



Bedfordshire
county council

Bedfordshire Aggregates Landbank Study, 2005



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Cuesta Consulting Limited

Cuesta

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1. Introduction & Terms of Reference

- 1.1 In October 2005, Cuesta Consulting Limited was appointed by Bedfordshire County Council (BCC) to provide independent geological advice regarding aggregate minerals within the County and, more specifically, to undertake an independent study of the issues relating to the maintenance of an aggregates landbank for Bedfordshire and Luton. This report presents the findings of that work.
- 1.2 The need for the study arose primarily in relation to the latest Minerals and Waste Local Plan (MWLP) review, and to the conversion of that document by BCC into a Minerals and Waste Development Framework (MWDF), in accordance with the requirements of the new planning system¹.
- 1.3 The new system places particular emphasis on the '**soundness**' of all planning documents and on the need for these to be developed from a '**robust and credible evidence base**'. Accordingly, BCC's strategy is to establish, from first principles, the most appropriate landbank requirements for Bedfordshire, based on an improved understanding of the geological reserves and resources within the County and of the ways in which these are used to meet different market requirements.
- 1.4 The new system also requires MWDFs to examine a range of policy options and to test these in terms of relative **sustainability** before identifying the preferred options to be taken forward to consultation with local communities and relevant stakeholders. The process of Sustainability Appraisal (SA) is necessarily an iterative one that needs to be integral to the preparation of the MWDF from the outset. This report does *not* constitute a formal Sustainability Appraisal, but it aims to provide some initial, evidence-based commentary on the sustainability implications of the options available to BCC for maintaining an appropriate landbank of aggregate minerals.
- 1.5 Within this wider context, the study was also required to provide background information that may be pertinent to the consideration by BCC of four current planning applications for concreting sand and gravel extraction within the county, particularly in terms of the need for the minerals involved.

Background

National Policy

- 1.6 As explained in Minerals Planning Guidance Note 6 (MPG6), a landbank is a stock of planning permissions for the winning and working of minerals. Policies providing for the maintenance of landbanks are an important feature of minerals planning and are required to be included in Minerals & Waste Development Frameworks. The draft Minerals Policy Statement 1 (MPS1) states that MPAs should aim to have a landbank which balances the need of industry to meet fluctuations in demand, but avoids the consequences of excessive provision. MPS1 also notes that landbanks for non-energy minerals, such as aggregates and silica sand, should reflect the nature of demand for the mineral concerned.

¹ Essential documents defining the current system of planning for the provision of aggregates within England include:

Planning and Compulsory Purchase Act 2004

Town & Country Planning (Local Development) Regulations 2004

Planning Policy Statement 1: Delivering Sustainable Development

Planning Policy Statement 12: Local Development Frameworks

Draft Minerals Policy Statement 1: Planning and Minerals

Draft MPS1 Annex 1: Aggregates Provision in England

Minerals Planning Guidance Note 6: Guidance on Aggregates Provision in England

- 1.7 Guidance on the length of landbanks for aggregate minerals is set out in MPG6 and in the draft Annex 1 to MPS1. These documents note that the minimum length of the landbank should reflect the time needed to obtain planning permission and to bring a site into full production. The draft Annex confirms the MPG6 guidance that this should be taken as 7 years, and that a landbank less than 7 years should be taken as an indication that additional reserves may need to be permitted. The annual supply rate used in calculating the length of the landbank represented by a given quantity of permitted reserves is apportioned at regional level in MPG6 (now superseded by ODPM's National and Regional Guidelines for the Provision of Aggregates in England, June 2003) and at MPA level by the RAWP (Regional Aggregates Working party). For Bedfordshire, the current requirement is for an average supply rate of 1.93 Million tonnes per year (mtpa), giving a total landbank requirement of 13.51mt of permitted reserves over 7 years.
- 1.8 MPG6 further notes that, in preparing development plans MPAs should be able to demonstrate that sufficient resources have been identified or can be identified to ensure that the landbank can be maintained at the requisite level throughout the Plan period. This does not imply, however, that the landbank should be equal to the duration of the Plan at the start of the Plan period. It means that adequate additional resources should be identified from which the landbank can potentially be 'topped up' through the granting of new planning permissions, during the lifetime of the Plan.
- 1.9 MPA boundaries constitute a suitable area basis on which to base a landbank policy, but MPAs are given the flexibility, in MPG6, to adopt either a sub-regional or a sub-county approach as appropriate. This is especially pertinent to the situation in Bedfordshire which is already a supplier of building sand and silica sand to neighbouring counties and regions, and where the possibility of net imports of concreting sand and gravel needs to be investigated as one of the options for meeting the ongoing need for these products within the County (see below).
- 1.10 MPG6 notes that it is essential that data on annual production, production capacity and reserves, disaggregated by material type where possible, for the area constituting the landbank unit should be publicly available. It points out this will be especially important where the landbank is comprised of a mixture of aggregate types which are not interchangeable, and uses the specific example here of building sand and concreting sand & gravel. In such circumstances, MPG6 notes that separate landbanks may be appropriate, *providing* that the reserves of the different aggregate types may be identified separately and unambiguously.
- 1.11 The figure of 13.51mt mentioned above relates to the total aggregates landbank in Bedfordshire and is a minimum requirement. It follows that, if separate landbanks of at least seven years are to be maintained for different, clearly identifiable resource deposits, and if the existing permitted reserves for one of those end uses already exceed the minimum requirements, then the total aggregates landbank requirement in the County may justifiably be greater than 13.51mt. This is the case in Bedfordshire, where the reserves of building sand are part of the same geological formations which supply specialist silica sands, which in turn are required to meet a landbank requirement of 10, rather than seven years². It follows that, if the building sand reserves in the County are unavoidably large (because they are so inextricably linked with the silica sands), and if a separate, 7-year landbank also has to be maintained for

² In the case of specialist 'silica' sands, the landbank requirement derives from Minerals Planning Guidance Note 15, which notes that "MPAs should aim ... to ensure that landbanks of at least 10 years are maintained for individual sites". The Inspector's Report on the Bedfordshire and Luton Minerals and Waste Local Plan Inquiry noted that 'sites' in this context should refer to production sites, not just processing sites, but that the extent to which every single extraction site needed to maintain a 10 year landbank would depend on the nature, end-use and scarcity of the particular sand deposit at each site. Given the very wide range of specialist end-uses for different types of silica sand (see Chapter 2), and the need to maintain separate land banks for each one (which this implies), the total landbank for all silica sand within the County is likely to exceed the minimum requirement of ten years.

concreting aggregate, then the total aggregates landbank requirement for the County must inevitably exceed the figure of 13.51mt.

- 1.12 The only circumstances in which this would not be true would be if the reserves (or at least a sufficient proportion thereof) were interchangeable between the different end uses (e.g. if some of the excess 'building sand' reserves could, practically and sustainably, be used in concreting applications); or if the shortfall of a particular type of aggregate could be supplied, in a sustainable manner, from permitted reserves within adjacent counties.
- 1.13 The key issues here are those of practicality and sustainability³: different types and sources of sand can often (though not always) substitute for one another on a technical level, but this may only be possible by means of technological solutions (such as increased water and cement requirements) and/or increased transportation distances. Both of these have very negative sustainability implications, not least because of the increased fossil fuel consumption and carbon emissions associated with both cement production and road haulage. The over-riding requirement in all of this is to identify a *preferred option* which can be justified in terms of its overall sustainability.

Local Policy Context

- 1.14 Table 1 of the Bedfordshire and Luton Minerals and Waste Local Plan (First Review: adopted January 2005) currently identifies only the total aggregate reserves within the County and, on this basis, identifies a total landbank of 19.8 years – far in excess of the minimum 7-year requirement and 3.8 years more than the total needed for the whole of the (16-year) Plan period (2000 to 2015 inclusive).
- 1.15 BCC's reasons for adopting this single landbank approach were:
- The difficulties in obtaining accurate and consistent data from site operators relating to the breakdown of their remaining reserves (building sand / concreting sand and gravel / silica sand); and
 - Consistency with regional practice and government guidance, both of which work to single aggregates landbanks
- 1.16 The first of these is a genuine difficulty (which the present study aims to resolve – at least in terms of the current breakdown⁴), but the second is more difficult to sustain: As noted above, national policy does make provision for the maintenance of separate landbanks; and the main reason for single landbanks being maintained in neighbouring counties is simply that those areas generally do not have significant, workable deposits of natural building sand such as the Cretaceous 'Greensand' from which most of Bedfordshire's building sand is derived; they have only deposits of concreting sand and gravel. The main exception to this is Buckinghamshire where reserves of Greensand are available, but are small in comparison to those of Quaternary gravels, and therefore do not have such a distorting influence on the overall landbank calculation.
- 1.17 The associated policy (M2) in BCC's MWLP does, however, state that the MPA will endeavour to maintain a landbank of at least seven years for both concreting sand & gravel and building sand (implying that it will endeavour to make adequate provision for each of these end uses).

³ Sustainability is a major factor in the development of minerals planning policies. A number of factors that are likely to affect the relative sustainability of alternative supply strategies are identified throughout this report and are drawn together within the final conclusions as issues that will need to be addressed in the formal Sustainability Appraisal process.

⁴ Although the present study provides a breakdown of current sales and corresponding reserves, the pattern of end use varies over time, partly in response to changes in demand but also (in some cases) in response to changes in company ownership, marketing strategy etc. The degree of variation is limited by the technical characteristics of each deposit, but at one or two of the silica sand quarries the potential changes could have a significant effect on the overall balance of calculated landbanks (see end of Chapter 4 for further discussion).

- 1.18 The accompanying text explains that, when predicting how much of each aggregate type will be required, a 50:50 split between building sand and concreting sand & gravel has hitherto been employed (e.g. in the preceding (1996) MWLP). If that were an accurate reflection of the current market requirements, and if the available permitted reserves were also split *and utilised* in a similar ratio, then the single landbank approach would adequately support both of these end use categories. The MWLP acknowledges, however, that this approach is fraught with uncertainties and that the requirements set out in its Table 1 may need to be revised. In particular, it acknowledges that Bedfordshire has proportionately larger reserves of building sand than other counties in the Region and that the historical assumption of a 50:50 split in the pattern of demand may no longer be a true reflection of the current market.
- 1.19 A number of potential implications follow from this:
- Firstly, the reserves of building sand within the County may be much greater than those of concreting sand & gravel (as indicated by an agreed Table produced at the recent Inquiry into the MWLP, referred to in para. 2.3.7 of the Inspector's Report). This, however, requires much closer scrutiny, particularly in terms of the allocation of 'undifferentiated' reserves to more specific (or multiple) end use applications);
 - Secondly, the 50:50 split may no longer reflect current market trends (in fact the industry presented unchallenged evidence to the Inquiry to suggest that *recent* demand for concreting sand in southern England (generally) has been proportionately greater than that for building sand, in a ratio closer to 70:30);
 - If both of these are true, *and if the ratio of 70:30 represents more than just a short term variation in the longer-term pattern of demand*, there could well be an excess reserve of building sand and a corresponding shortfall of concreting sand & gravel, over the Plan period;
 - If that were the case, then *unless* the building sand reserves can substitute adequately for concreting applications, or *unless* it would be impractical (or less sustainable) to rely on imports from adjoining counties, then additional new reserves may need to be permitted within the near future, especially if the current landbank of concreting sand & gravel were less than the minimum requirement of 7 years.
- 1.20 The Inspector's report on the recent Inquiry identified similar implications and noted (at para. 2.1.13) that "the strategy of the Plan would not appear to be accurate so far as this product ..." (concreting aggregate) "... is concerned". The Inspector concluded that the amended Plan should "ensure that sufficient reserves for both building sand and concreting sand & gravel are identified to provide a 7-year landbank for each".
- 1.21 With the requirement for that amendment in mind, this study aims to address the uncertainties outlined above, with the aim of providing BCC with the necessary '*robust and credible evidence base*' for identifying a preferred option for updating Policy M2 and Table 1, as part of the ongoing preparation of a new Minerals and Waste Development Framework.
- 1.22 In order to do so, it examines:
- the geological nature of the deposits at all of the main aggregate sites within the County;
 - the range of end uses to which each of these deposits are put and the split of production and reserves between these end uses at each site;
 - the current landbanks of permitted reserves for each of the main product groups, calculated using new data collected in this study;

- the extent to which the current balance of end uses could be changed if there were a need to do so (e.g. as one option for addressing any shortfall of sand & gravel reserves); and
- the extent to which any reliance on imports from other counties would be technically feasible, economically realistic, or desirable from a sustainability point of view.

1.23 The study is based on a detailed review of existing documentation (as listed in Appendix A); site visits to the majority of aggregate production sites within Bedfordshire; interviews with key personnel at each of the main operating companies and information on reserves, sales and end use suitability of the products from each site.

2. Geological Characteristics and Related End Uses

Introduction

- 2.1 The following account is based largely on field inspections of the majority of active production sites within Bedfordshire, together with a review of published geological maps and memoirs as listed in Appendix A, and discussions with the major operators.

Geological Setting

- 2.2 The sands and gravels worked within Bedfordshire fall into two distinct geological categories: the Cretaceous marine deposits of the Woburn Sands Formation, which crop out along the 'Greensand Ridge' from Leighton Buzzard in the South West to Potton in the north east of the area; and the Quaternary fluvial and glacio-fluvial sand & gravel deposits of the major river valleys.

Woburn Sands Formation

- 2.3 The Woburn Sands date from around the middle of the Cretaceous period, around 100 million years ago, and were laid down in a high energy, shallow sea environment. The deposits are made up, predominantly, of very fine- to coarse-grained, well-rounded quartz (silica) sand, with variable amounts of iron oxide, glauconite, and silt. Over many thousands of years, these 'impurities' have become oxidised by weathering at relatively shallow depths (tens of metres) to impart a range of different colours: brown to reddish brown where the iron staining is heavy, through various shades of orange and yellow to white (where the iron staining is minimal or absent). The sands at greater depth, where oxidation has not occurred, may be predominantly grey in colour.
- 2.4 In many of the pits, two or more distinct geological horizons can be identified, characterised by different colour and/or grain size, and in some cases separated by a marker bed of sandy or pebbly clay. Where this occurs, the sands are generally worked as discrete horizons, in order meet different end-use requirements (see below).
- 2.5 There is also a more general variation from the Leighton Buzzard area, where the sands exhibit a wide range of grain sizes and colours, including important white or 'silver' silica sand deposits, to those of the Potton area, which are generally finer-grained, silty to very silty and heavily iron-stained.
- 2.6 All of the deposits are markedly cross-bedded, with depositional surfaces often picked out by differences in the concentration of impurities. In some areas, most notably at Sandy Heath quarry in the Potton area, very heavy concentrations of iron oxide give rise to localised, discontinuous beds of hard ferruginous sandstone. Elsewhere, there are often more sporadic ironstone concretions within the sand.

Quaternary Sands & Gravels

- 2.7 The Quaternary sands & gravels of the area range from glacier-fed 'outwash' deposits associated with the Anglian glaciation, some 400,000 years ago, to younger river terrace deposits alongside and beneath the alluvium of the River Great Ouse and its tributary, the River Ivel. The terrace deposits largely represent the reworking of older glacial deposits by fluvial action in a braided river environment and are compositionally very different to the Woburn Sands. They exhibit a much wider range of grain sizes from coarse gravel to silt and clay particles, but are predominantly characterised by clean to slightly silty, medium- to coarse-grained, sub-rounded to sub-angular sand with fine to medium, sub-rounded to sub-angular gravel.

- 2.8 The sand fraction, having been 'washed' by fluvial action, is generally much cleaner and coarser-grained than the Woburn Sand deposits: most of the silt and clay and much of the fine sand fractions would have been winnowed out by the flow of water during deposition. The sand is also characteristically 'sharper', not only because of its grading but also because of the more angular nature of the individual grains, compared with the well rounded marine sands of the Woburn Formation.
- 2.9 The gravel fraction, which typically constitutes between 30% and 45% of the deposits, is in very marked contrast to the Woburn Sands, even the coarsest of which have only a minor (probably less than 1%) content of very fine gravel. The gravels found in the Ivel Valley, around Sandy and Biggleswade, are predominantly of flint but contain significant quantities of chalk, derived from the 'chalky boulder clay' of the Lowestoft Formation till, as well as from the Chalk outcrop itself, to the South. The gravels of the Great Ouse valley around Bedford contain less chalk and correspondingly higher proportions of flint, sandstone and other lithologies.

End Uses

- 2.10 The end uses to which the sands and gravels extracted within Bedfordshire are put are extremely varied.

Specialist Sands

- 2.11 'Silica sands' (i.e. those made up of predominantly silica grains, where the content of other mineral 'impurities' and silt is very small) are generally suitable, after processing, for a range of specialist, high value '**industrial**' applications. Although silica sand is perhaps most commonly associated with glass manufacture and foundry sand, none of the deposits in Bedfordshire are currently used for those particular purposes. Instead, they are used for a variety of other specialist applications, outlined below.
- 2.12 Where the content of impurities is extremely low, or where post-depositional 'leaching' has removed them, silica sands may be very pale or white in colour. Those which are, when processed by washing, screening and sizing, are generally suitable for use as specialist **non-staining** and **neutral sports sand**, including **golf courses**, **play sand**, sands for **brick facings** and for **horticultural** and **rootzone** products.
- 2.13 Silica sands may also be yellow, orange or brown in colour, however, and these have a different range of specialist end-uses in applications where colour is not of over-riding importance. Relatively coarse-grained varieties can be washed, screened and dried to produce a range of different grades of **water filtration sand**: a product for which the very rounded grains of the marine sands are particularly well-suited.
- 2.14 Fine- to medium-grained varieties of coloured silica sand may be suitable, after processing, for certain types of horticultural, rootzone, sports and **amenity products**. For these applications, consistency of product (grading, colour and chemical composition) is more important than colour and can be achieved through an understanding of the geological variations within the deposit and the adoption of appropriate extraction and processing techniques.
- 2.15 Finer-grained, processed silica sands may be used in a range of specialist sports applications, **resins**, **tile and brick facings** and **industrial filler** applications.
- 2.16 The very fine-grained varieties, and those with a higher proportion of silt, are often processed simply by dry screening and/or blending on-site for **agricultural** and **equestrian** applications. In this study, these are distinguished from the other types of specialist sand, described above, which generally require more complex processing including washing and (in some cases) drying and controlled storage – often at separate plant sites within other quarries.

Concreting Sand & Gravel

- 2.17 A very wide range of concreting applications exist, each with its own requirements in terms of the grading and other characteristics of the constituent aggregate. Individual British Standard specifications within BS 882 (now replaced by equivalent European standard EN 12620) set out the permissible grading limits and other requirements for individual products. For the purposes of this study it is useful to distinguish, primarily, between the following two main groups of product types:
- **'concreting aggregates'** (which include 0/20 and 0/40 'all-in' concrete aggregate, 4/20 and 4/40 graded concrete aggregate, and a range of single sized concrete aggregate from 4/10 to 20/40); and
 - **'concreting sands'** (which range from fine-grained 0/1 and 0/2 concrete sand FP, to medium-grained 0/4 concrete sand MP and coarse-grained 0/4 concrete sand CP).
- 2.18 The numbers in these EN product descriptions refer to the smallest and largest sieve sizes (in mm) needed to define the grading, rather than to the absolute smallest and largest particles that may be present (though in practice, most of the product will be between the stated sizes).
- 2.19 It is important to note that **concreting aggregates**, as defined by these standards, are generally produced from deposits (such as river terrace sands and gravels) which are capable of providing the full range of required grain sizes. They can, however, be produced by blending material from two or more sources, thus enabling some of the material from the Woburn Sands Formation to be used in combination with coarse aggregates (and more angular fine aggregates – see below) from other sources. This would not normally be considered a sensible proposition, since the inclusion of Woburn Sand in the mix would be at the expense of the equivalent sand fraction from the river deposits, which would therefore need to be taken out prior to blending and used for other purposes. This does, however, happen at Garside Sand's Grovebury Road site, near Leighton Buzzard, where the Woburn Sand is already present and the coarse aggregate fraction is brought in from other quarries by Cemex, who operate both concrete and mortar plants on Garside's land.
- 2.20 **Concreting sands**, as defined above, are capable of being produced from both the Quaternary river terrace deposits and from some parts of the Woburn Sands Formation, though again there will, in most cases, be a need for the Woburn deposits to be blended with sharp sand from elsewhere, in order to achieve an adequate mix.
- 2.21 In both cases, the need for blending arises, not only to obtain the required gradings, but also to achieve satisfactory performance without the use of excessive quantities of cement. This, in turn, depends to a large extent on particle shape. Concreting sands are commonly also known as 'sharp' sands – partly because they are relatively coarse grained, by comparison with 'soft' building sands, but also because their constituent grains are more angular. Angular grains allow the sand particles to pack together more densely, which both increases strength through mechanical interlock between the particles and also reduces void spaces in between. It follows that using Woburn Sands alone for the manufacture of concrete would result in a significantly weaker material and would increase the requirements for cement and water, with which the increased void spaces become filled during concrete manufacture.

Building Sands

- 2.22 Building sands, commonly known as 'soft' sands because of the smoother texture imparted by their finer grain size, encompass a range of individual product types, from flooring **screed sands**, at the coarser end of the range, to **mortar or masonry sands** and to **plastering sands** at the finer end of the spectrum. Again, each type is defined

by British Standard specifications under BS1200 and BS 882, all of which are now encompassed within the new European Standard EN13139. (For this reason, screed sands are included here as building sands, rather than as concrete products).

- 2.23 Most building sands are produced from deposits such as the Lower Greensand (= Woburn Sands Formation) with only simple dry screening operations and no washing. Unlike concreting sands, the natural silt content does not need to be removed as it helps to improve the adhesion and flow characteristics of the screed, mortar or plaster when it is being applied.

Asphalt Sand

- 2.24 **Asphalt sands** are at the finer end of the grading spectrum. They are used in combination with bituminous binder material to create a stiff asphalt matrix, between the coarse aggregate particles, that is capable of being rolled out into an even layer. The demand for asphalt sands, particularly for use in hot rolled asphalt, experienced a marked decline during the mid to late 1990s, due to the introduction of new, proprietary 'thin surfacing' materials which used little or no fine aggregate. This trend now seems to have stabilised and may even be reversing in some parts of the UK – notably in Eastern England.
- 2.25 As with the plastering and mortar sands mentioned above, some of the finer and siltier deposits within the Woburn Sands Formation – particularly those around Potton – are very suitable for the production of asphalt sand. The quantities involved are relatively small, however, and for the purposes of this report these materials are grouped together with building sand applications.

Other Applications

- 2.26 All forms of mineral extraction generate a proportion of material that is unsuitable for more specific end-uses and is either retained on-site for use in quarry restoration and landscaping or sold as low value **fill material** for construction projects. A significant proportion of the Woburn Sand is likely to fall into this category, particularly the finest sands and those with higher than usual silt contents.
- 2.27 By contrast, relatively little of the Quaternary sand & gravel deposits would be expected to fall outside the specifications for higher value concreting aggregate, although this may be the case where there is a higher than usual proportion of chalk or silt/clay within the gravel. Some of the gravel may also be used for **drainage** and **pipe bedding** applications which, for the purposes of this study, are grouped with fill material in the category of 'other' end uses.

End Use Flexibility

- 2.28 As indicated above, the various different deposits within Bedfordshire are suited to different applications. Although there is usually some degree of flexibility, and although a number of different end uses may be supplied from a single quarry, there is normally a commercial imperative for each quarry to be worked in such a way that maximises sales to the end uses which are most profitable. These, in general, are the products (such as industrial and other specialist sands) for which significant value can be added during processing. Deposits which are capable of being processed in this way, *at reasonable cost and without creating excessive waste*, are thus effectively reserved (in most, but not all cases) for the highest value industrial applications, instead of being 'squandered' on lower-value end-uses such as concrete or building sand, for which more suitable alternative resources are generally more widely available. This way of working, though commercially driven, therefore has wider economic and sustainability benefits.

- 2.29 Examples of this are seen at most of the Woburn Sand quarries operated by WBB Minerals, Garside Sands and LB Silica Sands around Leighton Buzzard, where material that is capable of being used as building sand is generally sold, preferentially, for use in higher value industrial applications. Similarly, the sand at Hanson's Clophill (Silsoe) quarry is preferentially used in brick manufacture (not least because of the proximity to Hanson's brick clay operations in the Marston Vale).
- 2.30 In other cases, however, the commercial imperative outlined above may be distorted by other commercial factors, leading to the existence of less obvious, and potentially less sustainable supply patterns. The most significant example of this in Bedfordshire is the use of relatively coarse-grained silica sand deposits from two Garside Sand quarries near Leighton Buzzard in the production of concrete (including concrete blocks), rather than in higher value industrial applications. This utilisation partially reflects the focus of the parent company (Aggregate Industries) on the construction market, rather than the industrial sector; but also its limited access to alternative sand & gravel reserves within this particular area, the more general shortage of such material within Bedfordshire and, not least, the attraction of a guaranteed market (achieved by virtue of an agreement to supply to the Cemex concrete batching plant located on their land).
- 2.31 Whatever the reasons for the particular markets served from each site, the MPA has no control over the end uses for which the permitted reserves are used, and a change of ownership or of marketing strategy could easily cause a shift in the balance of sales (and corresponding reserves) from one landbank category to another. It is therefore important, in assessing the availability of existing permitted reserves for different end use requirements, to consider not only the current and historical patterns of supply, but also the potential changes that might reasonably be expected to occur as a market response to any shortfall that may develop in any particular market sector. Paragraphs 3.67 et seq., in Chapter 3 provide further discussion on this issue, with particular regard to the Garside Sand operations noted above.
- 2.32 In considering market responses, economic factors are likely to be the main controlling factor: a deposit is not likely to be used for a particular application if the processing costs exceed the market value of the resulting product. Thus, although some of the more common deposits could, theoretically, be processed to meet the requirements of certain higher value applications, the cost of doing so may be prohibitively expensive. Moreover, for each tonne of higher value product created from such deposits, a much larger quantity of inferior by-products would be generated, which may be incapable of meeting the specification requirements for anything other than the lowest value fill material. This would apply, for example, to any attempts to produce concreting sand or a range of water filtration sand grades from a predominantly fine-grained soft-sand deposit. Working a deposit in such a way would clearly be undesirable in terms of both economics and sustainability.
- 2.33 In other cases, the range of end uses for which a particular deposit is suited may be limited by intrinsic physical properties such as colour or particle shape. Unlike grading characteristics and silt content, which can both be modified to some extent by conventional screening and/or washing, these intrinsic properties effectively cannot be changed. Relatively impure, iron-stained sands within the Woburn Formation therefore cannot be used for applications where higher purity, white, 'silica sands' are required. As outlined above, many of the lower purity sands are used instead for other specialist applications where colour is less important or (where grading precludes such uses) simply for use as building sands.
- 2.34 Particle shape is not such an obvious restriction on end use, but it does have cost and sustainability implications, through its effect on performance and the need for this to be compensated in order to meet specifications and to maintain customer satisfaction.

In the case of concrete mixes, for example, any increase in void space resulting from the use of more rounded Woburn Sand grains in place of the more commonly used angular river sand will inevitably increase the quantities of cement and water required in order to achieve a given performance. This clearly adds to the cost, but it also has adverse global sustainability implications because of the energy required to produce the cement and because of the carbon emissions given off during its production.

3. The Evidence Base: Geology, Production and Reserves at Specific Sites.

Introduction

- 3.1 This Chapter presents a detailed analysis of the geological deposits, permitted reserves, working methods, rates of production and end uses for each of the sand pits within Bedfordshire. It forms the evidence base for the calculation of landbanks, in the following Chapter.
- 3.2 Wherever possible, production (in 2003) and reserves data (for 31/12/2003) is based on written information supplied for the purposes of this study by the quarry operators. In other cases, some or all of the data represents an estimated breakdown of totals recorded previously in the AM2003 survey. Where estimates have been necessary, these are based only on a visual assessment of the quarries by the author and/or on knowledge of the geology at these sites gained from published sources. The operators concerned have been given the opportunity to consider the estimates for their sites and have either accepted them as reasonable estimates or not challenged them.
- 3.3 The figures are summarised at the end of the Chapter in Table 3.1 (2003 production) and Table 3.2 (2003 reserves), with different text colours to distinguish the different types of data involved, and different background shading to distinguish between the main product groups: specialist sands, concreting aggregate, building sands and 'other'. The locations of all quarries referred to in the Tables are shown in Figure 3.1, below, along with the approximate outcrop of the Woburn Sand Formation and some of the main settlements.

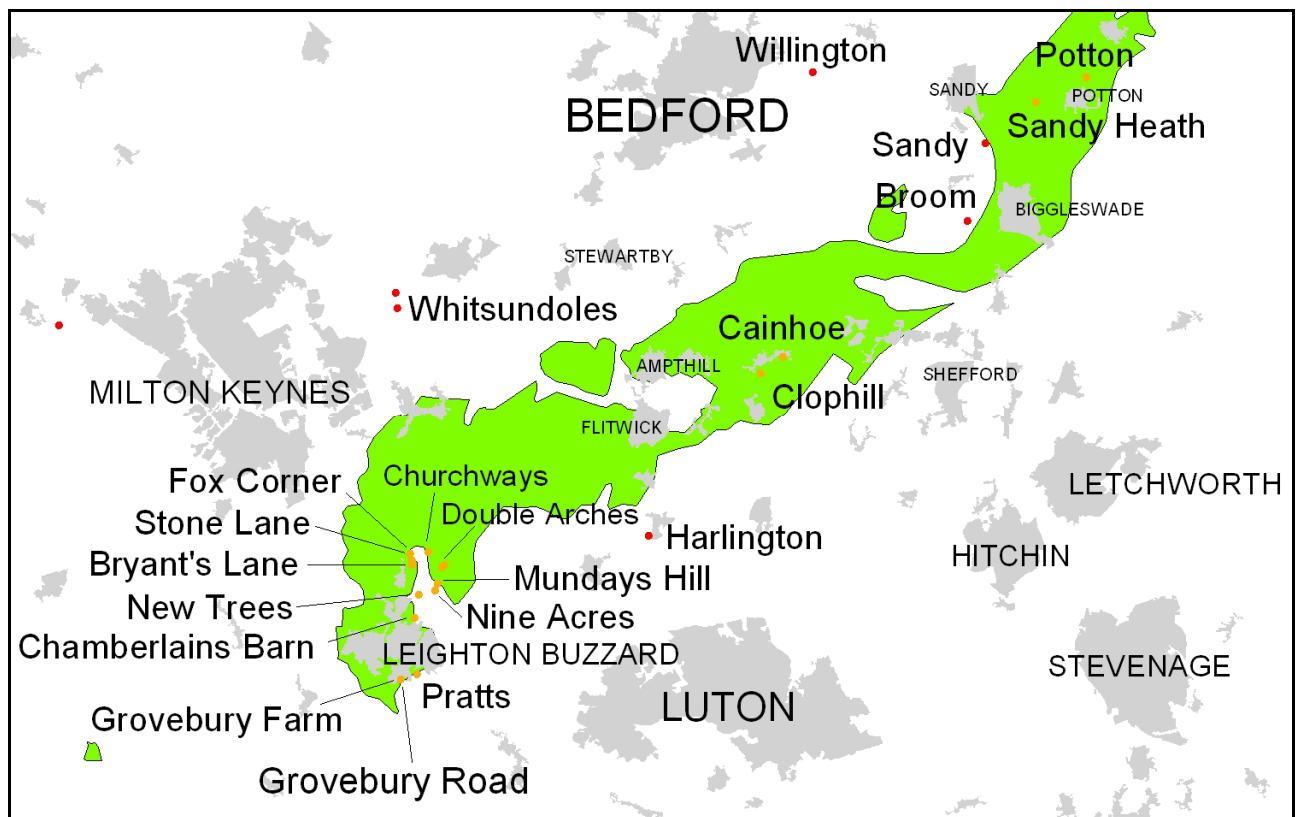


Figure 3.1: Quaternary sand & gravel quarries (red) and Woburn Sand pits (orange) within Bedfordshire, with the approximate outcrop of the Woburn Sand Formation (shown in green).

Quarries within the Woburn Sands Formation

LaFarge Aggregates: Sandy Heath

- 3.4 Sandy Heath quarry is located at the north-eastern end of the Woburn Sands outcrop within Bedfordshire and is characterised by predominantly fine to medium grained, silty to very silty, heavily iron-stained brown sand with some areas of thinly interbedded paler (orange to white) sands and significant but localised and discontinuous areas of hard ferruginous sandstone, known locally as 'carstone'.
- 3.5 The quarry is worked dry, above the water table, and the different colours and grades of sand are blended during extraction and processing to maintain a consistent mix that is ideally suited for use as a mortar sand in accordance with EN 13139. Detailed information from LaFarge, included in Table 3.1, below, confirms that almost 97% of the output is used for this purpose, with much smaller proportions being used for asphalt and 'other' end uses (mainly construction fill).
- 3.6 For the purposes of this study, the remaining permitted reserves at this site have been allocated in the same proportions in Table 3.2, below.

Tarmac: Potton (Myers Farm)

- 3.7 Tarmac's Potton site is located very close to Sandy Heath quarry at the north-eastern end of the Woburn Sands outcrop and is also characterised by predominantly fine to medium grained, silty to very silty, heavily iron-stained brown sand, overlain by similar but somewhat paler (orange to white) and finer-grained sands. Discontinuous layers of hard ferruginous sandstone ('carstone') occur within the deposits but are far less extensive than at Sandy Heath.
- 3.8 The quarry is worked dry, above the water table. Lighter coloured sands in the upper part of the quarry are worked separately from the generally darker sands below, but with mixing within each face during extraction and processing to maintain consistent products. The majority of the sand is sold for use in mortar, in accordance with EN 13139, whilst the finer fraction is processed separately as asphalt sand. Detailed information from Tarmac, included in Table 3.1, below, confirms that around 50% of the output is used for mortar, with a further 26% being used for asphalt and the remaining 24% for 'other' end uses (mainly construction fill). The latter figure seems abnormally high but illustrates the kind of distortion that can be introduced within a given period by major construction contracts which require material for specific applications from the most readily available economic sources.
- 3.9 For the purposes of this study, the remaining permitted reserves at this site have been allocated in the same proportions in Table 3.2, below, though it is likely that the supply of fill material would be less than this when averaged over a number of years. In practice, the balance between mortar and asphalt sand reserves is also likely to vary according to geological differences within the remaining deposits and future changes in the market. None of these changes, however, will affect the split between building and concreting sands, since the latter are not produced, and are *not capable* of being produced in any significant quantity, from this site.
- 3.10 Tarmac has indicated that concreting sand could, *theoretically*, be produced from the deposits at their Potton site. However, for every tonne produced, they estimate that approximately 15 tonnes of residue would accumulate, the grading of which would equate to a much finer-grained building sand than currently supplied to the market. This might prove to be acceptable to the market but, equally, there is the distinct possibility that a much higher proportion would be used only as a low-value fill material. More significantly, however, it is unlikely that any modern sand processing plant would have the ability or efficiency to cut such a grade from so large a

throughput. For practical purposes, therefore, it is reasonable to assume that concreting sand will not be produced in any significant quantities, from this site.

Cemex: Cainhoe

- 3.11 Cainhoe is located within the central part of the Woburn Sands outcrop, directly to the South of Bedford. The site has not been inspected as part of this study but is understood, from industry geologists and published sources, to be very similar in characteristics to the Potton and Sandy Heath sites described above, and to the 'brown sands' of the Leighton Buzzard area, described below, i.e. predominantly fine- to medium-grained silty sands with extensive iron-staining.
- 3.12 Cemex has indicated that the majority of output from this site is into the building sand market and that the material is generally not used either as specialist industrial sands or for the production of concrete. Previous returns made to BCC showed about 7% of the output to be into the concreting market (presumably in the form of fine to medium concreting sand).
- 3.13 For the purposes of this study, the remaining permitted reserves at this site in Table 3.2, below, have been allocated in the same proportions as the sales figures in Table 3.1. Once again, it seems reasonable to assume that large quantities of concreting sand are most unlikely to be produced from this site.

Hanson: Clophill (Silsoe)

- 3.14 Hanson's Silsoe site (also known as Clophill) is located close to Cainhoe quarry, to the south of Bedford and is understood, from Hanson's geologist and from the published BGS memoir, to work deposits which are broadly comparable to the brown sands of the Leighton Buzzard area, except that the overall grain size is finer.
- 3.15 The site is operated by Hanson Brick, rather than Hanson Aggregates, and 100% of its output is used as facing and/or body sand in brick production at nearby sites. This contradicts existing information for this site held by BCC, in which the output was attributed to the category of building sands (for which it is equally suitable). The new information is regarded by the author as being more reliable, although the discrepancy does highlight the fact that certain sands are interchangeable between different end uses, and that BCC has no control over the way in which reserves are used, once permission for their extraction has been given. In this particular case, however, the flexibility has little or no bearing on the availability of concreting aggregate.
- 3.16 For the purposes of the present survey, sand produced for brick manufacture is classed as one of the specialist sand end uses, rather than as building sand, and the reserves at this site have therefore been allocated to the specialist (dry-screened) category in Table 3.2, below.

Aggregate Industries (Garside Sands): Munday's Hill

- 3.17 Garside Sands, a subsidiary of Aggregate Industries, operates a number of Woburn Sand quarries within the Leighton Buzzard area. Munday's Hill is one of these quarries and is also the location of a central plant which processes specialist sands brought in from Garside's other quarries within this area. Detailed output and reserve figures for all of these quarries have been provided by the parent company.
- 3.18 Munday's Hill quarry works two distinct horizons within the Woburn Sand Formation. The upper unit is comprised of fine- to medium-grained industrial sand which is almost pure white in some areas and tinged with yellow and orange in others, with abundant fossil wood and lignite fragments and with hard, ferruginous 'carstone' reefs developed in places near the top of the succession. The lower unit is made up of much finer-

grained, silty brown sand (known locally as 'compo') containing thin interbeds of dark silty clay.

- 3.19 The upper unit is worked dry, entirely for the production of specialist industrial sands which are selectively extracted and processed (washed, graded, dried and stored) on site for a range of specialist end uses. The white sands are worked separately for use in applications where the highest levels of purity are required, whilst the various shades of yellow and orange are blended at the face to achieve a consistency of colour and grading for other applications. The annual production of these industrial sands from Munday's Hill quarry in 2003 represents a higher proportion of total output than can be maintained from the remaining supplies (simply because the working faces in this unit are already more advanced than those in the bench below).
- 3.20 The lower horizon of finer, brown sand is also worked dry, and is subject only to simple processing to meet specification requirements for construction applications (building sand only) and for some additional types of specialist sand that do not require full processing.
- 3.21 As indicated above, the remaining reserves at this site, as shown in Table 3.2, are not in the same proportion as current output. For reasons similar to those explained above for Sandy Heath and Potton, it is highly unlikely that any of the remaining fine-grained building sand material from Munday's Hill would be processed to meet concreting sand requirements. Equally, it is unlikely that any of the coarser-grained upper industrial sands would be used for that purpose, since this would reduce their profitability and would also be at odds with the concept of prudent use of natural resources. Given that coarse sand from two of Garside's other operations (see below) are used for concreting, the possibility of this happening at Munday's Hill cannot be ruled out, but it is thought unlikely.

Aggregate Industries (Garside Sands): Grovebury Road

- 3.22 In contrast to most other sand pits within Bedfordshire, the Woburn Sand deposits at Grovebury Road are worked 'wet', below the water table, by suction dredging. This precludes the possibility of selectively working individual horizons for specific products, although the lower unit of fine-grained 'compo' sands at the base of the succession, and the laminated 'silty beds' which separate these from the overlying coarser-grained sands are deliberately not extracted. The silty beds form a natural base for the dredging operations and prevent the inclusion of the lower sands within the extracted material. The process therefore yields primarily medium-grained sands which, in complete contrast to most other Woburn Sand operations, are used in concrete applications as well as for industrial purposes. Although the sand itself is incapable of making a satisfactory concrete, it is successfully blended with sharper sand and coarse aggregate from Quaternary sand & gravel sites elsewhere, brought in by Cemex who operate a concrete batching plant by agreement on the Grovebury Road site.
- 3.23 The remainder of the sand extracted from Grovebury Road is split between fully processed industrial applications, transferred to Munday's Hill for washing, processing and storage), other specialist applications including sports sands, processed primarily by dry screening on site, and natural building sands, also processed on site.
- 3.24 The subdivision of the remaining permitted reserves at Grovebury Road, in Table 3.2, reflects an assumption that similar proportions of the various different products will be extracted in future years. This, however, may not be a valid assumption since, once the reserves at the adjoining Grovebury Farm site (see below) are exhausted, there is likely to be an increase in production from Grovebury Road in order to maintain supplies of sand to the concrete block-making plant at that site. This would effectively

increase the proportion of concrete aggregate from approximately 50% to 63% of the total output. This would, however, have no effect on the overall landbank calculations, since it would simply entail a shift of production from one site to another.

- 3.25 In theory, an even higher proportion of the sand from Grovebury Road might be useable as concreting aggregate (as is the case at the adjacent Grovebury Farm site, see below). Whilst this is possible, it is not considered to be a very likely scenario, even if there were to be a severe shortage of concreting aggregate within the County in future years. This is because sand from Grovebury Road could only ever supply the fine aggregate (i.e. sand) fraction of the main concreting aggregate market: there would still be a need for coarse aggregate (i.e. gravel) from other sites which, once permitted, would also be able to supply the sand. Coarse aggregate could alternatively be supplied from crushed rock sources, imported into the County via the rail depot at Elstow, to the South of Bedford, though this would be a more expensive and less desirable option, as explained in para. 5.16 below.
- 3.26 The requirement for sand from Grovebury Road to replace the output from Grovebury Farm would therefore not be affected by a more general change in the concrete market: it would be linked only to the specific demand for concrete blocks from that operation.

Aggregate Industries (Garside Sands): Grovebury Farm ('Brickyards')

- 3.27 Garside's Grovebury Farm (Brickyards) site is directly comparable to Grovebury Road in terms of geology and methods of working, the main difference being that, here, 100% of the output is used on site for the manufacture of concrete blocks for paving. Unlike the more general market for concreting aggregate, concrete blocks are produced predominantly from medium to coarse sand, for which the Grovebury Farm deposits are well suited. Accordingly, all of the remaining permitted reserves at this site have been allocated, by Garside Sands, to that particular end use.

Aggregate Industries (Garside Sands): Churchways/Checkley Wood/Riddeys

- 3.28 These three adjoining pits are operated as a single site but are currently producing only small quantities of building sand and have not been inspected as part of this study. The breakdown of remaining reserves at this site, as provided by Aggregate Industries, indicates that a wider range of end uses should be possible in future, including dry-screened specialist sands as well as building sands and a smaller proportion of low value fill material, but no concreting sand.

WBB Minerals: general note

- 3.29 WBB Minerals also operate a number of sand pits within the Leighton Buzzard area. Unlike Garside Sands which, as part of Aggregate Industries, has a major interest in the construction market, WBB is primarily concerned with industrial minerals. As such, it does not produce any material from any of its sites specifically to comply with British or European construction aggregate standards. Having said that, the company acknowledges that some of the material sold directly to collecting customers is likely to be used in the construction market. The majority of WBB's production, however, is focused on a range of industrial and other specialist applications. For each of its sites, the company has provided information on the total sales for industrial uses (this being the material transported to and processed at its Double Arches plant site) and has indicated the approximate percentage of remaining permitted reserves at each of its sites which is likely to supply the same markets. These figures are shown in red in Tables 3.1 and 3.2, respectively. The remaining output and reserves figures shown against other end uses are simply estimates of the breakdown of the remaining material (i.e. the difference between the industrial sand and total figures), based on

limited information regarding the geology of each site. In the absence of more precise data, these estimated breakdown figures have been accepted by WBB as reasonable approximations for the purposes of this study.

WBB Minerals: Pratts Quarry

- 3.30 Pratts Quarry, located at the southern edge of Leighton Buzzard, comprises an upper sequence of coarse- and medium-grained, iron-stained reddish brown sands, underlain by a lower sequence of finer-grained yellow sands with sporadic concentrations of heavier iron-staining and localised concretions of hard ferruginous sandstone, extending beneath the water table. Groundwater is pumped out of the base of the pit to enable dry excavation to take place from discrete horizons, as required.
- 3.31 The upper sands here display the coarsest grain size distribution within the area and are used, primarily, to produce a range of specialist industrial gradings for the water filtration market, along with sports sands and horticultural sands. Together, these end uses account for around 63% of production. Other industrial uses include resins, acid-resistant roofing tiles, flooring compound sand, specialist brick facings, and fluid-bed boiler sands, bringing the total proportion of processed industrial sands at this site to around 75%.
- 3.32 All of the remaining 25% of production is allocated, in BCC's existing figures, to concreting sand & gravel. This, however, seems an unlikely use of the coarse sand, given the demand for so many higher value materials that this could otherwise be used for. Evidence from the site visit suggests that the remaining output – primarily derived from the finer-grained lower sands – is used instead for the production of various agricultural and horticultural products and for building sand. All of these are simply dry-screened, blended as necessary and sold directly from site. For the purposes of this study, it is therefore assumed that the 25% 'non-industrial' output from Pratts is divided more or less equally between other specialist sands, concreting sands and building sands.

WBB Minerals: Stone Lane

- 3.33 Stone Lane displays one of the clearest distinctions within the area between different geological horizons within the Woburn Sand. This comprises an upper unit of white to buff-coloured medium- to fine-grained sands, with localised iron-staining picking out some of the shallow cross-bedding; and a lower unit of heavily iron-stained brown and reddish-brown medium-grained sands with much steeper cross bedding; the two being separated by a well-defined marker-bed of laminated sandy clay. A further horizon of lighter-coloured fine- to medium-grained sand with orange and brown staining, often picking out fossil burrows within the sand, occurs at the base of the pit.
- 3.34 The upper sequence of white and buff sand is taken for washing and processing at the Double Arches site for use in a variety of specialist applications, including non staining and neutral sports sand, brick facings and horticultural and rootzone products. This material is estimated to make up approximately 25% of the remaining reserves at Stone Lane.
- 3.35 The lower sequence of predominantly brown sands is dry-screened, blended for consistency and sold directly from the site, primarily as a building sand for mortar, but with some additional sales of specialist sands for golf courses and other applications. The estimated split between these additional end uses is based on the geological characteristics of the deposit and verbal information from site personnel. They are subject to amendment if and when WBB is able supply more accurate breakdown information. However, the deposits are too fine to be seen as a sensible source of

concreting sand and, as WBB has confirmed, the estimates are therefore likely to be adequate for the purposes of this assessment.

WBB Minerals: Nine Acres

- 3.36 The Nine Acres pit exposes a single geological horizon within the Woburn Sand, and one which is significantly finer-grained than any of those described above. It comprises thin beds of white to grey fine-grained silty sand with thin laminations of clay and silt together with local concentrations of iron staining and lignite particles along sub-horizontal bedding planes.
- 3.37 Nine Acres is worked only intermittently, with all of its output being processed through the Double Arches plant site. The material is screened to remove excessive clay and silt and is used entirely as a specialist sand for a range of sports and equestrian applications, as well as in resins, tile and brick facings and industrial filler applications.

WBB Minerals: New Trees

- 3.38 The New Trees pit has not been inspected as part of this study but is understood, from the BGS geological memoir, to comprise a sequence of medium to coarse-grained, slightly pebbly, cross-bedded white, buff and orange-coloured sands, correlating perhaps with the finer-grained upper white sands found at Stone Lane (see above) and Bryant's Lane (see below). Unlike those quarries, however, the lower unit of medium brown sand is not believed to be exposed at New Trees.
- 3.39 WBB's geologist has advised that around 60% of the remaining reserve is likely to be used for industrial applications after processing off-site. Based on the geological characteristics outlined above, including the absence of the lower brown sands which are used elsewhere for mortar, it seems likely that most if not all of the remaining 40% will be used for other specialist applications which require only simple processing on site.

WBB Minerals: Chamberlain's Barn

- 3.40 The Chamberlain's Barn site is worked intermittently and, again, has not been inspected. The BGS memoir describes a sequence, closely related to that in New Trees, in which an upper unit of medium to coarse-grained, slightly silty and often pebbly, red sands overlie the unit of white, buff and orange-coloured sand. Information from WBB describes the sands here as being predominantly orange in colour with a variable degree of iron staining on and within the individual quartz grains, and similar in overall grading characteristics to the uppermost white sands exposed at Stone Lane.
- 3.41 WBB state that it is possible to produce some industrial grades from Chamberlain's Barn, including some types of horticultural, rootzone, sports and amenity products. They advise that approximately 60% of the deposit is likely to be used for such purposes, after processing off-site. Based on the geological characteristics outlined above, including the increased iron staining and fines content, compared to New Trees, it seems likely that the remaining 40% will be split between other specialist applications which require only simple processing on site, and building sand products. The deposits are probably too fine grained to make the production of concreting sand an economic proposition.

WBB Minerals: Double Arches

- 3.42 Reserves at the Double Arches site are currently under review by WBB and none of the deposits are currently being worked. Much of the reserve is located beneath the centralised plant site which processes industrial sands from all of WBB's sites in

Bedfordshire and others as far away as Redhill in Surrey. The plant represents a very substantial long-term investment and is unlikely to be removed within the foreseeable future.

- 3.43 In the absence of any further information, it has been assumed for the purposes of this study that the reserves at this site will have a similar distribution of end uses to that assumed for Chamberlain's Barn, above, and will thus be unlikely to include any material suitable for concrete aggregate production.

LB Silica Sands: Bryant's Lane (incl. Reach Lane)

- 3.44 Leighton Buzzard Silica Sands is an independent company which claims to operate in a very different way to the larger operators, taking much greater care to selectively extract individual geological horizons in such a way that allows for a much greater number of grades to be produced for higher value niche markets. The company is not, however, willing to disclose any sales or reserves information to confirm this in any detail.
- 3.45 The geological succession is virtually identical to that seen in the adjacent Stone Lane quarry (see above) but the deposits do appear to be worked rather more selectively, with a separation of the upper, whitish-yellow fine-grained sands from the middle sequence of more heavily iron-stained, steeply cross-bedded, medium-grained sands (as at Stone Lane), but with a further separation of this middle unit from the lower sequence of lighter-coloured fine- to medium-grained sands with orange and brown staining. A further unit of finer-grained clayey 'compo' type sand occurs above the whitish-yellow sands at the very top of the sequence at Bryants Lane, and this is also worked separately. Dewatering takes place from a small sump at the base of the excavation to enable the lowest units to be worked in dry conditions.
- 3.46 Whereas, in Stone Lane Quarry, the middle and lower units are generally blended together to produce a consistent material, primarily for use as a building sand, the more selective approach used at Bryants Lane is claimed by the operators to allow a much higher proportion of this material to be used for specialist applications. Some of the output is no doubt still used as building sand, but the proportion is claimed to be small, and a small quantity of concreting sand is produced, but only for high value heritage applications where it is important to match the colour of existing masonry etc.
- 3.47 The breakdown of sales and the corresponding breakdown of remaining reserves shown for this quarry in Tables 3.1 and 3.2, below are entirely speculative, though they are based on direct observation of the deposits and, once again, they are thought likely to be reasonable insofar as the distinction between concreting and building sand is concerned.

DB Standing: Fox Corner

- 3.48 This very small scale operation has very limited reserves and is not likely to be significant for the purposes of this study. The site has only basic processing equipment and appears to produce a limited range of building sands and blended horticultural products in small quantities.

Quarries within the Quaternary Sands and Gravels

LaFarge Aggregates: Willington

- 3.49 Willington contrasts markedly with all of the sand pits described above, being a sand & gravel quarry primarily geared to the production of aggregates for concrete. The sands and gravels occur beneath minimal overburden as extensive sheets of varying grain size with minimal fines content, and are typical of the braided river sediments found

within major river valleys in many parts of central and southern England, laid down after the disappearance of the ice sheets which covered this area during the Anglian glaciation.

- 3.50 Detailed information supplied by LaFarge for the specific purpose of this study, as shown in Table 3.1, reveal that 89% of current production is used in concrete applications, with a more or less equal split between concrete aggregate (i.e. inclusive of coarse aggregate) and concrete sands. The remaining 11% includes a very small quantity of washed building sand, derived from the finer fraction, but is primarily used for 'other' end uses including constructional fill and drainage material.
- 3.51 In view of the consistency of the deposit and its ideal suitability for the concrete market, it is reasonable to assume that the remaining reserves at this site will be used in the same proportions as for current production, and this is reflected in Table 3.2, below.

Tarmac: Broom

- 3.52 Broom quarry is broadly similar to Willington in most respects, the main differences being that the deposits are generally thinner and contain a relatively high proportion of Chalk fragments. They are regarded by the BGS as being of glacio-fluvial origin, i.e. deposited by meltwater from the glaciers which laid down the 'chalky boulder clay' of the Lowestoft Formation. By comparison with river terrace deposits, such as those seen at Willington, glacio fluvial sediments are often less well sorted, i.e. they have a wider grading envelope with somewhat higher proportions of fines and also higher proportions of any relatively weak rock types (such as Chalk, in this case). These differences reflect the fact that the sediments have not been transported as far by flowing water, by comparison with the fluvial deposits found in river terraces.
- 3.53 Detailed sales information supplied by Tarmac, as presented within Table 3.1, reveal that 92% of production is used in concreting applications, but this time with a distinct predominance of concreting sand and a lower proportion of coarse aggregate. The remaining 8% is used for constructional fill, drainage etc.
- 3.54 Once again, it is reasonable to assume that the remaining reserves will be utilised in the same proportions, as shown in Table 3.2.

Cemex: Sandy (Warren Villas)

- 3.55 This deposits at this site are similar in most respects to those at Broom Quarry, described above: although the deposits here are more clearly part of a river terrace sequence, they are only a short distance downstream of the glacio-fluvial sediments seen at Broom, and are likely to have been derived from them. As such, they still contain a higher proportion of Chalk fragments than the more far-travelled terrace deposits seen at Willington.
- 3.56 Cemex has confirmed that the quarry at Sandy supplies the same range of end uses as Broom. The figures given in Tables 3.1 and 3.2 are therefore based on the totals previously reported to BCC by the operator, with the percentage split from Broom being used to estimate the subtotals for coarse and fine concreting aggregate and of residual fill material.

Aggregate Industries: Whitsundoles

- 3.57 This site had very limited reserves in 2003 and has not been visited as part of this study. The figures for this site in Table 3.2 are taken from BCC's existing information, with a breakdown confirmed by the operator to be very similar to that for Willington.

Henlow Building Supplies: Henlow Plant Site

- 3.58 This is a dormant IDO permission with limited reserves and was not operational in 2003 (or since). The reserves do, nevertheless, contribute to the available landbank. The figures for this site in Table 3.2 are taken from BCC's existing information, with an assumed breakdown of probable end uses similar to that for Willington.

Barbour Partnership: Box End Farm

- 3.59 This site was operational in 2003 but closed in 2005 and is now in restoration. Output and reserves figures are nevertheless included in Tables 3.1 and 3.2 because they contribute, albeit in a small way, to the overall picture of market demand and available reserves at that time. The figures are based on those already held by BCC, with an assumed breakdown of probable end uses similar to that for Willington.

Summary

- 3.60 Tables 3.1 and 3.2, below, summarise the available output and reserves information for all sand pits and sand & gravel sites within Bedfordshire. The sites are grouped by operator and divided into Woburn Sand pits, in the upper part of each table, and Quaternary sand & gravel pits, in the lower half.
- 3.61 For each quarry, a breakdown is given for the output and corresponding reserves associated with each of up to nine end use categories. The wide range of specialist sands are simplified, for the purposes of this study, into those which are generally produced by simple dry-screening at the extraction site, and those which are fully processed, usually involving washing, screening into size fractions and drying, at a separate plant site. Concreting materials, i.e. those sold to EN 12620 Specifications, are subdivided into concreting aggregate (a range of products which include coarse aggregate as an essential component) and concreting sand (which excludes coarse aggregate). Building sands, i.e. those sold to EN 12139 Specifications, are subdivided, where possible, into screed sands, mortar sands and plastering sands. Asphaltting sands are shown separately but, being similar to (and often interchangeable with) building sands, are grouped with them in subsequent landbank calculations, in Chapter 4. Most quarries also produce material that is sold as general fill or for other uses, such as drainage, pipe bedding etc. Not all operators provided figures for such material, however, and the totals for the proportions used in this way are therefore likely to be underestimates – especially for the Woburn Sand quarries.
- 3.62 Figures shown in red in these tables were supplied directly by the quarry operators. Those shown in blue text are the author's estimates which have been seen and not disputed by the operators concerned, and are within the limits of totals previously submitted by the operators to BCC. Though somewhat less reliable, these estimates are considered adequate for the purposes of this study. Totals shown in black correspond to those already held by BCC from returns made previously by the operators for 2003. Totals shown in purple text represent subsequent amendments, by the operators, to those earlier returns.
- 3.63 The subdivision of permitted reserves by end use reflects the current marketing of material from each site, modified as necessary by any known differences in the remaining proportions of different gradings available (e.g. a site with two different types of sand may sell to two corresponding end uses in equal proportions, but if there are different quantities of each type remaining within the pit then this should be reflected in the breakdown of reserves - though in practice this may not always be possible). Future changes in marketing strategies could theoretically produce a different balance of reserves in different end use categories, and the implications of this are considered in more detail below.

- 3.64 It is clear from the totals in Tables 3.1 and 3.2 that the Quaternary sand and gravel sites supply to a relatively limited range of end uses, 55% of current sales being as concreting sand and a further 36% being as coarse aggregate for concrete, but also that these sites supply the large majority (82%) of all concreting aggregate supplied from Bedfordshire quarries. The Woburn Sand quarries, as a group, are far more versatile, supplying material for all of the end use categories other than coarse concreting aggregate, with only a minor share (18%) of the concreting aggregate market. This, however, disguises the very important differences between individual sites, most of which supply to only a narrow range of categories. Of particular importance to this study, only a few of the sixteen listed Woburn Sand quarries are known to supply sand into the concreting market, and none of those sites is able to contribute to the supply of coarse aggregate for concreting or other purposes.
- 3.65 The tables also demonstrate that, whilst the total sales from Woburn Sand quarries and those from Quaternary sites are almost balanced (56% and 44% of total sales, respectively), there is a substantial imbalance in terms of permitted reserves – the Woburn Sand quarries accounting for almost 90% of the total. Given that building sand is obtained almost exclusively from the Woburn Sand quarries, and that, as noted above, concreting aggregate is derived predominantly from Quaternary sand & gravel sites, the latter supplies are clearly under much greater pressure (similar levels of demand but only one tenth of the total available reserves).
- 3.66 The picture is further distorted, however, by the very large total quantities of material available at the Woburn Sand quarries: although the proportion of this material likely to be used in concreting applications is rather small (about 10% on the basis of the current assessment in Table 3.2) this equates to more than 3 million tonnes – almost as much as the total reserve of concreting sand and gravel remaining within the Quaternary deposits (close to 3.5 million tonnes).
- 3.67 This highlights the significance of the decision by certain suppliers (notably Garside Sands) to supply silica sand into the concreting aggregate market, and hence the vulnerability of this kind of assessment to the commercial strategies of major producers.
- 3.68 At one extreme, a decision to supply only industrial grades from these sites in future would immediately reduce the available reserves of concreting aggregate by almost half, and would increase the pressure on other sites to supply to Garside's existing customers.
- 3.69 At the opposite extreme, a decision to increase the proportion sold for concreting applications would create the appearance, at least, of a healthier landbank for concreting aggregate. This would be something of an illusion, however, since (as already pointed out) the Woburn Sand operations are only able to supply the fine aggregate fraction. In the absence of the coarse aggregate fraction, this material would have a very limited market of its own and would do little or nothing to meet the more general requirement for mixed sand and gravel that is needed for use in most concreting applications.
- 3.70 In reality therefore, although variations in the marketing of Woburn Sand deposits from one year to another have the ability to distort landbank *calculations*, they can have only limited influence on the *actual availability* of material needed to supply the more general concreting aggregate market.
- 3.71 This is almost an argument for maintaining separate landbanks of aggregate for different types of concrete products, but that would only add to the current difficulties of monitoring. Instead, there must be a pragmatic recognition that any future reduction in output from existing Quaternary sand & gravel sites, as permitted reserves at those sites become exhausted, will not be able to be adequately replaced by

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increased output from the Woburn Sand deposits. The implications of this are considered further in the following Chapter.

Operator	Site	SPECIALIST SANDS		CONCRETE PRODUCTS		BUILDING SANDS			ASPHALT	OTHER	TOTAL
		Dry-screened only	Fully processed	Concrete Aggregate	Concrete Sands	Screed	Mortar	Plaster	Asphalt	Fill, Drainage etc	
LaFarge	Sandy Heath	0	0	0	0	0	136,830	0	2,441	1,971	141,242
Tarmac	Potton	0	0	0	0	50,265	0	0	26,274	24,811	101,350
Cemex	Cainhoe	0	0	0	2,000	0	28,000	0	0	0	30,000
Hanson	Clophill (Silsoe)	3,000	0	0	0	0	0	0	0	0	3,000
Aggregate Industries (Garside Sand)	Munday's Hill	10,000	50,000	0	0	0	7,000	1,000	0	0	68,000
	Grovebury Road	0	120,000	0	128,000	0	24,000	0	15,000	0	287,000
	Grovebury Farm (Brickyard)	0	0	0	30,000	0	0	0	0	0	30,000
	Churchways / Checkley Wood/ Riddeys	0	0	0	0	0	3,000	0	0	0	3,000
WBB	Pratts	16,000	131,000	0	16,000	0	15,700	0	0	0	178,700
	Stone Lane	18,500	22,400	0	0	0	72,700	0	0	0	113,600
	Nine Acres	0	44,200	0	0	0	0	0	0	0	44,200
	New Trees	0	1,800	0	0	0	0	0	0	0	1,800
	Chamberlain's Barn	3,700	7,000	0	0	0	2,300	0	0	0	13,000
	Double Arches	9,000	12,000	0	0	0	6,000	0	0	0	27,000
LB Silica Sand	Bryant's Lane & Reach Lane	24,000	73,000	0	5,000	1,500	4,500	3,000	0	0	111,000
DB Standing	Fox Corner	800	0	0	0	0	400	0	0	0	1,200
TOTALS, Woburn Sand Formation		85,000	461,400	0	181,000	51,765	300,430	4,000	43,715	26,782	1,154,092
LaFarge	Willington	0	0	139,132	134,875	0	5,715	0	0	26,331	306,053
Tarmac	Broom	0	351	120,495	272,589	0	0	0	0	33,036	426,471
Cemex	Sandy (Warren Villas)	0	73	25,146	56,886	0	0	0	0	6,895	89,000
Aggregate Industries	Whitsundoles	0	0	42,180	40,890	0	1,730	0	0	7,984	92,784
Henlow Bdg. Supplies	Henlow Plant Site	0	0	0	0	0	0	0	0	0	0
Barbour Partnership	Box End Farm	0	0	4,361	4,228	0	179	0	0	825	9,593
TOTALS, Quaternary Sand & Gravel		0	424	331,314	509,468	0	7,624	0	0	75,071	923,901
TOTALS, Bedfordshire		85,000	461,824	331,314	690,468	51,765	309,054	4,000	43,715	101,853	2,077,993

Table 3.1: Annual Output of Aggregate & Silica Sand in Bedfordshire (tonnes) in 2003

red = data from operators; blue = consultant's estimated breakdown not challenged by operators; purple = operator's amendment to data previously reported to BCC; black = data previously reported by operators to BCC (see accompanying text for full explanation)

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Operator	Site	SPECIALIST SANDS		CONCRETE PRODUCTS		BUILDING SANDS			ASPHALT	OTHER	TOTAL
		Dry-screened only	Fully processed	Concrete Aggregate	Concrete Sands	Screed	Mortar	Plaster	Asphalt	Fill, Drainage etc	
LaFarge	Sandy Heath	0	0	0	0	0	3,623	0	64	53	3,740
Tarmac	Potton	0	0	0	0	1,196	0	0	625	590	2,411
Cemex	Cainhoe	0	0	0	0	9	116	0	0	0	125
Hanson	Clophill (Silsoe)	767	0	0	0	0	0	0	0	0	767
Aggregate Industries (Garside Sand)	Munday's Hill	745	600	0	0	0	575	35	135	0	2,090
	Grovebury Road	0	1,700	0	2,050	0	340	0	0	0	4,090
	Grovebury Farm (Brickyard)	0	0	0	720	0	0	0	0	0	720
	Churchways / Checkley Wood/ Riddeys	500	1,000	0	0	0	1,500	500	500	110	4,110
	Pratts	100	880	0	100	0	95	0	0	0	1,175
WBB	Stone Lane	19	32	0	0	0	75	0	0	0	126
	Nine Acres	0	184	0	0	0	0	0	0	0	184
	New Trees	275	412	0	0	0	0	0	0	0	687
	Chamberlain's Barn	1,595	3,892	0	0	0	1,000	0	0	0	6,487
	Double Arches	240	600	0	0	0	160	0	0	0	1,000
LB Silica Sand	Bryant's Lane & Reach Lane	920	2,790	0	200	58	174	115	0	0	4,257
DB Standing	Fox Corner	10	0	0	0	0	15	0	0	10	35
TOTALS, Woburn Sand Formation		7,171	10,090	0	3,079	1,254	7,673	650	1,324	763	32,004
LaFarge	Willington	0	0	205	198	0	8	0	0	39	450
Tarmac	Broom	0	2	550	1,243	0	0	0	0	150	1,945
Cemex	Sandy (Warren Villas)	0	0	205	460	0	0	0	0	55	720
Aggregate Industries	Whitsundoles	0	0	68	66	0	2	0	0	14	150
Henlow Bdg. Supplies	Henlow Plant Site	0	0	137	132	0	5	0	0	26	300
Barbour Partnership	Box End Farm	0	0	114	110	0	4	0	0	22	250
TOTALS, Quaternary Sand & Gravel		0	2	1,279	2,209	0	19	0	0	306	3,815
TOTALS, Bedfordshire		7,171	10,092	1,279	5,288	1,254	7,692	650	1,324	1,069	35,819

Table 3.2: Permitted Reserves of Aggregate & Silica Sand in Bedfordshire (thousands of tonnes) at 31/12/ 2003

red = data from operators; blue = consultant's estimated breakdown not challenged by operators; black = data previously reported by operators to BCC

(see accompanying text for full explanation)

4. Landbank Calculations

- 4.1 For the purposes of this analysis, separate landbank calculations are provided below for different types of aggregate, not because this is *necessarily* the best way forward, but to examine the differences involved and their implications for the monitoring and calculations required in support of BCC's Minerals & Waste Development Framework.

A) Calculations based on Sales in 2003

Concreting Aggregate

- 4.2 Based on the detailed information presented in Tables 3.1 and 3.2, above, the total permitted reserves of concreting aggregate within Bedfordshire in December 2003 amounted to 6.567 million tonnes (mt). Of this, almost half (3.079mt) was at Woburn Sand quarries, and the remainder (3.488mt) was at Quaternary sand and gravel sites. The corresponding total sales to concreting applications in 2003 were 1.022mt, of which only 0.181mt was from Woburn Sand quarries and the majority, 0.841mt, was from Quaternary deposits. At these combined levels of demand, the available reserves of all concreting aggregates would theoretically last for **6.4 years**. In reality, however, this would not be the case, since the majority of the demand (82%) is clearly for the mixed sand & gravel material from Quaternary sites which, as explained in Chapter 3 of this report, simply cannot be supplied from the Woburn Sand deposits.

- 4.3 For practical purposes, a very important distinction must therefore be made between the reserves of concreting aggregate and concreting sand within the Quaternary deposits, which will last for only **4.2 years** (from December 2003) at current rates of consumption from those sites, and the reserves of concreting sand at the Woburn Sand pits, which would last for **17 years** at the much slower rates at which that material is currently being used. Even the combined figure of 6.4 years is less than the MPG6 minimum requirement of 7 years, and allowing for the fact that no further reserves of concreting aggregate have been added since December 2003, the landbank can now (December 2005) be expected to have reduced to around 4.4 years, indicating a very marked shortfall. By the same argument, the landbank for Quaternary sand & gravel is now likely to be little more than 2 years.

Building Sand

- 4.4 Total reserves of building sand at the end of 2003 (including asphalt sand but excluding specialist sands and fill material) were 10.920mt, with corresponding sales in 2003 of just 0.407mt, giving a very healthy indicative landbank of **26.8 years**. Virtually 100% of this material is supplied from the Woburn Sand quarries.

Total Aggregate

- 4.5 The total reserves of all aggregate materials within Bedfordshire, including fill materials but excluding all specialist sands, amounted to 18.556mt in December 2003. Based on the corresponding total sales of these materials in 2003 (i.e. 1.531mt), this would represent an overall landbank of just over **12 years**. Even allowing for the subsequent 2 years of production since December 2003, the figure is in excess of the minimum landbank requirement of 7 years. Taken at face value, this would seem to be acceptable in planning terms, *but only if it were accepted that there should be a single landbank for all aggregate materials* (see Chapter 5 for further discussion). It should also be noted that this calculation is based only on a single year's sales information and that the true landbank figure may therefore be different when alternative methods of calculation are used, as discussed below (see especially para. 4.14).

B) Calculations based on apportionment sales requirements

- 4.6 The figures presented above are based only sales figures for 2003, rather than on the average of three consecutive years, as should ideally be used to reduce the influence of short term variations in demand. Unfortunately, consecutive data are not currently available in the level of detail needed for this analysis but an alternative solution, which would enable the foregoing calculations to be seen in a wider context, would be to use the average annual sales needed to meet the total apportionment figure for Bedfordshire over the Plan period, with this being broken down into individual aggregate types in accordance with recent market trends.
- 4.7 From para. 1.7, above, the total aggregates apportionment for Bedfordshire equates to an average annual sales requirement of 1.93mt. This figure is significantly higher than the total aggregate sales figures for 2003, which amounted to 1.429mt, and will therefore inevitably reduce the length of the calculated landbanks.
- 4.8 The corresponding annual apportionment figures for concreting aggregate and building sand can be derived from the total requirement on the basis of the likely split in demand for the two product groups. Historically (see para. 1.18), that split has been approximately equal (i.e. 50:50). As noted earlier, however, industry maintains that *recent* demand for concreting sand in southern England (generally) has been proportionately greater than that for building sand, in a ratio closer to 70:30. This claim is supported by the sales figures for 2003 (Table 3.1, above) which indicate a ratio of 71:29 in favour of concreting aggregate.
- 4.9 Further subdivision of the concreting aggregate figures can only be done, at present, on the basis of the 2003 sales which, as mentioned earlier, revealed that only 18% was from Woburn Sand quarries whilst the majority, 82%, was from Quaternary sand & gravel pits (giving a ratio of 18:82). If this ratio proves not to be representative when similar data for other years is obtained, the calculations will need to be refined.
- 4.10 Subject to that proviso, Table 4.1, below, summarises the resulting landbank estimates for December 2003 based on each of the above methods of calculation.

Concreting Aggregate

- 4.11 For concreting aggregate, the range of calculations shown in Table 4.1 simply reinforce the message that there is already a shortfall of permitted reserves overall and that, for the Quaternary sand & gravel reserves which supply the majority of the market, the shortfall is extremely acute, with these being forecast to become exhausted within **3.1 to 4.4 years** from December 2003. **Replacement of these deposits, whether from the release of new reserves within Bedfordshire or by other means, could therefore be needed from as early as January 2007 onwards.**
- 4.12 By contrast, even at the highest anticipated levels of consumption, the reserves of concreting sand from Woburn Sand pits are not likely to become exhausted until at least the middle of 2016. This suggests that there are ample reserves of this material to support the production of concrete blocks etc throughout the whole of the Plan period.

Building Sand

- 4.13 For building sand, the calculations in Table 4.1 suggest landbank figures of between **11.3 and 26.8 years** from December 2003. If separate landbanks for building sand and concreting aggregate were required, these figures for building sand would be well above the minimum requirement of 7 years, although there may be only limited surplus capacity if the higher demand estimates were to prove the more reliable, and careful monitoring will be needed to keep the situation under review.

	Concreting Aggregate			Building Sand
	TOTAL	Woburn Sand	Quaternary Sand & Gravel	TOTAL
permitted reserves at 31/12/03 (<i>thousands of tonnes</i>)	6,567	3,079	3,488	10,920
A) Landbanks calculated using 2003 sales				
annual sales (<i>tonnes</i>)	1,021,782	181,000	840,782	407,534
Landbank from December 2003 (<i>years</i>)	6.4	17.0	4.2	26.8
B1) Landbanks calculated using apportionment with 50/50 split between concreting/building aggregate and with 18:82 split between Woburn & Quaternary sources (as per 2003 sales)				
annual sales (<i>tonnes</i>)	965,000	173,700	791,300	965,000
Landbank from December 2003 (<i>years</i>)	6.8	17.7	4.4	11.3
B2) Landbanks calculated using apportionment with 70/30 split between concreting/building aggregate and with 18:82 split between Woburn & Quaternary sources (as per 2003 sales)				
annual sales (<i>tonnes</i>)	1,351,000	243,180	1,107,820	579,000
Landbank from December 2003 (<i>years</i>)	4.9	12.7	3.2	18.9
B3) Landbanks calculated using apportionment with 71/29 split between concreting/building aggregate and with 18:82 split between Woburn & Quaternary sources (both as per 2003 sales)				
annual sales (<i>tonnes</i>)	1,372,029	246,965	1,125,063	557,971
Landbank from December 2003 (<i>years</i>)	4.8	12.5	3.1	19.6

Table 4.1: Landbank calculations, from the end of 2003, for available concreting aggregate and building sand reserves in Bedfordshire, based on a range of different assumptions regarding average annual sales.

(Figures for both reserves and sales exclude fill material etc. and all specialist sands).

Total Aggregate

- 4.14 For all aggregate reserves within Bedfordshire, including fill materials but excluding all specialist sands, the apportionment figure of 1.93mt per year, combined with the total reserves of 18.556mt, indicate an overall landbank of **9.6 years** from December 2003. Allowing for a further 2 years of production to December 2005, **this is now only just within the minimum value of 7 years required by MPG6.**
- 4.15 This has important implications for BCC's options for the Minerals and Waste Development Framework. It means that, *unless the apportionment figures are found to be excessive by comparison with actual demand*, the MPA cannot rely wholly on either substitution between building sand and concreting sand sources within the County, or on the importation of aggregates from neighbouring counties. As noted earlier (in para. 1.7), MPG6 states that a landbank of less than 7 years should be taken as an indication that additional reserves need to be permitted within the County.

5. Discussion

- 5.1 The foregoing calculations indicate very clearly that there is currently a shortfall of concreting aggregate reserves overall (and of mixed sand and gravel reserves at Quaternary sites in particular) compared with the minimum requirements dictated by MPG6, and that this shortage is likely to affect the market within the next few years.
- 5.2 By contrast, the reserves of building sand appear to be sufficient for the whole of the Plan period.
- 5.3 These differences highlight the importance of monitoring separate landbanks for the two main types of aggregate (concreting aggregate and building sand) and also for monitoring the differences between concreting aggregate supplies from the two different types of deposit (Woburn Sand and Quaternary Sand & Gravel). Although such monitoring is important, there need not *necessarily* be a formal requirement to maintain separate landbanks at the minimum level required by MPG6, *providing that acceptable alternatives can be developed*.
- 5.4 The options available to Bedfordshire County Council for dealing with the projected shortfall, as the Mineral Planning Authority responsible for maintaining supplies of aggregate needed to support sustainable development, are essentially twofold:
- The release of further reserves of concreting sand & gravel within Bedfordshire in order to 'top up' the depleted landbank(s); and
 - The 'Do Nothing' option (which effectively would mean relying on market forces to solve the problem).
- 5.5 The latter option would only be available if the total aggregates landbank within the County meets MPG6 guidelines. At present, based on demand estimates derived from the County's apportionment figures, the total landbank only just meets the minimum requirement.

Release of Further Reserves of Sand & Gravel within Bedfordshire

- 5.6 The most 'obvious' or conventional option, against which alternatives need to be compared is the notion of releasing new permitted reserves of Quaternary sand and gravel deposits within Bedfordshire.
- 5.7 Four planning applications for the release of a total of 4.88mt of new reserves were submitted to Bedfordshire County Council between 2003 and 2005 and are currently awaiting determination. These comprise:
- Willington - Octagon Farm South (Lafarge, December 2003) – 0.48mt;
 - Broom Quarry extension (Tarmac, March 2005) – 1.4mt;
 - Medbury Farm, Elstow (Cemex (formerly RMC), March 2005) – 1.6mt; and
 - Dairy Farm (Lafarge, March 2005) – 1.4mt.
- 5.8 All of these sites are very close to Bedford (see Figure 5.1, below) and are for the working of very similar deposits to those currently in operation. From both a technical and a locational perspective, these sites are therefore directly comparable to the existing workings, and their release would directly address the most serious current shortfall of Quaternary sand & gravel reserves within the County. Environmental Statements accompany each of the applications and that information can be fed into the wider sustainability appraisal of policy options, to compare against the environmental issues relating to alternative sites (as discussed below).
- 5.9 If all of these applications were approved, the addition of 4.88mt to the total reserves of concreting sand & gravel available at the end of 2003 would bring that total to

11.447mt, representing a landbank of between 8.3 and 11.9 years from December 2003 (using the same range of demand estimates shown in Table 4.1, above). This would equate to landbanks of between 6.3 and 9.9 years from December 2005.

- 5.10 More specifically, the addition of 4.88mt to the December 2003 total of concreting aggregate reserves at Quaternary sites would bring that total to 8.368mt, representing a landbank of between 7.4 and 10.6 years at those sites from December 2003 (again using the demand estimates from Table 4.1). Except in the case of the higher demand projections, this would largely resolve the most acute shortfall, whilst leaving the other landbanks unchanged.
- 5.11 At the pessimistic end of this range, even this would not be sufficient to satisfy MPG 6 requirements when allowance is made for two further years of production up to December 2005, and additional solutions would then need to be found within the near future.
- 5.12 In order to clarify this point it would be sensible to update the landbank calculations to the end of 2005 as soon as possible, by obtaining sales figures for 2004 and 2005 from each of the sites. This would make it possible to revise the reserve calculations and to use an average of three consecutive years of sales to determine the landbanks.

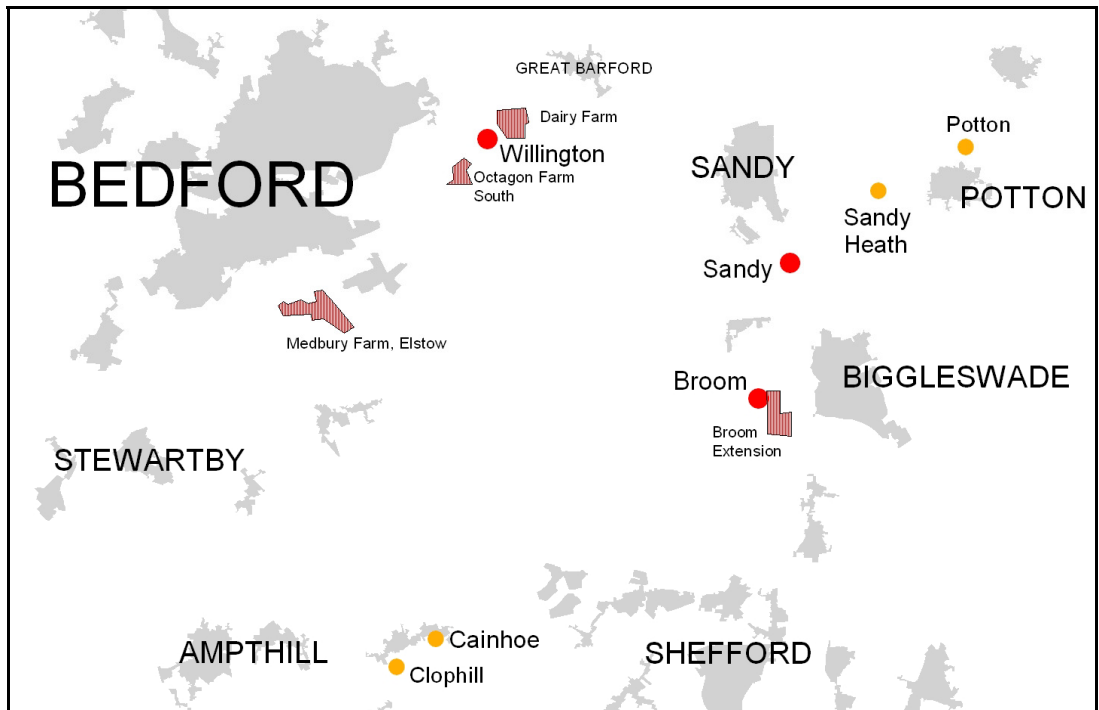


Figure 5.1: Current planning applications for new sand & gravel workings in Bedfordshire, with existing Quaternary sand & gravel quarries (red) and Woburn Sand pits (orange).

The 'Do Nothing' Option

- 5.13 As previously noted, this option would only be open to BCC if it were accepted that a single landbank for all types of aggregate were appropriate for Bedfordshire (see para's. 1.10 to 1.20 in chapter 1, for background).
- 5.14 *If* that were the case, and *if* that total landbank exceeded the minimum MPG6 requirement, it could be argued that there would be no necessity, at present, for the release of new reserves, providing that alternative and acceptable solutions could be found. In practice, the total landbank does exceed the 7 year requirement if based on

sales figures for 2003 (see para. 4.5, above), but it fails to do if higher levels of demand required by the MPG6 apportionment for the County are allowed for (see para. 4.14).

- 5.15 Whether or not the single landbank approach is adopted by BCC, it is useful to examine what the consequences of the 'Do Nothing' option might be. These would depend on the market reaction to the depletion of traditional sand & gravel supplies from within Bedfordshire, which, in turn, would depend on two main factors:
- The extent to which additional material from the Woburn Sand pits could substitute for the shortage in sand & gravel;
 - The extent to which supplies of Quaternary sand & gravel could be economically brought into the markets currently served from the Bedfordshire sand & gravel pits.

Substitution by Woburn Sand

- 5.16 Firstly, as already noted, Woburn Sand is unable to substitute fully for Quaternary sand & gravel deposits because it lacks the essential coarse aggregate fraction that is needed for most concreting applications. This would be a serious limitation, and would be compounded by the fact that even the sand fraction would need to be blended with a sharper sand from other (Quaternary or crushed rock) sources in order to produce an acceptable concrete mix (see para. 2.34, above). Although there are no crushed rock sources within the County, or in any adjoining Counties, such material is imported into Bedfordshire via the rail depot at Elstow, primarily for use in road construction (where a more angular gravel is required in preference to natural gravel). Crushed rock could be blended with Woburn Sand to produce material for concrete production but the cost would be higher and the resulting aggregate would be 'gap-graded' by comparison with natural sand & gravel deposits, i.e. some of the grain sizes would be missing and the concrete would therefore be less satisfactory unless the deficiency were resolved, by the use of additional aggregate of the required grading and/or by the use of additional cement or other additives – all at further additional cost. It therefore seems unlikely that this option would be economically viable. If the coarse aggregate and sharp sand were sourced instead from Quaternary deposits (whether locally, if new reserves were released, or from neighbouring counties) it is likely that those sources would supply all of the mix: in most cases this would be far more logical, for the readymix producers, than blending such material with Woburn Sand.
- 5.17 It should also be noted that Woburn Sand is generally too fine grained and/or too rounded to make satisfactory concrete without significantly increasing cement and water requirements, with corresponding increased costs and environmental implications – both of which would need to be reflected in the overall sustainability appraisal of this option.
- 5.18 It is also reasonable to suppose that, in most cases, Woburn Sand would not be used for concrete if it could otherwise be used for much higher value end uses, as is normally the case. This logic might theoretically be overcome if, as a result of a real shortage and the absence of alternatives, the market price of concreting aggregate within Bedfordshire were to increase substantially. It is unlikely, however, that the construction industry would be able to sustain such a large local price increase: there would instead be a fall-off in demand (e.g. delays to, or relocation of construction projects) which would limit the rise in prices.
- 5.19 The only portion of the Woburn Sand reserves which might be 'immune' from that logic and thus available to be switched from industrial to concrete applications is that found at Garside Sands' operations at Grovebury Road and (to a lesser extent) Munday's Hill. Inspection of the figures in Table 3.2 shows that, even if all of the

reserves currently allocated to specialist uses at these sites were to be made available for concreting applications, this would only extend the concreting aggregates landbank by two to three years (depending on the demand estimates used). In practice, the effect would be even less significant than this because there would be a continuing commercial need for the company to retain its presence in the specialist sands market.

- 5.20 It is concluded that not all (and probably very little) of the reserves at Woburn Sand quarries (other than those already allocated for the manufacture of concrete blocks) would be likely to be switched into additional concrete production, and that there would still be a substantial need for additional material from mixed sand & gravel units within reasonable proximity to the areas of demand currently served.

Substitution by Imported sand & gravel

- 5.21 The possibility that Quaternary sand and gravel supplies might be brought in from neighbouring Counties would seem to be a far more realistic, practical and economic proposition, and would almost certainly come about as a natural market reaction if there was a loss of future production within Bedfordshire. It would not necessarily provide a long term solution, however, and there would be sustainability implications relating to the increased transport distances involved, as explained below.
- 5.22 In the following analysis, it is assumed that the market currently served by the Bedfordshire sand and gravel sites is centred on a point some distance to the south of Bedford, and includes the towns of Milton Keynes, Luton, Hitchin and Letchworth as well as Bedford itself and various smaller settlements within that area (Figure 5.2, below). It is also assumed that the market radius which can be economically served by concreting sand & gravel sources is most commonly within 20 to 30 miles. Whilst these assumptions are probably reasonable, a more definitive economic assessment would need to be carried out before the implications outlined below can be more thoroughly tested as part of the sustainability appraisal of Bedfordshire's MWDF options.
- 5.23 Alternative sources within 20 miles of the centre of the Bedfordshire market, as defined above, are the Quaternary river terrace and floodplain sand & gravel quarries within **Northamptonshire** (Passenham, Bozeat, Earl's Barton, Wollaston, Ditchford, Irthlingborough, Stanwick); and two of those within **Cambridgeshire** (Little Paxton and Buckden). Slightly further distant are other sites within Cambridgeshire (Needingworth Complex, Colne Fen, Somersham); the Kesgrave Formation fluvial sand & gravel sites in **Hertfordshire** (Westmill, Panshanger, Water Hall, Bedwell Park, Hatfield, Tyttenhanger and Westwood); and the river gravels at Bois Moor Road in **Buckinghamshire**.
- 5.24 All of these sites supply primarily to the concreting market and a number of them already supply into Bedfordshire. There would therefore be no difficulties in maintaining the *status quo* in terms of performance and customer satisfaction. However, by comparison with the existing Bedfordshire sites (and those for which planning applications are currently pending), all of these alternative quarries are located two or three times further away from the centre of the Bedfordshire market.
- 5.25 The Northamptonshire and Cambridgeshire quarries, in particular, are located further away from all of the major urban areas within that market (except for Milton Keynes, in the case of some of the Northamptonshire pits). The Hertfordshire quarries are roughly the same distance away from the Luton, Hitchin and Letchworth markets, compared with the Bedfordshire sites, but are further away from Milton Keynes and Bedford.

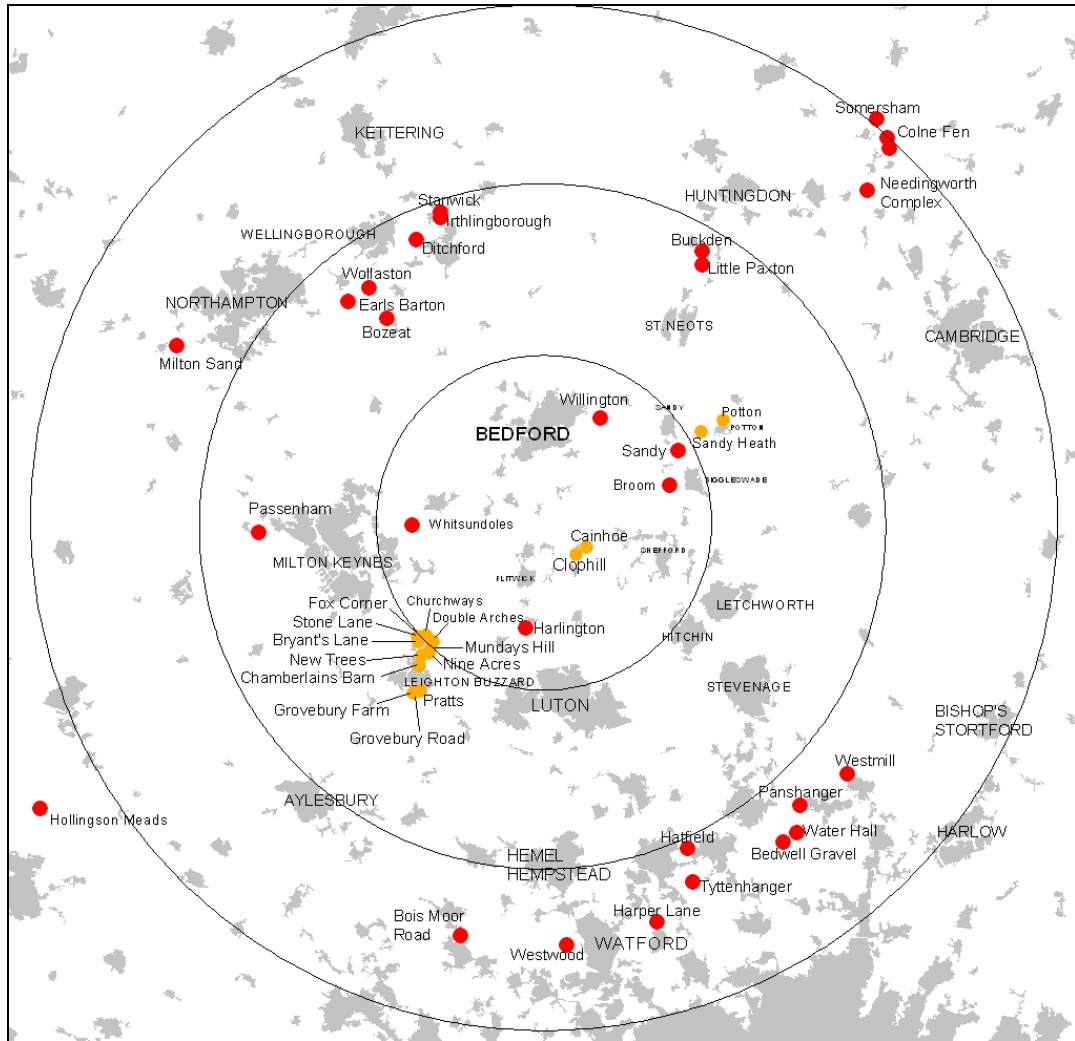


Figure 5.2: Quaternary sand & gravel quarries (red) and Woburn Sand pits (orange) within 10, 20 and 30 mile radii of the approximate centre of the Bedfordshire concreting aggregate market.

- 5.26 Overall, it seems inevitable that, if reliance were placed on imports of sand and gravel from these neighbouring Counties, the average transport distances would be increased, compared to the existing situation. Another way of demonstrating this is to compare the markets capable of being served within a nominal 10 mile radius of each of the quarry locations. This is illustrated in Figure 5.3, below, which shows the combined 10 mile radii of all Bedfordshire quarries (purple outline) and similar combined radii of nearby sand & gravel pits in the neighbouring counties (yellow shaded areas). The area of purple shading in the centre of the diagram, which includes most of Bedford and Luton, together with Hitchin, Letchworth and all intervening settlements, represents the area which could only be served from other sources by means of increased transport distances.
- 5.27 The increased lorry-miles needed to supply from the alternative sources would have direct economic implications (in terms of increased aggregate prices) and would also give rise to a range of increased environmental impacts (carbon emissions, fossil fuel consumption, traffic nuisance etc.). These effects, and their overall sustainability implications for the comparison of this scenario with the alternative of releasing new reserves within Bedfordshire, need to be assessed in greater detail as part of a wider sustainability analysis of Bedfordshire’s policy options.

- 5.28 More detailed consideration also needs to be given to the longer term practicalities of relying on imported sand and gravel if that option were to be chosen. All of the quarries mentioned above have existing markets to serve elsewhere, and any additional requirements for them to supply into Bedfordshire would increase the rate of depletion of their reserves. In many cases, those reserves are already limited and all of the Counties involved are faced with a need to release new reserves, simply to satisfy existing projections of demand (which do not allow for additional supplies to compensate for the cessation of production within Bedfordshire).
- 5.29 In the case of Northamptonshire, in particular, the options for releasing new reserves are becoming increasingly limited, as existing river terrace deposits in accessible locations are worked out and as greater reliance has to be placed on glacial deposits which are more difficult to work and may be of inferior quality. Unworked resources within Cambridgeshire and Hertfordshire are more plentiful but their exploitation is increasingly restricted by important environmental constraints. Unless the environmental impacts of working those resources would be any less significant than those relating to sites within Bedfordshire, such working would create further sustainability 'losses' in addition to those associated with increased transportation. This is another issue which would need to be addressed more thoroughly in the main sustainability appraisal of policy options.

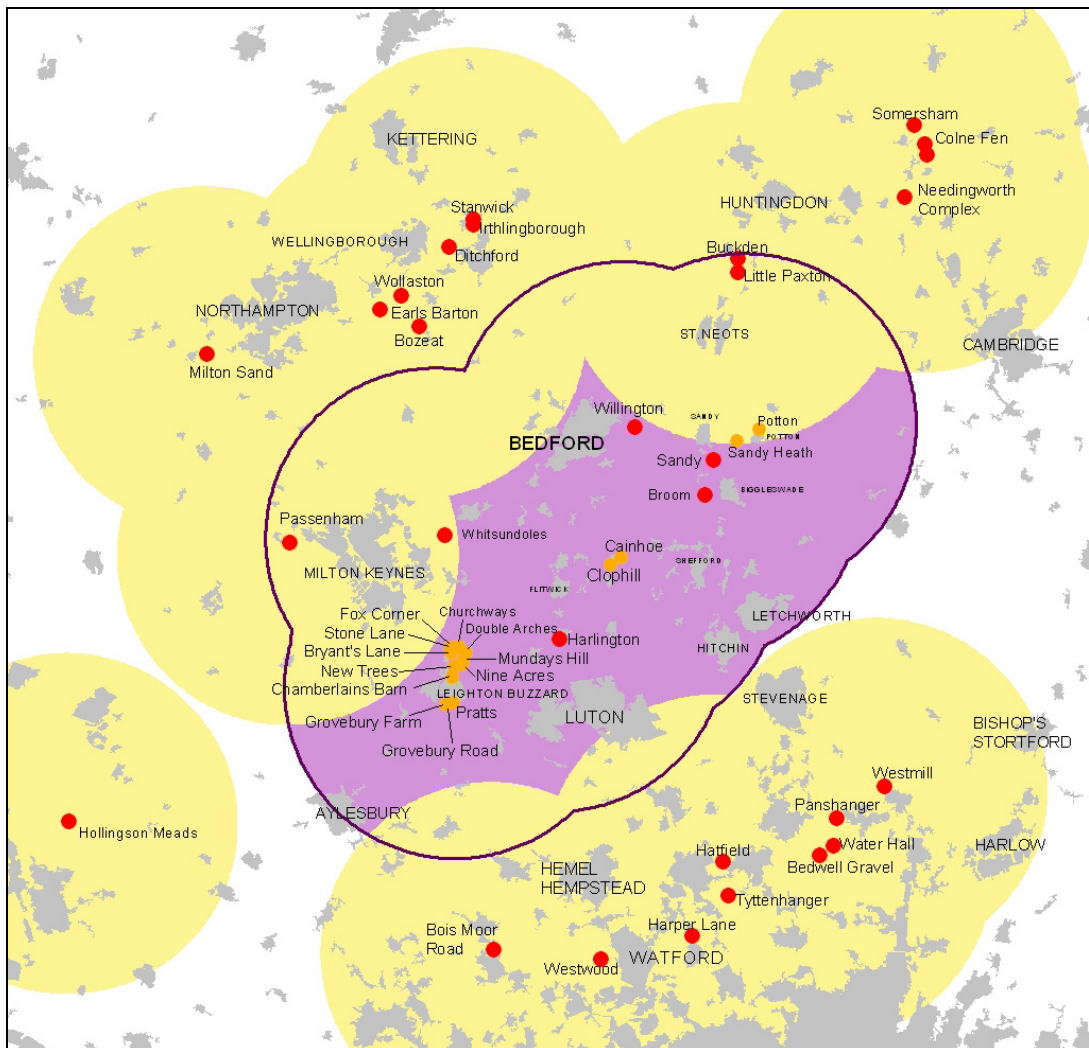


Figure 5.3: Comparison of the market areas capable of being served within a nominal ten mile radius of existing quarries in Bedfordshire (purple) and neighbouring counties (yellow).

6. Conclusions

- 6.1 This study has been able to refine the information available to BCC regarding the breakdown of both Woburn Sand and Quaternary sand and gravel reserves within Bedfordshire, in terms of their suitability and likelihood of being used in different applications. Previously, one third of the total permitted reserves in the County – mainly at Woburn Sand pits within the Leighton Buzzard area – were regarded by BCC as being ‘undifferentiated’ in terms of their probable end use. This has now been substantially refined, particularly in terms of the proportion of those deposits which can realistically be expected to contribute to the concreting market.
- 6.2 This has helped to confirm that there is a very clear shortfall of concreting sand & gravel reserves within Bedfordshire but, more importantly, that this relates primarily to the Quaternary sand & gravel deposits which are essential for the manufacture of most concrete products. Existing permitted reserves in those deposits are forecast to become exhausted within 3.1 to 4.4 years from December 2003. Replacement of these deposits, whether from the release of new reserves within Bedfordshire or by other means, could therefore be needed from as early as January 2007 onwards, and a strategy for resolving this issue is needed as a matter of urgency.
- 6.3 By contrast, the reserves of concreting sand from Woburn Sand pits are not likely to become exhausted until *at least* the middle of 2016. This suggests that there are ample permitted reserves of this material (which are used primarily to support the more limited production of concrete blocks) for the whole of the Plan period. These deposits are largely unable to contribute to the more general concreting aggregate requirement because of grading and other differences which create both practical and sustainability problems.
- 6.4 For building sand, the calculated landbank figures are between 11.3 and 26.3 years from December 2003. If separate landbanks for building sand and concreting aggregate were required, these figures for building sand would be well above the minimum requirement of 7 years, although there may be only limited surplus capacity if the higher demand estimates were to prove the more reliable, and careful monitoring will be needed to keep the situation under review.
- 6.5 These differences highlight the importance of monitoring separate landbanks for the two main types of aggregate (concreting aggregate and building sand) and also for monitoring the differences between concreting aggregate supplies from the two different types of deposit (Woburn Sand and Quaternary Sand & Gravel). Although such monitoring is important, there need not *necessarily* be a formal requirement to maintain separate landbanks at the minimum level required by MPG6, *providing that acceptable alternatives can be developed*.
- 6.6 The options available to Bedfordshire County Council for dealing with the projected shortfall are essentially twofold:
- The release of further reserves of concreting sand & gravel within Bedfordshire in order to ‘top up’ the depleted landbank(s); and
 - The ‘Do Nothing’ option (which effectively would mean relying on market forces to solve the problem).
- 6.7 The latter option would only be available if the total aggregates landbank within the County meets MPG6 guidelines (if it doesn’t, the MPA is obliged to take action). At present, for all aggregate reserves within Bedfordshire, including fill materials but excluding all specialist sands, the overall landbank is calculated to be between 9.6 and just over 12 years from December 2003, depending on the demand estimates used.

Allowing for a further 2 years of production to December 2005, the lower end of this range is now only just within the minimum value of 7 years required by MPG6.

- 6.8 This has important implications for BCC. It means that, *unless the apportionment figures are found to be excessive by comparison with actual demand*, the MPA cannot rely wholly on either substitution between building sand and concreting sand sources within the County, or on the importation of aggregates from neighbouring counties. In order to maintain compliance with both MPG6 guidelines and the apportionment requirements, at least some additional reserves will need to be permitted within the county, either instead of or as well as other alternatives.
- 6.9 **In view of this, and in view of the acute urgency of the shortfall in Quaternary sand & gravel reserves, it is recommended that further reserves of such material should be permitted as quickly as possible.**
- 6.10 Once the immediate shortfall has been addressed, the total aggregates landbank within the County will be acceptable, and both of the options noted above then become available for the purposes of future strategy.
- 6.11 **The release of further reserves within Bedfordshire (beyond those associated with the current applications) will need to be seriously considered as part of the MWDF process. Based on the analysis presented in this report, it is logical that these should be sought from remaining areas of Quaternary sand and gravel deposits within the County, and not from deposits within the Woburn Sand Formation.**
- 6.12 The 'Do Nothing' alternative would be justified, in theory, once the total aggregates landbank meets MPG6 requirements, but that would not necessarily produce an acceptable or more sustainable solution. The most likely outcome of this option would be the increased supply of concreting sand and gravel from neighbouring Counties (the alternative of substitution from Woburn Sand deposits having been largely discounted). **The acceptability of increased reliance on imported aggregates will depend on the outcome of a more detailed assessment and sustainability appraisal that will need to be carried out as part of the MWDF process.** This, however, cannot be undertaken until specific sites (or at least preferred areas) for potential future extraction have been identified within Bedfordshire.

Dr. Alan Thompson, B.Sc., Ph.D., C.Geol. FGS

The logo for Cuesta Consulting Ltd. features the word "Cuesta" in a blue, serif font. A green, wavy line starts under the 'e' and extends to the right, ending under the 'a'.

Director, Cuesta Consulting Ltd.

January 2006

Appendix A: List of Information Sources Used

Bedfordshire and Luton Minerals & Waste Local Plan. *First Review, Adopted January 2005.* Bedfordshire County Council. 129pp.

Bedfordshire and Luton Minerals & Waste Local Plan Inquiry. *Inspector's Report.* 108pp.

Benham, Morigi, Barron, Cameron, Spencer, Shaw, Bloodworth, Lott and Highley, 2003: **Mineral Resource Information in Support of National, Regional and Local Planning: Buckinghamshire & Milton Keynes.** *British Geological Survey, Commissioned Report CR/03/77N.* 12pp + 1:100,000 scale map.

Benham, Morigi, Bloodworth, Cameron, Spencer, Evans, Lott and Highley, 2003: **Mineral Resource Information in Support of National, Regional and Local Planning: Hertfordshire & Northwest London Boroughs.** *British Geological Survey, Commissioned Report CR/03/075N.* 11pp + 1:100,000 scale map

Bloodworth, Cameron, Morigi, Highley & Holloway 2000: **Mineral Resource Information for Development Plans: Phase One Northamptonshire – Resources and Constraints.** *British Geological Survey, Technical Report WF/00/4.* 36pp + 1:100,000 scale map.

Harrison, Henney, Cameron, Spencer, Steadman, Evans, Lott and Highley, 2003: **Mineral Resource Information in Support of National, Regional and Local Planning: Cambridgeshire (comprising Cambridgeshire and the City of Peterborough).** *British Geological Survey, Commissioned Report CR/02/131N.* 14pp + 1:100,000 scale map.

Highley & Cameron, 1995: **Mineral Resource Information for Development Plans: Bedfordshire – Resources and Constraints.** *British Geological Survey, Technical Report WF/95/2.* 20pp + 1:100,000 scale map.

Moorlock, Sumbler, Woods & Boreham, 2003: **Geology of the Biggleswade District: A Brief Explanation of the Geological Map.** *Sheet Explanation of the British Geological Survey 1:50,000 Sheet 204 Biggleswade (England & Wales).* 26pp + 1:50,000 scale map.

Richardson, 2003: **Bedfordshire Sands.** *Memo to Duncan Wardrop of Lafarge Aggregates Ltd., detailing the results of concrete trials using alternative sands* 6pp.

Samuel, 1982: **A preliminary study of the sand and gravel deposits of part of the Ouse valley in Bedfordshire, Buckinghamshire and Northamptonshire.** (1:25,000 sheets SP 84, 85, 95 and TL 05). *Institute of Geological Sciences, Keyworth.* 22pp + 1:25,000 scale map.

Shephard-Thorn, Moorlock, Cox, Allsop & Wood, 1994: **Geology of the Country Around Leighton Buzzard.** *Memoir of the British Geological Survey, Sheet 220 (England & Wales).* 128pp + 1:50,000 scale map.

Wardrop, 2003: **Bedfordshire Mineral Local Plan, December 2003: Photographs of Bedfordshire Construction Sand.** *Report submitted to the Local Plan Inquiry on behalf of Lafarge Aggregates Ltd.* 6pp.