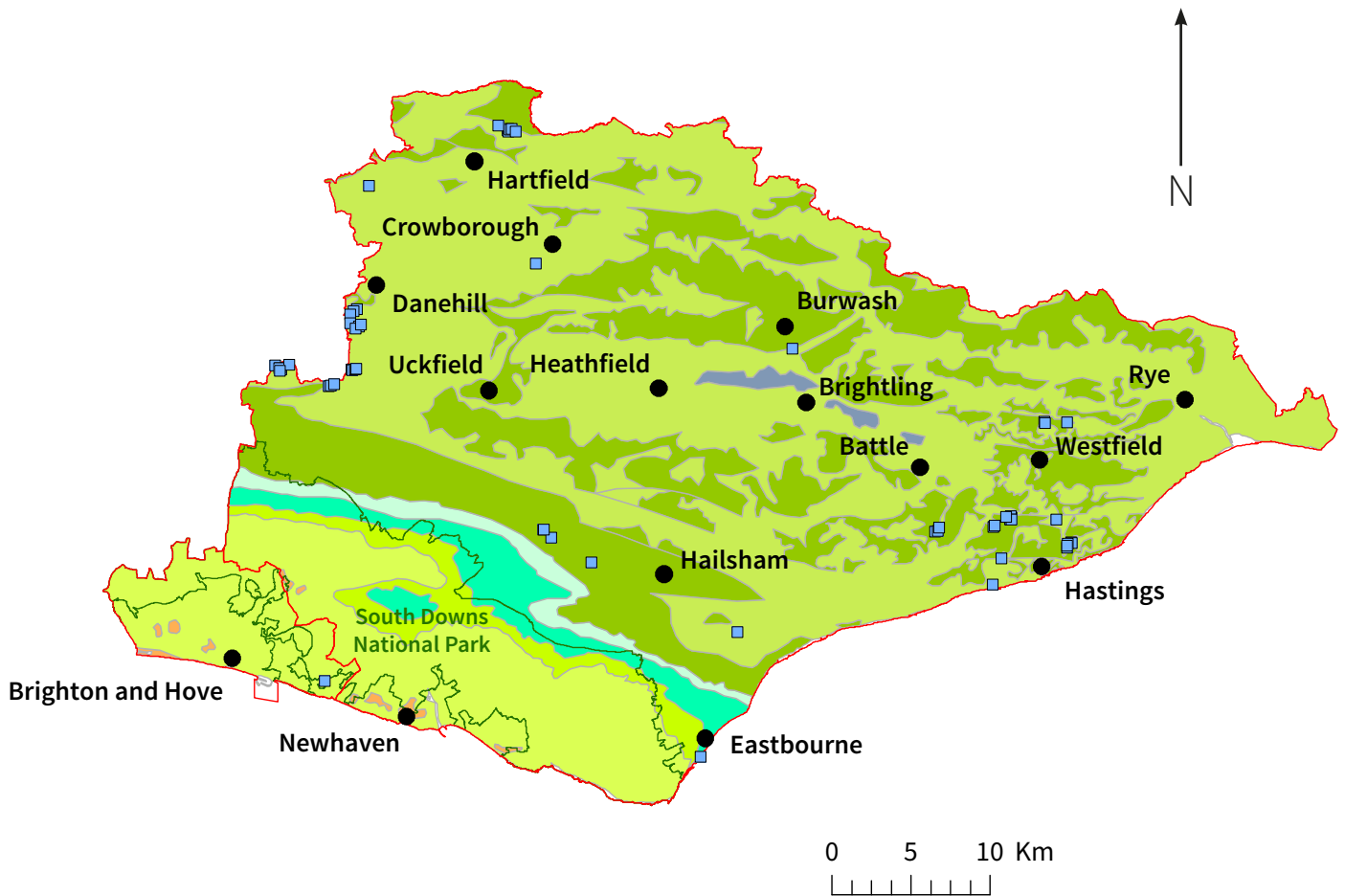
East Sussex (including Brighton and Hove Unitary Authority)

Published November 2015

PERIOD	GROUP	FORMATION / MEMBER		BUILDING STONES
QUATERNARY	Various / not defined	Various / not defined		<ul style="list-style-type: none"> Tufa Ferricrete Downland Field Flint, Beach Pebble Flint, River Terrace Flint
TERTIARY (PALAEOGENE)	Lambeth Group	Upnor, Woolwich and Reading formations		<ul style="list-style-type: none"> 'Sandstones and Ironstones' 'Ferruginous Flint Conglomerate' Sarsen Stone
UPPER CRETACEOUS	Chalk Group	White Chalk Subgroup	Culver Chalk Formation	<ul style="list-style-type: none"> Chalk Quarry Flint
			Newhaven Chalk Formation	
			Seaford Chalk Formation	
			Lewes Nodular Chalk Formation	
			New Pit Chalk Formation	
LOWER CRETACEOUS	Selborne Group	Upper Greensand Formation		<ul style="list-style-type: none"> Eastbourne Sandstone
		Gault Formation		
	Lower Greensand Group	Folkestone, Sandgate and Hythe formations		
	Wealden Group	Weald Clay Formation		<ul style="list-style-type: none"> Sussex Marble <i>(Small and Large Paludina Limestones)</i>
			Horsham Sand Member	<ul style="list-style-type: none"> Horsham Stone-slate Horsham Stone
		Tunbridge Wells Sand Formation	Grinstead Clay Member	<ul style="list-style-type: none"> Cuckfield Stone
			Ardingly Sandstone Member	<ul style="list-style-type: none"> Ardingly Sandstone
		'Hastings Beds' Subgroup	Wadhurst Clay Formation	<ul style="list-style-type: none"> Northiam Sandstone Hog Hill Sandstone Tilgate Stone Cliff End Sandstone Wadhurst Clay Ironstones <i>(including Rye Ironstone)</i>
			Ashdown Formation	<ul style="list-style-type: none"> Ashdown Sandstone
UPPER JURASSIC	Purbeck Group	Durlston Formation		<ul style="list-style-type: none"> Greys Limestone
		Lulworth Formation		<ul style="list-style-type: none"> Blues Limestone

Table 1. Summary (Interactive) of stratigraphical names applied to Jurassic, Cretaceous and Cenozoic sediments in East Sussex.

East Sussex Bedrock Geology Map



East Sussex Bedrock Geology

- BUILDING STONE SOURCES
- **LAMBETH GROUP** - CLAY, SILT, SAND AND GRAVEL
- **WHITE CHALK SUBGROUP**
- **GREY CHALK SUBGROUP** } **CHALK GROUP** - CHALK
- **GAULT FORMATION AND UPPER GREENSAND FORMATION (UNDIFFERENTIATED)** - MUDSTONE, SANDSTONE AND LIMESTONE
- **LOWER GREENSAND GROUP** - SANDSTONE AND MUDSTONE
- **WEALDEN GROUP** (*principally Wadhurst Clay Formation and Weald Clay Formation, but includes generally finer grained lithologies of the Tunbridge Wells Sand Formation*) - MUDSTONE, SILTSTONE AND SANDSTONE
- **WEALDEN GROUP** (*principally Ashdown Formation and generally coarser grained lithologies of the Tunbridge Wells Sand Formation*) - SANDSTONE AND SILTSTONE, INTERBEDDED
- **PURBECK GROUP** - LIMESTONE AND MUDSTONE, INTERBEDDED

Derived from BGS digital geological mapping at 1:625,000 scale, British Geological Survey © NERC. All rights reserved

Upper Jurassic and lowermost Cretaceous

Purbeck Group

Purbeck Limestone

In East Sussex, Purbeck Limestone crops out in three partially fault-bounded inliers located towards the centre of the county around Broadoak (from Heathfield to Brightling), north of Netherfield, and west of Whatlington (near Battle). These limestones represent the oldest strata that occur at the surface in the Weald and are very similar to the Purbeck Group limestones of Dorset.

The two main types of Purbeck Limestone identified in East Sussex are rather susceptible to weathering, typically delaminating along bedding surfaces and crumbling. Consequently, both limestones have only been employed to a limited extent as building stones in the county.

Lulworth Formation

Blues Limestone

The Blues Limestone is approximately 12 m thick and consists of light blue to grey blue limestones with calcareous mudstones. The limestones are mainly medium-grained crystalline calcarenites, but lower beds are frequently fine-grained (calclutites); some algal and pelletal limestones also occur. The limestones often contain freshwater fossils and shelly material, including bivalves (such as the clam *Neomiodon*, and the oyster *Praeexogyra*) and infrequent gastropods (*Viviparus*); fossil fish bones, scales, plant remains and ostracods also occur at some levels.

The Blues Limestone has been used for polished paving slabs at Penhurst church, and for memorial slabs in churchyards, such as at Brightling. It is also employed as a rubble stone in the walls of All Saints Church, Mountfield, near Battle.

Durlston Formation

Greys Limestones Member

Greys Limestone

The Greys Limestone is up to 26 m thick and comprises mainly grey, medium-grained (but occasionally coarser) crystalline



Purbeck Greys (and Blues) Limestone was used as rubble stone in walls of All Saints Church, Mountfield

calcarenites with a characteristic freshwater fossil fauna, including the bivalve *Neomiodon*; some beds are packed with shelly bioclasts.

Greys Limestone was worked mainly for the production of agricultural lime. However, it has been used as a rubble stone in the walls of All Saints' Church, Mountfield and as garden paving stones at Bateman's, near Burwash.



Newenden Bridge, built of Wealden Sandstone, including Ashdown Sandstone most likely obtained from the nearby 'Hastings Beds'

Lower Cretaceous

Wealden Group

Wealden Sandstone

The Wealden Group in South-East England, comprises a thick sequence of early Cretaceous sediments. The history of the Wealden Group stratigraphy is long and complex and various names have been applied to different parts of the succession at various times. This is partly the result of the lateral facies variations shown by these sediments across their outcrop area, which is an issue that has particular relevance to the numerous sandstones that occur within the Wealden Group and have been employed for building purposes.

The situation is further complicated by the recognition that, even within individual formations, a wide range of sandstone varieties may be present; several named lithological varieties of sandstone may even occur together within the same exposed quarry face. Consequently, distinguishing individual sandstones when seen *ex-situ* or assigning them to specific formations or source quarries is, at best, extremely difficult, and often impossible. For convenience, therefore, the term 'Wealden Sandstone' is used in this study of East Sussex building stones in a generic sense for any sandstone that is believed to originate from within the Wealden Group, but is otherwise of uncertain stratigraphic position.

Wealden Sandstone crops out over much of central and northern East Sussex (including the Weald) north of a line

extending from the east of Burgess Hill, via Barcombe and Laughton, to Polegate. The sandstones are typically grey to light-brown in colour, and fine- to medium-grained. There is, however, a large variation in both lithology and colour, including yellowish-brown and cream-tinted types. These sometimes calcareous sandstones can be hard and massive, more thinly-bedded and flaggy, or occur as large concretions. They are frequently micaceous and are associated with coarser-grained pebble beds, which are typically encountered at either the top or base of individual sandstone units. The more massive, quartzitic, or iron-cemented, sandstones are usually fairly hard and resistant.

Wealden Sandstone has been widely employed as the primary building stone throughout its outcrop area in East Sussex, being seen mainly in walls as a coursed rubble stone, or as roughly cut blocks, but only occasionally as ashlar. It was formerly worked from small pits and was used especially for church construction; fine examples are found at Uckfield, Crowborough, Old Heathfield, Little Horsted, Frant, Hailsham, Battle, Bexhill, Hastings, Rye, Wadhurst, Tycehurst, Etchingham, Hastings (especially at Ore with 'crazy paving' effect), Winchelsea and Michelham Priory.

'Hastings Beds' Subgroup

The term 'Hastings Beds' is an informal stratigraphic name applied to a sequence comprising the combined Ashdown, Wadhurst Clay and Tunbridge Wells Sand formations (which are each described further below). The 'Hastings Beds' are provisionally given Subgroup status pending formal definition by BGS.

Ashdown Formation

Ashdown Sandstone

The Ashdown Sandstone crops out in a broad, but irregular, partly fault-controlled belt and forms much of the bedrock geology of northern and central East Sussex. The formation is juxtaposed with strata assigned to both the Wadhurst Clay and Tunbridge Wells Sand formations, and underlies wide tracts of land encompassing Forest Row, Danehill, Ashdown Forest to Crowhill, Framfield to Westfield via Heathfield and Whatlington, further extending to Fairlight, Hastings, Pett, Udimore and Rye. Ashdown Sandstone is superbly exposed in the cliffs between Bexhill and Cliff End, which is the type area for these strata.

The formation contains units of fine-grained, yellowish-brown to pale grey sandstones. Each of the main sandstone units is typically up to 6 m thick, and has a thin, pebble bed at its base. The uppermost unit is termed the **Top Ashdown Sandstone**. The formation is reported to reach a total thickness of nearly

230 m at Crowborough, but this may reflect duplication of part of the sequence by reverse faulting. The sandstones include a number of varieties, ranging from massive to flaggy; they are sometimes ripple-marked on the uppermost surface, and often cemented with calcite and iron oxides. Fossils in the sandstones are generally sparse and poorly preserved, but may be locally abundant and include freshwater bivalves, gastropods and plants, with occasional rolled dinosaur bones in the thin basal pebble-bearing beds.

In common with most of the harder Wealden Sandstones in East Sussex, the Ashdown Sandstone has been employed as a building stone throughout its outcrop area, mainly in walls as a coursed rubble stone, or as roughly cut blocks, and occasionally as ashlar. Particular noteworthy examples of its use are Bateman's (near Burwash), Etchingam Station, the ruins of Bayham Abbey (Lamberhurst) and the churches at Crowborough, Old Heathfield and Rye. It is also used, in combination with Tunbridge Wells Sandstone, at St. Leonards School, Mayfield.



Etchingam Station, built mainly of Ashdown Sandstone with Caen Stone dressings



St Andrew's Church, Fairlight, built mainly of Cliff End Sandstone quarried nearby

Wadhurst Clay Formation

The Wadhurst Clay Formation variably abuts strata assigned to the Ashdown and Tunbridge Wells Sand formations and crops out through northern and central East Sussex. It extends to the coast near Bexhill and Hastings, and is superbly exposed in cliffs between Bexhill and Cliff End.

The formation reaches 50 m in thickness and comprises mainly grey mudstones and red/green mottled clays with subordinate sandstones, siltstones, thin conglomerates and (in the lower part of the succession) distinctive sideritic clay-ironstones. Several impersistent sandstone units are recognised and have been used for building purposes on a minor, localised scale along their outcrop. Although various names have been applied to these sandstones (e.g. Cliff End Sandstone, Tilgate Stone, 'Hastings Granite', Hog Hill Sandstone, Northiam Sandstone), in common with many of the other Wealden Group sandstones, the Wadhurst Clay Formation sandstones tend to be similar lithologically. As a result, they usually cannot be distinguished from one another when seen ex-situ unless their exact provenance is known.

Cliff End Sandstone

The Cliff End Sandstone occurs at the base of the Wadhurst

Clay Formation and is confined mainly to the Hastings area of East Sussex. It is very well exposed in cliff sections between Hastings and Rye, and crops out extensively in the immediate hinterland. It is a massive, pale grey sandstone, reaching 10 m in thickness at its type section on the coast. The top of the sandstone is commonly purplish in colour due to the presence of finely organic material, notably in the form of long slender stems and lateral rootlets which may extend downwards for a couple of metres. Locally, the top of the sandstone is also marked by a pebble-bed cap.

Cliff End Sandstone was formerly worked in quarries near Fairlight. It is of very minor use as a building stone in East Sussex, the most noteworthy example of its use being St. Andrew's Church in Fairlight.

Tilgate Stone ('Hastings Granite')

In East Sussex, the name Tilgate Stone (or bizarrely 'Hastings Granite') is generally applied to hard, calcareous sandstone beds and lenses that occur within the Wadhurst Clay Formation. This contrasts with the usage of this name in West Sussex, where 'Tilgate Stone' was the name given by Gideon Mantell to horizons of distinctly hard calcareous sandstone occurring within the Cuckfield Stone Bed (Grinstead Clay Member, Tunbridge Wells Sand Formation).

In East Sussex, Tilgate Stone occurs within the main outcrop area of the Wadhurst Clay Formation in the south-eastern part of the Weald, but it is also recorded from near Lewes (Hempstead and Springham Wood), in the Tenterden district (in outliers near Iden, Reighton and Great Bellinghurst) and in the vicinity of Hastings (around Brede, Udimore, Ninfield, Crowhurst and between Westfield and Winchelsea). Tilgate Stone is also exposed in cliff sections between St. Leonards and Hastings.

Tilgate Stone is a pale bluish-grey to brown, hard, calcareous sandstone that is similar to Cuckfield Stone but is usually more thinly-bedded, flaggy and micaceous. It may also occur as lenses or large concretions (called 'doggers') up to 40 cm thick. Beds of Tilgate Stone rarely attain a total thickness exceeding 1.2 to 2.5 m, although exceptionally they may reach up to 5 m, as at Brede and Udimore. The sandstones are usually fairly hard and resistant, especially where calcite-cemented. However, Tilgate Stone doggers are prone to decalcification, producing ochreous 'rottenstones' that contain just a residual

core of calcareous material.

The stone is widely employed as a general walling and building stone along its outcrop. Tilgate Stone has been extensively used at Winchelsea, where the church, Court Hall, armoury, well, town wall and gates are all primarily constructed from this stone. Other notable examples of its use are Udimore Church and Hastings Castle, where it is used in combination with Ashdown Sandstone, Flint cobbles and occasional ironstones. Tilgate Stone was also worked near Brede for road dressing in the 1900s.

Hog Hill Sandstone

This sandstone is named from Hog Hill, near Icklesham, but it is best known from the Hastings area. The unit is up to 8 m thick, and comprises buff- or khaki-coloured sandstones, typically interbedded with grey and brown clays. The lower boundary is marked by an abrupt change from sandstone into mudstone.



The armoury and town well in Castle Street, Winchelsea, are built mainly of Tilgate Stone



The Frewen Chapel at St. Mary's Church, Northiam, is constructed mainly of Northiam Sandstone obtained from nearby quarries

As with other sandstone units in the Wadhurst Clay Formation, the Hog Hill Sandstone is laterally impersistent, and rapid lateral variations in lithology are common. Where present, it occupies a stratigraphic position approximately in the middle of the Wadhurst Clay Formation. Hog Hill Sandstone has seen only very minor and localised use as a building stone along its outcrop.

Northiam Sandstone

Northiam Sandstone occurs in the upper part of the Wadhurst Clay Formation, just below a series of distinctive red mottled clays. It has a relatively limited distribution in East Sussex, and is best known from the area around Northiam (extending to Sandhurst, just over the county border in Kent) and Hastings. It is a massive, pale buff, fine-grained sandstone unit up to 8 m thick, typically containing sandy beds with small quartz pebbles or laminated, lozenge-shaped clay-ironstone pebbles (up to 5 cm long, called 'boxstones'). Occasional poorly preserved fossils may be present, and comprise mainly plant debris (horsetail ferns) or bivalve moulds.

Current-bedding and festoon-bedding structures are characteristic of the sandstone beds, and frequent washout, scour-and-fill structures and evidence of reworking are also present. Northiam Sandstone has seen only very minor and localised use along its outcrop. One noteworthy example, however, is provided by the Frewen Chapel at St. Mary's Church in Northiam.

Wadhurst Clay Ironstone (Rye Ironstone)

Ironstone bands mainly occur within the lower parts of the Wadhurst Clay Formation cropping out along the edge of the High Weald, extending from Framfield south-eastwards to Bexhill and Hastings, via Horam. Isolated, fault-bounded outcrops containing ironstone also occur around Rye, Brede and Udimore. The ironstones are invariably deep reddish-, purplish- or dark brown-coloured. In terms of their form, they may vary from lenticular or tabular bands (up to 25 cm thick) to sideritic, clay ironstone nodules or concretions. Occasionally, the tabular beds may also contain thinner layers of sideritic mudstone or clay ironstone, and are locally highly fossiliferous containing abundant unflattened bivalve or ostracod shells. The well-cemented ironstones and nodules tend to be very hard and resistant to weathering.

The ironstones were formerly an important source of iron and were worked from shallow bell-pits. They typically saw only minor use as a building stone in East Sussex, but where employed, they are highly distinctive. Some of the best examples of their use are found in Rye (the **Rye Ironstone**), where Landgate Arch (in East Cliff) contains many lenticular blocks of deep purple-brown coloured ironstone, and the walls of the Baptist Church (in Cinque Ports Street) are partly composed of very hard, homogenous, knapped, sideritic concretions and ironstone lenses. Ironstone was also used on a small scale in the construction of



Conspicuous blocks of Rye Ironstone and Wealden Sandstone (including Ashdown Sandstone) in the C14th Landgate Arch, Rye

Hastings Castle's walls (in combination with larger quantities of Ashdown Sandstone, Tilgate Stone and Flint cobbles, the latter being obtained from nearby beaches).

Tunbridge Wells Sand Formation

The basic three-fold subdivision of the Tunbridge Wells Sand Formation into a Lower Tunbridge Wells Sand and an Upper Tunbridge Wells Sand separated by the Grinstead Clay Member (as used in West Sussex) is less easy to apply in East Sussex, especially beyond the western part of the High Weald. The formation generally contains more siltstone than the corresponding strata in West Sussex, and progressing eastwards through East Sussex the upper part of the formation becomes increasingly clay-dominated with subordinate thin sandstones. The Grinstead Clay Member is not present east of the East Hoathley to Hellingly area.

In East Sussex, the Tunbridge Wells Sand Formation is present over much of the Weald area in two wide, broadly NW-SE trending belts. The southern belt extends from Wivelsfield and Fletching to Mansfield, Hadlow Down to Uckfield, and through Chailey, East Hoathley, Chiddingly, Herstmonceux to Hastings, Westham and Pevensey. The northern belt, meanwhile, extends from Withyham via Frant, Cousley Wood, Hurst Green, Ewhurst and Beckley to Peasmarsh. Generally, the outcrop becomes more irregular in the south-east of the county where fault-bounded areas of the Wadhurst Clay and Ashdown Sand formations tend to dominate the bedrock geology.

The Tunbridge Wells Sand Formation is approximately 75 m thick and comprises fine-grained, buff or pale brown to pale grey sandstones which show a wide variety of textures and colours, similar to the other Wealden Group sandstones (from which they cannot usually be distinguished unless their provenance is known). *In-situ*, the sandstones are usually interbedded with siltstones and clays, which become more dominant further eastwards in the county. Fossilised rootlets and plant debris, including lignite, are abundant through much of the succession in the west of the county, but are generally rare further east.

Tunbridge Wells Sandstone is very commonly used as the principal building stone across its entire outcrop in East Sussex, although many houses (even in the Weald, where the outcrop is best developed) are constructed from brick. Where employed, the sandstone is used as the main walling stone, often as rough block-work or coursed rubble. Notable examples of its use include the Roman walls at Pevensey Castle, garden walls in the Victorian suburbs of Hastings, and at Stone House and St. Leonards School (both in the Main Street), Mayfield. Tunbridge Wells Sandstone is also widely used in churches across the Weald, including those at Chiddingly, Uckfield, Little Horsted and Frant.

Another stone name associated with the Tunbridge Wells Sand Formation is **Horsted Sand**. This stone, with its type area around Little Horsted, near Uckfield, was originally identified and defined on lithological grounds by Gideon Mantell in the 1820s. However, Mantell's scheme was not based on geological mapping and contained errors in correlation. Subsequent work has established the true stratigraphic position of the Horsted Sand, which is within what is now regarded as the lower part of the Tunbridge Wells Sand Formation.

The most important distinguishable sandstones occurring within the Tunbridge Wells Sand Formation which have been employed



Stone House, in the High Street, Mayfield, is built of Tunbridge Wells Sandstone with some Ardingly Sandstone

as building stone are described individually below.

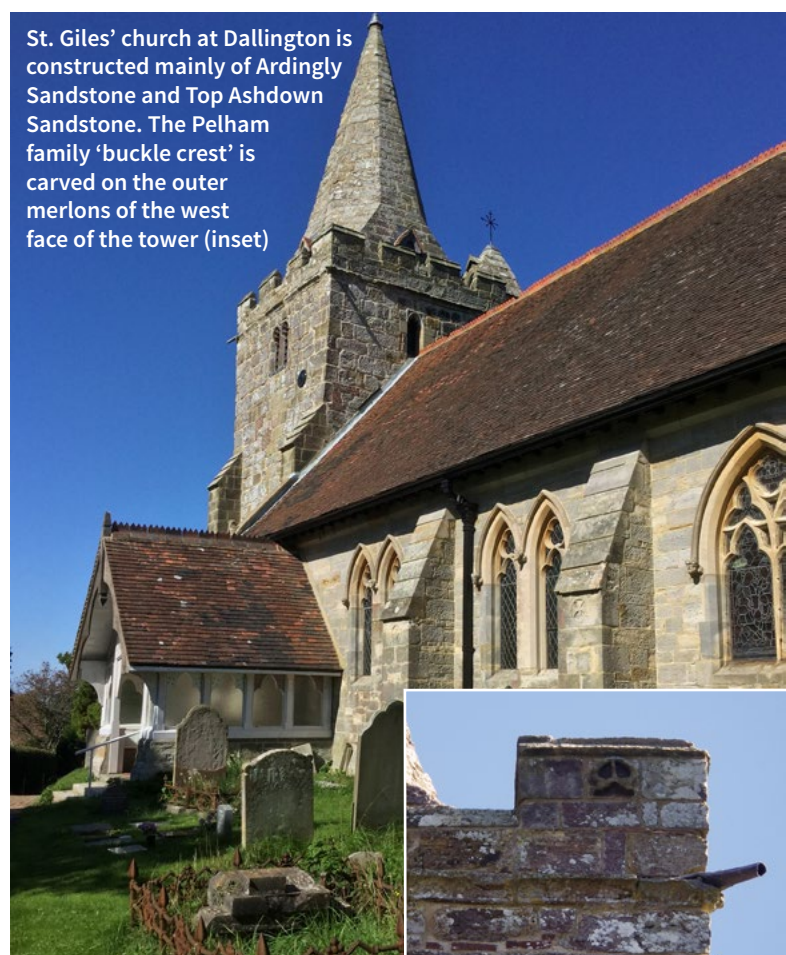
Lower Tunbridge Wells Sand and Ardingly Sandstone Member Ardingly Sandstone

The outcrop of the Ardingly Sandstone broadly follows a similar pattern to that of the Tunbridge Wells Sand Formation, but it tends to be more localised in the central-western and central-northern part of the High Weald. There are two main outcrops, a northern one occurring in the Withyham to Frant area, and a southern one extending from Fletching via Mansfield and Chailey to Isfield. Locally, it often forms small crags or gives rise to very steep slopes.

The Ardingly Sandstone Member is usually 12–20 m thick. It is a distinctive blue-grey or silver-grey coloured ‘sandrock’, comprising mainly massive, fine-grained, well-sorted quartz sands. The best quality and hardest building stone beds contain a small amount of calcite cement and occur towards the top of the unit, below the Grinstead Clay Member. Visually, the Ardingly Sandstone appears to be a ‘cleaner’ more consistently-coloured sandstone than other Wealden sandstones. Although soft when freshly quarried, Ardingly Sandstone subsequently hardens and weathers evenly over time, with a distinctive tough surface skin developing on exposed surfaces.

Ardingly Sandstone is used for high quality ashlar, other walling and fine decorative work (it is readily carved for ornamental features) throughout its outcrop area. Typically, it is employed

as a subsidiary building stone within about 8 km of the margins of the outcrop and in settlements located along rivers such as the Ouse and upstream of the Adur. One of its most notable uses is as ashlar and quoins (along with Top Ashdown Sandstone) in the Church of St. Giles, Dallington (which also features one of the East Sussex ‘Pelham towers’ constructed by the Pelham family in the early C16th).



St. Giles' church at Dallington is constructed mainly of Ardingly Sandstone and Top Ashdown Sandstone. The Pelham family 'buckle crest' is carved on the outer merlons of the west face of the tower (inset)

Grinstead Clay Member

Cuckfield Stone

The Cuckfield Stone occurs mainly in the north-west corner of East Sussex in a series of inliers. These occur at Danehill, north of Withyham, Hartfield and Ashurstwood, close to the boundary with West Sussex. East of a line extending from Danehill to Sheffield Park, the Cuckfield Stone rests directly on Ardingly Sandstone (the intervening upper Grinstead Clay being absent), and the lithological differences between Cuckfield Stone and Ardingly Sandstone here are insufficient for them to be practically distinguished.

Cuckfield Stone varies in thickness from 2–9 m and comprises internally flaggy, thickly bedded sandstones with lenses of hard calcareous sandstone. These are typically dark reddish-brown to brown in colour, although shades of light-brown or even grey also occur. Upon weathering, the stone develops ochreous and rusty hues, which make it attractive as a building stone. Locally, the sandstones may contain fossilised plant fragments and bivalves. The presence of festoon- or cross-bedding and dark brown staining are fairly distinctive, but it is not always possible to distinguish Cuckfield Stone from other lower Weald Group sandstones unless the provenance is actually known.

Cuckfield Stone has a relatively localised use as a building stone within and near its outcrop area, being seen mainly in walls as rough block-work and coursed rubble. North of Burgess Hill, around Folly Farm near boundary with West Sussex, a number of old pits were dug through the upper Grinstead Clay to work the underlying Cuckfield Stone for paving and roofing slabs.

Weald Clay Formation

Horsham Stone

Horsham Stone crops out in the far west of East Sussex near Wivelsfield, although it is absent from the Tenterden and Lewes areas. It comprises two sandstone horizons varying between 1.0 and 1.5 m in thickness, which sometimes contain ironstone nodules. Horsham Stone is a fine- to very fine-grained, hard, flaggy, calcareous sandstone, typically pale buff to pale grey in colour. Bands of iron-staining are commonplace, and longitudinal ripple structures are often present on the surfaces of fine-grained sandstone paving slabs. Apart from trace fossils and bioturbation features, fossils are uncommon in the Horsham Stone; those that are present include poorly-preserved casts and moulds of freshwater bivalves, wood



Horsham Stone, used with flint in the old C12th Church of St. Peter, at Hamsey

fragments (lignite) and rare impressions of dinosaur footprints (*Iguanodon*).

Although Horsham Stone was historically quarried from shallow pits in the Wivelsfield area (notably at pits around Bedelands Farm, Theobalds, Antye Farm, Lunce's Hall and Holford Manor), it saw relatively little use as a building sandstone in East Sussex (in contrast to its extensive use in West Sussex). Wivelsfield Church provides one example where Horsham Stone was employed as roughly cut blocks (in association with other sandstones, including Tunbridge Wells Sandstone). It was also used with Tunbridge Wells Sandstone in churches at Fletching and Chailey and with flint in the old C12th church at Hamsey. Paving slabs composed of Horsham Stone develop smooth, hard surfaces.



The C15th Anne of Cleves House in Lewes, exhibits a distinctive Horsham Stone-slate roof

Horsham Stone-slate

Horsham Stone-slate occurs in the upper part of each of the Horsham Stone horizons where they become finely laminated and can be readily split into 2–3 cm thick slates. These slates are medium- to dark-grey in colour and exhibit few structures apart from lamination and occasional broad amplitude ripple structures. When weathered, older roofs made of Horsham Stone-slate often develop a characteristic black cover of algae and lichen.

Like Horsham Stone, Horsham Stone-slate was relatively little used in East Sussex, reflective of the fact that the main quarries were located in the Horsham area of West Sussex (where most of the roofing stone originated). Examples of its use as a roofing slate in East Sussex are provided by Anne of Cleves House, Southover Grange and several other larger houses in Lewes.

Sussex Marble (Paludina Limestone)

Sussex Marble forms a narrow, intermittent band within the Weald Clay Formation between Barcombe Cross (near the River Ouse) and Lower Dicker (by the Cuckmere River). When fresh it is a grey, crystalline limestone, but it quickly weathers to a brownish colour due to the presence of iron minerals. The

stone is characteristically packed with the fossil shells of the freshwater gastropod *Viviparus*, which appear whitish in section and are commonly infilled with patches of transparent crystalline calcite.

Two forms of the limestone occur in East Sussex:

A lower **Small Paludina Limestone** which occurs in beds varying from 5–15 cm in thickness, and contains closely packed shells and fragmentary remains of the small fossil gastropod *Viviparus infracretacicus*;

An upper **Large Paludina Limestone** (also called **Laughton Stone, Winklestone or Bethersden Marble**) which occurs in beds varying from 10–30 cm in thickness, composed largely of the globose fossil gastropod *Viviparus fluviorum*. The Large Paludina Limestone may also contain very thin marly beds with fossil ostracods.

Sussex Marble was formerly dug from shallow pits called delves. The limestone takes a good polish, and was frequently employed internally for decorative or ornamental purposes such as altar tables, tombs and ledgers, fonts, columns and fire-places. Despite Sussex Marble's weakness as an external building stone (it readily weathers due to water penetration),



Sussex Marble (Large Paludina Limestone) is employed as rubble stone in several walls at East Chilmington Church

it has been occasionally employed as a rubble stone in barns, farmhouses and cottages along its outcrop, notably in the Laughton area. It can also be seen in church walls at Plumpton, Laughton, Streat, and East Chilmington.

Lower Greensand Group

Over most of East Sussex, the Lower Greensand Group strata comprise mainly interbedded clays, silts and unconsolidated sands with occasional, laterally impersistent pebbly units. These beds are soft, typically with very little topographic expression, and are poorly exposed, thinning rapidly eastwards across the county. They are the equivalent of the Hythe, Sandgate and Folkestone formations which are much harder, thicker and better developed in West Sussex (where these formations have yielded important building stones including the Hythe Sandstone, Hythe Chert, Bargate Stone, Pulborough Sandrock and Carstone). However, in the East Sussex area, the Lower Greensand lithologies present are often insufficiently distinct to permit the recognition of separate formations at outcrop. They are usually worked as sources of sand and gravel (not building stone) in the county area.

Selborne Group

The Upper Greensand is absent across the whole of the South Downs east of Westmeston/Plumpton and throughout the Lewis area, where the Chalk Group rests unconformably on the Gault Clay Formation. The uppermost beds of the Gault Clay are occasionally micaceous and silty; these are the unconsolidated equivalents of the 'Malmstone' facies that occurs further west, close to West Sussex where they are much more extensively developed. In East Sussex, the Upper Greensand Formation only re-appears again in the vicinity of Eastbourne and Beachy Head, where a glauconitic sandstone facies (the Eastbourne Sandstone) is exposed.

Upper Greensand Formation Eastbourne Sandstone

The Eastbourne Sandstone crops out only in the Beachy Head and Eastbourne areas where the beds are up to 10 m thick. It is a characteristic pale- to dark-green coloured, fine- to medium-grained, micaceous, glauconitic sandstone which is often highly bioturbated, with occasional phosphatic nodules and

serpulid worm fossils. Ventnor Stone (imported from the Isle of Wight and used in West Sussex) is very similar to Eastbourne Sandstone, but typically contains more small brownish phosphatic pebbles and exhibits a more varied fossil fauna, including bivalves (scallops, oysters), ammonites and brachiopods in addition to serpulid worms.

Eastbourne Sandstone weathers badly, and the surface flakes and spalls when exposed to the elements. Historically, however, the stone was quarried on a large scale from the foreshore at Eastbourne and was widely used as a rubble stone and coarse ashlar around Eastbourne (especially in Victorian walling) and in the south-west of the county. It was also employed for window tracery and door jambs. Examples of its use include wall buttresses and dressings of St. Andrew's Church, Beddingham (which also incorporates stone reused from Lewes Priory following the Dissolution during the C16th), blocks in the walls of Pevensey Castle and the impressive Norman tower of the Church of St. Mary the Virgin at Eastbourne. The sandstone for this tower was quarried from a site located near the present day Queens Hotel on Eastbourne seafront.



The C16th Old Parsonage adjoining St. Mary's Church has walls constructed of irregular Flint nodules and pebbles with occasional blocks of Ironstone, and quoins of Eastbourne Sandstone



The Norman tower, Church of St. Mary the Virgin, in Eastbourne, is built from locally quarried Eastbourne Sandstone



Roughly dressed blocks of Chalk in a barn wall at Place Farm, Hamsey

Upper Cretaceous Chalk Group Chalk

In East Sussex, Chalk crops within the southern coastal area extending from Brighton to Eastbourne, where it forms the South Downs (which rise to 200 m above sea level). The Chalk outcrop encompasses Brighton, Stanmer, Lewes, Newhaven, Seaford, Alfriston and Eastbourne.

Chalk is a relatively soft, fine-grained, white limestone, which is typically massive and lacks discernible structures. The Chalk Group in East Sussex is up to 425 m thick and the upper 90% of this is represented by the White Chalk Subgroup. This, distinguished by its pure white colour and layers of flint nodules, forms much of the south-facing chalk dip slope of the

South Downs and coastline between Brighton and Eastbourne. The lower 10% is represented by the Grey Chalk Subgroup, which crops out along the northern edge of the escarpment; this is a darker, typically greyish colour and is devoid of flints, but includes thin marly layers and intercalations ('griotte') between thicker chalk limestone units.

Although long established, no quarrying of chalk now occurs in East Sussex. Historically, chalk was extracted for use in the manufacture of cement in the Ouse Valley, north of Lewes; chalk was never extensively quarried for building purposes in East Sussex. Latterly, chalk extraction was limited to one site lying within the outcrop of the White Chalk Subgroup at Tarring Neville, near Newhaven, where high quality chalk was worked (until 2014) for use in specialist plasters.

Chalk is generally unsuitable for use externally, as repeated wetting, drying and frost action causes the relatively soft rock to powder and disintegrate into small angular fragments. Softer forms of the stone when used externally may show 'concave weathering' away from mortar lines. Chalk has therefore been used primarily for interior work, although it has been occasionally used as infill rubble across the outcrop area. One of the few examples of its external use is provided by a barn wall at Place Farm, Hamsey, near Lewes.

White Chalk Subgroup Quarry Flint

Quarry Flint is commonly and widely used as a building stone adjacent to and within the outcrop area of the White Chalk Subgroup across the South Downs (encompassing Brighton, Stanmer, Lewes, Newhaven, Seaford, Alfriston and Eastbourne).

It is an extremely fine-grained (cryptocrystalline), hard form of silica containing microscopic, quartz-crystal aggregates. It usually occurs as irregularly-shaped nodules 10–20 cm across, or as (sub-) rounded pebbles and cobbles; occasionally, it is also found as weakly banded tabular sheets or layers up to 20cm thick. The colour is very distinctive; fresh flint nodules have a white outer cortex with a darker coloured (black, dark grey) interior. Quarry Flint breaks with a characteristic conchoidal fracture, producing razor-sharp fine edges; the cleaved surfaces may exhibit banded structures resulting from the alternation of layers of slightly different composition. Flint nodules may contain cavities lined with translucent botryoidal chalcedony or small transparent quartz crystals; some flints sometimes contain well preserved fossils – echinoids, sponges, bivalves and



Knapped Quarry Flint and Downland Field Flint was used in the building of St. Andrews Church, Alfriston



The early C14th gatehouse of Lewes Castle, includes much Knapped Quarry Flint in its construction

burrow-structures being the most commonly encountered types.

Quarried flint is used extensively in walls in a wide variety of ways: it is laid to course as rough tabular 'sheets' or nodules; in squared blockwork or chequer-work; as knapped, faced, trimmed or cleaved faced stone in random or decorative arrangements; or as galleting used to fill interspaces between irregular flint nodules or other stones when the mortar is wet, thus reinforcing the mortar. It is also frequently seen interlocking with brick or other stone dressings, quoins, window and door jambs, serving to help consolidate the building. Notable examples of its use include the walls of St. Pancras Priory, Lewes and as dressed facings in the Old Grammar School and St. Michael-in-Lewes Church, both also in Lewes. In addition, it is used extensively in All Saints' Church, Laughton and St. Andrews Church, Alfriston, and in the walls and gatehouse of Lewes Castle.

The extremely hard and resistant nature of Quarry Flint-type nodules has resulted in their having been recycled by natural processes into younger deposits, where they show specific characteristics - these types of flint are described in the Quaternary section of this Atlas.

Tertiary (Palaeogene)

Lambeth Group

Upnor, Woolwich and Reading formations

Sarsen Stone (erratics)

The origin of Sarsen Stones is generally uncertain and within the Brighton area no specific source has yet been positively identified. At Black Rock, however, several sarsens are embedded in chalky drift infill within a dry valley, and sarsen cobbles and pebbles also occur in nearby beach deposits. Some may have been derived from secondary-cemented portions of the formerly more extensive Woolwich and Reading Beds. Others may be the eroded remnants of a bed of silica-cemented sand at the base of the Lambeth Group (Upnor Formation) which sat directly above the Chalk of the South Downs; re-worked boulders of this material may have subsequently been transported to the Brighton and Eastbourne areas.

Sarsen Stones are usually grey to pale brown in colour, becoming distinctly creamy-buff when weathered. They are very fine- to fine-grained, comprising sub-rounded quartz grains set within a silica matrix, which is visible on a fractured surface. Sarsens often occur as rounded or elongate pebbles, cobbles, boulders or even metre-scale slabs (up to 3 m in length). Their surfaces are often smooth and they may occasionally show poorly-defined bedding structures; beach-worn Sarsens may exhibit an 'elephant-skin' surface texture.

Although they are very hard and resistant, Sarsen Stones are a very minor building stone in East Sussex. They were typically collected as beach cobbles or pebbles, along with similarly fashioned flint, and used to only a very limited extent in old rubble walls near the coast, notably in Brighton, Newhaven and Seaford. Sarsen Stones typically make up only about 0.1% of the stone used in these predominantly flint pebble walls. Isolated Sarsen Stones are also seen in church walls at Preston, Ditchling, Ovingdean, Brighton and Seaford.

'Ferruginous Flint Conglomerate'

Residual patches (remanié) of Ferruginous Flint Conglomerate deposits occur on the Chalk outcrop of the South Downs between Brighton and Eastbourne, notably at West Blatchington, Hove Park, near Lewes along the A27 road, at Falmer and as hill cappings at Rottingdean and Saltdean. The stone is very distinctive and occurs as a dark brown or red-brown, iron-stained, sub-angular flint and quartz-pebble conglomerate with minor

ferruginous sandstones and clays. The clasts typically occur in a sandy matrix cemented by iron oxides. The relatively unabraded flints characteristically exhibit a dark green staining, which is caused by a coating of glauconite. The conglomerate reaches up to 2 m in thickness in the Worthing area.

Ferruginous Flint Conglomerate weathers relatively easily, and crumbles on exposure to water where upon the flint clasts are released. Consequently, it has seen only minor use as a building stone. It may be observed as an occasional rubble stone in church walls at Telscombe, Patching, East Blatchington, Kingston and Falmer; small amounts are also visible in walls at Lewes Priory.

'Sandstones and Ironstones'

Small outliers of medium-grained, glauconitic sandstones and ferruginous siltstones and ironstones overlie the Chalk Group strata of the South Downs between Brighton and Seaford. The colour of these sediments varies depending on their lithology, but in general, the ferruginous sediments are a rich-red or rust colour, whereas the glauconitic sandstones are grey-green. The sediments are often massive and exhibit few features with the exception of some glauconitic sandstones, which contain shelly horizons with the fossil oyster *Ostrea*.

The hardness varies from relatively soft (in the case of the easily weathered, slightly friable glauconitic sandstones) to relatively hard (in the case of the tougher, coarser-grained sandy ironstones which often occurs in association with Ferruginous Flint Conglomerate). These Sandstones and Ironstones have seen only very minor use as an irregularly shaped rubble stone, and may be observed in church walls at West Blatchington and Hangleton.





St. Pancras Church at Kingston, built in the C13th, has walls constructed mainly of local Downland Field Flint nodules with lesser amounts of Ferruginous Flint Conglomerate and occasional blocks of Tufa

Quaternary Quaternary Flint

Quaternary Flint (including Coombe Rock and Clay-with-Flints) occurs in large quantities in southern East Sussex and is distributed across wide areas of the Chalk Downs and coastal plains. Its widespread availability, combined with its hardness and resistance to weathering, means that Quaternary Flint is one of dominant types of building stone used in the county. It typically occurs as irregularly-shaped nodules or as (sub) rounded pebbles and cobbles (depending on the flint type). The colour may be variable; less weathered flint nodules or pebbles have a cream outer cortex with darker coloured (greyish) interiors; weathered flints or those that have lain in soil or superficial deposits for a long period, may be variously discoloured or bleached, often with brown-stained interiors due to the precipitation of iron hydroxides from percolating ferruginous water.

Quaternary Flint is used extensively as a walling stone in a wide variety of ways: as nodules or pebbles laid roughly to course; as squared blocks forming part of chequer-work; as knapped, faced, trimmed or cleaved faced stone in random or decorative arrangements; or sometimes as galletting (when flaked flints are used to fill the spaces between irregular flint nodules or other stones).

Three main types of Quaternary Flint are recognised.

Downland Field Flint

This type of flint occurs as irregularly-shaped nodules on the field surface of the Chalk Downs. The size of the nodules varies from 10–30 cm, but larger nodules occasionally occur. The outer ‘skin’ (cortex) of the nodule is usually cream coloured with a darker brownish or greyish interior which becomes white on old fractured surfaces. This ‘lightly weathered’ appearance helps distinguish Downland Field Flint from the much ‘fresher-looking’ Quarried Flint, which has a white outer cortex and a very dark grey or black interior.

Downland Field Flint is a very common and widely used stone in West Sussex, and is employed in a wide variety of buildings and structures across the area of the Chalk Downs and (to a lesser extent) along the coastal plains. It was used extensively in walls in a variety of ways, with nodules often being selected for their shape and size, and laid in either a random or coursed manner.

Beach Pebble Flint

Beach (and Raised Beach) Pebble Flint typically occurs as pale to dark greyish, rounded pebbles and cobbles up to 10 cm in size, but are occasionally larger. The pebbles often exhibit a ‘frosted’ surface appearance or ‘chatter-marks’ (small surface cracks) caused by impacts with other beach pebbles.



Beach Pebble Flint laid to course in C18th Old Town Cottages, Eastbourne

The collection of Beach Pebble Flint is now prohibited, but it was formerly one of the commonest and most widely used building stones in East Sussex and Brighton & Hove. Typically the stone was employed as and where it was found, in a variety of ways and in a range of structures within coastal towns and villages stretching from Brighton to Eastbourne and Hastings. It was also used in many buildings inland, especially in Lewes, Alfriston and Pevensey, where large flint cobbles form a significant part of the castle walls.

The main use for Beach Pebble Flint was for walling, where flint pebbles and cobbles were often sorted according to size and laid to course, such as can be seen in C18th Old Town cottages along Church Lane in Eastbourne. Occasionally, the pebbles were used in more decorative fashion, with the long axis either vertical or at an inclined angle creating an imbricate pattern.

River Terrace and Fan Gravel Flint

This type of flint occurs as water-washed, sorted, sub-rounded pebbles, usually up to 15 cm in length, which are either stained brown or bleached white. It is employed mainly as a walling stone and good examples of its use can be seen in and around Lewes, Cuckmere, West Dean and Eastbourne.

Ferricrete (Iron Pan)

Ferricrete typically exhibits a distinctive conglomeratic or brecciated texture, created by clasts of sandstone, chert or flint set within an iron-oxide sandy matrix. It occurs intermittently in irregular layers up to 50 cm thick, and was formerly quarried on a small scale from shallow pits dug in river terrace and floodplain deposits near the rivers Ouse, Cuckmere, Brede, Tillingham and Rother, and on the Pevensey Levels. Ferricrete has been employed as a building stone on a small scale; a

good example of its use as roughly cut lenticular blocks is provided by the Roman outer curtain wall and towers at Pevensey Castle. Ferricrete was also occasionally used as isolated blocks of rubble stone in Medieval church walls, such as at Northiam.

Tufa (Travertine)

Tufa is a whitish- or pale-grey coloured, highly porous limestone formed by the precipitation of calcium carbonate (lime) from springs where the water has passed through calcareous rocks (such as limestone or Chalk). Its occurrence in East Sussex is still poorly understood; it is known to have formed in springs emanating from the Purbeck limestones near Burwash, but is also thought to occur in association with as yet undiscovered springs which at some stage in the past emerged from the Chalk Group succession.

Tufa is soft and crumbly when freshly-quarried, and easily cut

into ashlar, but upon exposure to air it quickly hardens. It has been only very occasionally employed as a building stone in East Sussex, but where used it is typically seen as roughly cut or rubble stone blocks in old walls and Medieval churches, as for example in Brighton, West Blatchington, Wilmington and Kingston.



A southern tower of Pevensey Castle, showing the marked boundary between blocks of purplish Ironstone and pale grey 'Hastings Beds' sandstones



Ferricrete and Ironstone blocks in the Roman outer wall and tower at Pevensey Castle

Imported Stones

Building stone has been imported into East Sussex since Roman Times. It was during Norman times, however, that this trade increased greatly, with many tonnes of stone being shipped into the county from France, especially for the construction of grander buildings in the coastal regions.

There was also considerable transport of British-derived stones

into East Sussex, especially Purbeck Stone and Purbeck Marble from Dorset (Isle of Purbeck). Bembridge Limestone, Ventnor Stone, Quarr Stone and Bonchurch Stone from the Isle of Wight, Chilmark Stone from Wiltshire and Bath Stone, Doultling Stone and Beer Stone from South-West England serve as other notable examples.

A summary list of imported building stone types seen in East Sussex is provided in Table 2.

Stone Name & Place of Origin	Source Stratigraphy	Stone Characteristics and Selected Examples of Use
Bembridge Limestone Isle of Wight	Tertiary (Eocene/Oligocene) Bembridge Limestone Formation, Solent Group	Buff, fine-grained, shelly limestone (freestone); the fossils include the gastropod <i>Galba</i> and alga <i>Chara</i> . Small amounts used as ashlar in Wilmington.
Quarr Stone Binstead, Isle of Wight	Tertiary (Eocene/Oligocene) Headon Hill Formation, Solent Group	Pale grey to buff, porous, open-textured, shelly limestone; the fossils typically present as internal moulds. Used as a subsidiary building stone in churches across the coastal area from Brighton to Lewes, also much used in Lewes Priory.
Purbeck Marble Isle of Purbeck, Dorset	Lower Cretaceous Durlston Formation, Purbeck Group	Dark grey to buff, shelly limestone, containing fossil <i>Viviparus</i> shells (smaller than Sussex Marble) and other finely-broken shell material. Used mainly for internal church memorials, ledgers, columns, bases and capitals, especially in Battle Abbey and Winchelsea Church. Also sometimes used for paving.
Portland Stone Isle of Portland, Dorset	Upper Jurassic Portland Stone Formation, Portland Group	Very pale, white, fine-grained limestone. Used as a freestone in many civic buildings, facades and columns. Notable examples include the Royal Pavilion Brighton (with lesser amounts of Bath Stone), and Lewes and Eastbourne Town Halls.
Caen Stone Normandy, France	Middle Jurassic (Bajocian)	High quality, creamy or pale yellowish coloured limestone (freestone). Principally features in Norman stonework, but was used up to c.1400. Frequently recycled into later stone buildings, for example Southover Grange and elsewhere in Lewes, and the Court Hall in Winchelsea.
Bath Stone Bath, NE Somerset	Middle Jurassic Chalfield Oolite Formation, Great Oolite Group	Creamish to ochreous, oolitic limestone (freestone). Often used as ashlar and as a Victorian replacement in many churches.
Clipsham Stone Rutland	Jurassic Upper Lincolnshire Limestone Formation, Inferior Oolite Group	Durable, cream-buff coloured, bioclastic limestone. Often used as ashlar and a (very common) Victorian replacement in many churches (notably as quoins).
‘York Stone’ (Elland Flags) Halifax area, Yorkshire	Carboniferous , Lower Coal Measures Formation, Pennine Coal Measures Group	Grey to buff coloured, flaggy sandstone. May be ripple marked and exhibit trough cross bedding. Used as paving in North Street, Brighton.
Tournai Marble Tournai, Belgium	Lower Carboniferous (Tournaisian)	Black, very fine-grain limestone, which takes a high polish. Occasional fossils preserved in white calcite. Resistant to weathering. Normally used for interior memorials. Numerous examples in Rotherfield, Ticehurst and Wadhurst churches.

Table 2. Summary table of some of the main building stone types imported into East Sussex



Quarr Stone, used extensively with other stones (Flint, Wealden Sandstone and minor amounts of ironstone) at Lewes Priory



Southover Grange, Lewes, constructed mainly from Caen Stone



Portland and Bath Stone dressings are employed in the impressive façade of Brighton Royal Pavilion

Further descriptions of imported stones relevant to East Sussex can be found in several of the references listed in the Further Reading section of this Atlas.

Glossary

Bioclasts: Fragmentary fossil remains of marine or land organisms found in sedimentary rocks, especially limestones.

Bioturbated: Sediments that have been reworked or disturbed by burrowing organisms such as worms.

Bivalve: A mollusc with two shells, which may be marine or freshwater. Examples are cockles, clams, scallops, oysters.

Botryoidal chalcedony: A pale coloured type of flint or chert, often found inside a flint nodule, which has grown with a smooth, grape-like structure.

Calcarenites: A type of limestone containing more than 50% sand-sized grains (medium-grained limestone).

Calcareous: A sedimentary rock containing a significant amount (10-50%) of calcium carbonate.

Calclutites: A type of limestone containing more than 50% clay- or silt sized grains (fine-grained limestone).

Chalk: A soft, white limestone, sometimes powdery, which was formed at the bottom of a sea during Late Cretaceous times.

Chatter marks: Small cracks and indentations on the surface of a flint or chert pebble (or sometimes on the surface of a Sarsen Stone) caused by collisions with other objects (usually pebbles).

Conchoidal fracture: A smooth fracture surface, often occurring in a fine-grained rock such as flint, which shows a curved pattern of fine concentric rings or ripples.

Concretion: A rounded or elliptical mass of harder rock occurring within a (usually softer) sedimentary rock.

Cross-bedding (or Current-bedding): A structure in the layers (beds) of a sedimentary rock formed by the movement of water or air. The term is usually applied to sandstones and the feature itself typically resembles sets of lines which are inclined with respect to the bedding planes or form regular arc-shaped patterns.

Echinoid: A type of marine organism formed of calcareous plates, commonly called a sea urchin. Often found in Chalk sediments.

Facies: A term describing the principal characteristics of a sedimentary rock that help describe its mode of genesis.

Ferricrete: A dark reddish-brown coloured iron-oxide cemented layer formed in soil profiles or superficial (surface) deposits of Quaternary age. Typically, it contains rounded or angular pebbles of flint, chert or sandstone up to 6 cm in diameter.

Festoon-bedding: A form of cross-bedding in sedimentary rocks which form elongate, scoop-like structures containing finer lines (laminations).

Flaggy: A sedimentary rock, often a sandstone, which splits into slabs and may be used for paving.

Flint: A form of very hard, micro-crystalline quartz. Typically occurs in Chalk deposits as rounded or irregular shaped masses (nodules) and has a dark grey or black coloured inner 'core', with a white outer 'skin'.

Gastropod: A mollusc with one shell, which may be marine or freshwater. Examples are whelks, snails, limpets.

Glaucinite: A mineral composed of iron and silica. It often occurs in Cretaceous and Tertiary sedimentary rocks as small greenish coloured specks or grains. It gives the green colour to the rock type Greensand.

Greensand: A sandstone so-called because of the presence of the greenish-brown mineral glauconite.

Inlier: An outcrop of rock or a Formation, often (but not always) with faulted boundaries, completely surrounded by rocks of a younger age.

Ironstone: A hard sedimentary rock cemented by iron oxide minerals. Often dark brownish or rusty coloured.

Jamb: The vertical support of an opening for a door or window to which it is attached.

Knapped flint: Worked flint which has been fractured (cleaved) to reveal the interior of the nodule.

Lithology: The description of a rock based primarily on its mineralogical and grain size characteristics, e.g. sandstone, limestone, mudstone etc.

Massive: Describes a sedimentary rock which is homogeneous and lacks any internal structures (such as cross-bedding or ripple-marks) or fractures.

Micaceous: A rock containing a discernible quantity of small, fine plates or flakes of the micaceous minerals muscovite and/or biotite. Micaceous rocks tend to exhibit a shiny or 'sparkly' surface.

Nodule: A small, hard rounded or elliptical mass within a sedimentary rock. Resembles a pebble or larger cobble.

Ostracods: Small fossil shells (of crustaceans), usually less than 2 mm long, which resemble seeds.

Outlier: An outcrop of rock or a Formation, often (but not always) with faulted boundaries, completely surrounded by rocks of an older age.

Phosphatic: Rocks or sediments containing a significant proportion of Phosphate. The term is often applied to nodules (i.e. phosphatic nodules) which typically are dark brown or brownish-black coloured, and very hard.

Quartzitic sandstone: A sandstone, which possesses a significant quantity of the mineral quartz, and is therefore often hard and resistant to weathering.

Quaternary: A period of geological time that lasted from approximately 2.6 million years ago to the present Day. It includes the last Ice Age.

Remanié: A part or fragment (often a pebble or fossil) of an older geological formation which has been incorporated into a geologically younger deposit.

Ripple marks: Wave-like structures that occur in sandstones caused by the movement of water or wind when the sands were being deposited (often best seen on the upper surfaces of sandstone layers or beds).

Sarsen Stone: A very hard sandstone formed mainly of silica-cemented quartz grains, which is found as boulders on the Chalk Downs, in Chalk dry-valley deposits and in modern beach and raised beach deposits.

Scour-and-fill: A sedimentary structure formed by a high velocity flow of water, comprising a concave-upwards surface (the scour) and a sedimentary infill (the fill).

Serpulid: A fossil marine worm, with a straight, curved or coiled tube.

Sideritic: A rock or nodule that contains the iron mineral siderite. Often applied to sedimentary rocks and ironstones.

Stone-slate: A fine-grained sedimentary rock which can be split into thin layers (usually around 2cm thick) and used as slates for roofing or paving.

Trace fossil: Fossil marks in a sedimentary rock left by animal activity such as burrows, or footprints.

Unconformity: The contact surface between two 'packages' of rock strata which are separated by a period of geological time when there was no deposition of any intervening strata, or those intervening strata were removed by erosion.

Acknowledgements

This study, written by Dr Andy King (Geckoella Ltd., Geckoella@gmail.com), is part of East Sussex's contribution to the Strategic Stone Study, sponsored by Historic England and the South Downs National Park Authority.

This report incorporates data from a number of sources, including local geologist Roger Cordiner, BGS memoirs and references (listed below), and independent fieldwork by the author. Considerable use has been made of the BGS on-line lexicon of named rock units (www.bgs.ac.uk/lexicon), particularly with regard to the stratigraphic division and nomenclature of Lower Cretaceous (Wealdon) sandstones.

Designed by Colin Matthews (PaperPixels.ink).

Technical advice and editorial comments were kindly provided by the following (in alphabetical order):

Anne Bone, SDNPA

Don Cameron, British Geological Survey

Dr Steve Parry, British Geological Survey

Clara Willett, Historic England

Chris Wood, Historic England.

BGS Memoirs, Sheet Explanations and Mineral Resource Reports

Bristow, C.R. & Bazley, R.A. (1972). *Geology of the Country around Royal Tunbridge Wells*. Memoir of the Geological Survey of Great Britain, Sheet 303 (England and Wales). 161pp.

McEvoy, F. M., Bloodworth, A. J., Cameron, D. G., Hobbs, S. F., Spencer, N. A., Evans, D. J., Lott, G. K., Steadman, E. J., Bartlett, E. L. & Highley, D. E. (2002). *Mineral Resource Information in support of National, Regional and Local Planning, East Sussex* (comprising Brighton and Hove and East Sussex). British Geological Survey Commissioned Report CR/02/126N (and accompanying 1:100,000 scale map, Brighton and Hove and East Sussex Mineral Resources), 16pp.

Lake, R.D. & Shepherd-Thorn, E.R. (1987). *Geology of the Country around Hastings and Dungeness*. Memoir of the British Geological Survey. Sheets 320 and 321. (England and Wales). 81pp.

Lake, R.D., Young, B., Wood, C.J. & Mortimer, R.N. (1987). *Geology of the country around Lewes*. Memoir of the British Geological Survey, Sheet 319 (England and Wales). 117pp.

Shepherd-Thorn, E.R., Smart, J.G.O., Bisson, G. & Edmonds, E.A. (1966). *Geology of the Country around Tenterden*. Memoir of the Geological Survey of Great Britain, Sheet 304 (England and Wales). 123pp.

Topley, W. (1875). *Geology of the Weald*. Memoir of the Geological Survey. 503pp.

White, H. J. O. (1926). *The geology of the country near Lewes*. Memoir of the Geological Survey of Great Britain. Explanation of Sheet 319. 97pp.

Young, B. & Lake, R. D. (1988). *Geology of the country around Brighton and Worthing*. British Geological Survey, Memoir for 1:50,000 geological sheets 318 and 333 (England and Wales), 115pp.

Further Reading

Allan, P. (1949). *Wealden petrology: The Top Ashdown Pebble Bed of the Top Ashdown Sandstone*. Quarterly Journal Geological Society, 104, 257–321.

Anderson, F.W. & Bazley, R.A.B. (1971). *The Purbeck Beds of the Weald (England)*. Bulletin of the Geological Survey of Great Britain, 34.

Birch, R. (2006). *Sussex Stones: The story of Horsham Stone and Sussex Marble*. Roger Birch, Horsham, 64 pp.

Birch, R. & Cordiner, R. (2014). *Building Stones of West Sussex*. Published by the authors. 349 pp.

Dawson, B. (1998). *Flint buildings in West Sussex*. West Sussex County Council, Planning Department. Chichester, 65pp.

East Sussex County Council, South Downs National Park Authority and Brighton & Hove City Council (2013). *East Sussex, South Downs and Brighton & Hove Waste and Minerals Local Plan* (adopted 19 February 2013), 158pp.

Howwitt, F. (1964). *Stratigraphy and Structure of the Purbeck Inliers of Sussex (England)*. Quarterly Journal of the Geological Society of London, 120, 77–113.

Lott, G. K. & Cameron, D. G. (2005). *The building stones of south east England; mineralogy and provenance*, in: 10th Euroseminar on Microscopy applied to Building Materials, Paisley, Scotland (21–25 June 2005), 16pp.

Mantell, G. (1827). *Illustrations of the Geology of Sussex*, Cornhill, London. 81pp + plates.

Mantell, G. (1833). *The Geology of the South-East of England*. Longman, Rees, Orme, Brown, Green & Longman, London, 415 pp.

Robinson, D. (2013). *The Geology and Scenery of the South Downs National Park*. Sussex Archaeological Society, Lewes, 104 pp.

Ulllyott, J. S., Whiteman, C. A. & Nash, D. J. (2000). *Landscape Evolution in the eastern South Downs with particular reference to sarsens and Quaternary deposits*. Proceedings of the Geologists' Association. 111, 91–96.

