# Kent Minerals and Waste Local Plan

***Planning for the future of minerals and waste in Kent***

## Evidence Base for the Draft Minerals and Waste Plan

# Interchangeability of Construction Aggregates

**September 2013**

Kent County Council

### 2.6.3 Slag

Slag is the by-product of metal smelting. Slag is the stony waste matter separated from metals during the smelting or refining of ore. It may be used in structural concrete as a ground powder, in coated macadam or as a sub-base material in road construction. It may even be used as a fertiliser.

Slag produced at the Sheerness steelworks on the Isle of Sheppey has been used in Kent as a secondary aggregate.

*BS EN 15167-1:2006 Ground granulated blast furnace slag for use in concrete, mortar and grout*. *Definitions, specifications and conformity criteria* is the British standard used to control its use.

### 2.6.4 Power Station Ash or Pulverised Fuel Ash (PFA)

When coal is burnt in coal fired power stations, the ash produced as a residue may be used as an engineering fill or as a component in concrete. It may also be used as a lightweight aggregate to make concrete blocks.

Kingsnorth Power Station in Medway was the only operational coal fired power station (ceased generation March 2013) that locally supplies pulverised fuel ash, stockpiles are currently being exploited. A new source of secondary aggregate, the bottom ash from the Allington waste to energy plant, is now used in the manufacture of breeze blocks.

*BS 6610:1996 Specification for Pozzolanic pulverized-fuel ash cement* and *BS 3892-1:1993. Pulverized-fuel ash. Specification for pulverized-fuel ash for use with Portland cement* are two standards that specify composition, production and properties of processed ash. Describes supporting tests and gives procedure for equivalence of mixer combinations to blended cements.

## 2.7 Recycled aggregates

**2.7.1** Recycled aggregates are increasing in importance year on year as confidence grows in the products produced and the techniques and management of aggregate recycling improve. At least two companies in Kent now employ aggregate washing plants in the production process.

**2.7.2** 2003 was the first year in which the Aggregate Monitoring Report for the South East England Regional Assembly first quantified the contribution recycled aggregates made to the construction aggregate regional supply. This contribution is now an integral part of the construction aggregate supply chain.

**2.7.3** Once used as a general fill, improvements in controlling and reducing contaminants has resulted in these aggregates being used in concrete and coated macadam. In 2010, 90% of secondary and recycled materials were used as aggregates. As mentioned in the building sand section below, the British Standard

(*BS EN 12620: 2002 Aggregates for concrete*) also specifies the properties that recycled aggregates need to meet to be acceptable for making concrete. FM Conway is one Company in Kent that uses recycled aggregates in concrete[8].

### 2.8 Building sand

**2.8.1** Building sand is fine aggregate that is less than 5mm in size. It has a wide range of uses that include mortar sand, plastering sand and asphalt sand. It can be found naturally in geological horizons such as the Folkestone Beds or it can be manufactured from crushed rock. It can be prepared for use simply by dry screening or it may be washed and graded using sophisticated washing and grading plants. Building sand is sometimes referred to as soft sand.

**2.8.2** Building sand differs from concreting sand being generally finer and softer in texture. The two distinct sands are processed to meet different British Standards for example, *BS EN 13139:2002 Aggregate for mortar* deals with mortar sands whilst *BS EN 12620:2002 Aggregates for concrete* specifies the properties of aggregates and filler aggregates obtained by processing natural, manufactured or recycled materials and mixtures of these aggregates for use in concrete.

## 3 Case history: the effect of geology on a Kent construction aggregate

### Geology of the Hythe Formation (Ragstone and Hassock)

**3.0.1** This geological horizon has a long history of supplying material to the construction industry. This section deals with how its exploitation has changed over the centuries and how modern quarrying techniques have improved its sustainable use.

**3.0.2** In the south of England the Cretaceous rocks have been exposed by the Wealden anticline an eroded elongated dome that extends in England from the Dover Straits in the east to the west of Petersfield in Hampshire. The Lower Cretaceous horizons are framed by the arched Upper Cretaceous escarpment of the Chalk.

**3.0.3** The Hythe Formation lies within the Lower Cretaceous forming a continuous horizon and distinctive escarpment feature overlooking the flat Weald Clay valley from Hythe on the Kent coast along the northern section to Leith Hill Surrey, the highest point at 294 m AOD around its westernmost extremity at Petersfield Hampshire returning to the coast between Eastbourne and Pevensey in Sussex.

**3.0.4** The Hythe Beds vary in thickness from 18 to 90 metres. The lithology[9] of the beds also varies significantly consisting of hard sandy limestone interbedded with loosely cemented calcareous, argillaceous sandstone in Kent and Sussex (east of the River Arun). Whilst west of the Arun and in Surrey and Hampshire, the beds are sandstones with lenticular beds of chert.

8 See http://www.fmconway.co.uk/services/AsphaltAndAggregateProducts.aspx
9 See Appendix 3: Glossary

**Figure 11 - The Interchangeability of Construction Aggregates 1990**

*THE PRINCIPAL REQUIREMENTS*

| a. Coarse aggregate | b. Fine aggregate | | | | a. Base Course | b. Surfacing | a. Coarse aggregate | b. Fine aggregate | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Structural concrete | | 2. Buried concrete | 3. Bulk fill | 4. Granular bases | 5. Coated roadstone | | 6. Hot asphalt | | 7. Highway surface dressing | 8. Building sands | 9. Industrial Sand | ***AVAILABLE MATERIALS*** |
| (I) LOCAL RESOURCES | | | | | | | | | | | | |
| * | (*) | * | | | | | | | | | | 1. Beach gravels |
| * | * | * | * | * | | | | | | | | 2. River gravels a. flint dominant |
| | | * | * | * | | | | | | | | b. sandstone dominant |
| | | * | * | | | | | | | | | 3. Ragstone |
| | * | | * | | | | * | | | * | * | 4. Soft sands a. Folkestone Beds |
| | | | * | | | | | | | | | b. Thanet Beds |
| | | | * | | | | | | | * | | c. Oldhaven & Woolwich |
| * | * | * | * | * | * | | * | | | | | 5. Potential deep-mined limestone |
| (II) IMPORTS | | | | | | | | | | | | |
| * | * | * | * | * | | | | | | | | 6. Marine dredged sand and gravel |
| * | * | * | * | * | * | * | * | (*) | * | | | 7. Granite and gritstone |
| * | * | * | * | * | * | | * | | | | | 8. Somerset and Avon limestone |
| (III) SUBSTITUTE MATERIALS | | | | | | | | | | | | |
| | | | * | * | * | * | * | | * | | | 9. Slag |
| | | | * | | | | | | | | | 10. Power station ash (PFA) |
| | | | * | | | | | | | | | 11. Colliery waste |
| | | | * | * | | | | | | | | 12. Cement-stabilised minestone |

(*) WHEN BLENDED WITH NATURALLY OCCURRING SANDS

**4.0.2** Figure 11 did not include recycled aggregates at the time this report was written. This figure illustrates the uses applied to the various aggregate sources available at that time. This report will update that figure as now applies some 20 years later.

**4.0.3** On the basis of the technology and investment applied to the winning and working of ragstone at Hermitage Quarry and the growth in the use of recycled aggregates it is possible to update Figure 11 above. The revised figure is set out opposite (Figure 12).

## Figure 12 - The Interchangeability of Construction Aggregates 2012

***THE PRINCIPAL REQUIREMENTS***

| a. Coarse aggregate | b. Fine aggregate | | | | a. Base Course | b. Surfacing | a. Coarse aggregate | b. Fine aggregate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Structural concrete | | 2. Buried concrete | 3. Bulk fill | 4. Granular bases | 5. Coated roadstone | | 6. Hot asphalt | | 7. Highway surface dressing | 8. Building sands | ***AVAILABLE MATERIALS*** |
| (I) LOCAL RESOURCES | | | | | | | | | | | |
| * | (*) | * | | | | | | | | | 1. Beach gravels |
| * | * | * | * | * | | | | | | | 2. River gravels a. flint dominant |
| | | * | * | * | | | | | | | b. sandstone dominant |
| * | * | * | * | * | * | | * | | | * | 3. Ragstone |
| | * | | * | | | | * | | | * | 4. Soft sands a. Folkestone Beds |
| | | | * | | | | | | | | b. Thanet Beds |
| | | | * | | | | | | | * | c. Oldhaven & Woolwich |
| * | * | * | * | * | * | | * | | | | 5. Potential deep-mined limestone |
| (II) IMPORTS | | | | | | | | | | | |
| * | * | * | * | * | | | | | | | 6. Marine dredged sand and gravel |
| * | * | * | * | * | * | * | * | (*) | * | | 7. Granite and gritstone |
| * | * | * | * | * | * | | * | | | | 8. Somerset and Avon limestone |
| (III) SUBSTITUTE MATERIALS | | | | | | | | | | | |
| | | | * | * | * | * | * | | * | | 9. Slag |
| | | | * | | | | | | | | 10. Power station ash (PFA) |
| | | | * | | | | | | | | 11. Colliery waste |
| | | | * | * | | | | | | | 12. Cement-stabilised minestone |
| | | * | * | * | * | * | * | * | | | 13. Recycled Aggregates† |

(*) WHEN BLENDED WITH NATURALLY OCCURRING SANDS

(†) DEPENDENT ON THE QUALITY OF THE RECYCLING

* CHANGES IN FIGURE 12 FROM FIGURE 11

**4.0.4** With improved processing particularly the washing of the aggregate, ragstone and recycled aggregates have shown that better use of local resources can make a bigger and more sustainable contribution to the construction aggregate market in Kent. By selective processing a proportion of recycled coated materials may be blended with primary aggregates in the production of coated roadstone, asphalt and granular bases. Crushed concrete aggregates may be used in buried concrete mixes and most recycled aggregates can meet bulk fill needs.

# 5 Conclusions

**5.0.1** Construction aggregates are sourced from a diverse collection of materials. They range from those that are naturally occurring to those that have been purposely manufactured, recycled or exist as by-products/waste from other industrial activities.

**5.0.2** The varied nature of construction aggregates and their uses is based and controlled by a system of standards designed to ensure the aggregates are fit for purpose for particular applications.

**5.0.3** Different construction aggregates meet differing needs and uses, therefore care has to be taken to ensure the application will be sustainable and will endure for the planned life of the structure.

**5.0.4** Not all construction aggregates can be substituted directly for each other. Flint aggregate, for example, though extremely durable should not be used in road surfacing due to its low anti-skid polished stone value (PSV) unlike a sandstone with a high PSV value even though chemically they may be very similar their physical characteristics are different, to the degree that they are not interchangeable in this particular application.

**5.0.5** Similarly soft sand is required in mortar mixes (it cannot be substituted by sharp sand or recycled aggregate) in the construction industry where it is generally applied.

**5.0.6** Though interchangeability does happen, a variety of different types of aggregate including land won sand and gravel, marine dredged aggregates, crushed rock and recycled aggregates can now be used in concrete and concrete products, this exemplifies that there is flexibility in application that helps to ensure an efficient and sustainable management of aggregate resources.