AGGREGATE RESOURCE ALTERNATIVES: FUTURE OPTIONS FOR MEETING AGGREGATE MINERALS SUPPLY FROM OUTSIDE NATIONAL PARKS AND AREAS OF OUTSTANDING NATURAL BEAUTY.

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Abstract

The town and country planning system aims to make the best use of land for society as a whole, taking into account a wide range of issues which have a land use dimension; by sustaining the natural environment in which those activities take place; and, by managing the resources on which they depend. As mineral resources, and particularly construction mineral resources (principally aggregates), are used to create the 'goods' that society 'needs' (e.g., housing and infrastructure development), the working of mineral resources is necessary.

Planning for, and the working of aggregate minerals can be a contentious issue with regulators, industry and society, particularly where mineral extraction is undertaken or proposed in areas of high landscape / ecological value. Applications for the working of minerals in such areas come under particularly close scrutiny.

This work, funded through the Aggregates Levy, analysed data on the current distribution, sales and reserves of primary, land-won aggregates in England in respect of the contribution made from quarries that are inside National Parks and Areas of Outstanding Natural Beauty. It also assessed the future potential, and issues surrounding possible alternative supply options for meeting the quantity of aggregates currently supplied from these designations. Such options include extraction from indigenous resources which lie outside National Parks and AONBs, intra-UK imports from Wales, Scotland and Northern Ireland, imports from outside the UK, marine dredging, secondary and recycled aggregates.

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Introduction

A significant amount of the land area of England has been designated for its environmental or cultural heritage. These environmental designations range from international designations, through national designations to (non-statutory) designations of local importance. In total, 24% (30,868 km^2) of England has either been designated as a National Park or an Area of Outstanding Natural Beauty (AONB).

Minerals Policy Statement 1 (MPS1): Planning and Minerals (Department for Communities and Local Government, 2006), sets out the Government's objectives and national planning policies for minerals. One of the national policies stated in MPS1 is to 'protect internationally and nationally designated areas of landscape value and nature conservation importance from minerals development other than in exceptional circumstances'. This includes proposed major mineral developments in National Parks and AONBs where consideration of applications for mineral working require an assessment of:

- the need for the development, including in terms of national considerations of minerals supply and the impact of permitting it, or refusing it, upon the local economy;
- the cost of, and scope for making available an alternative supply from outside the designated area, or meeting the need for it in some other way;
- any detrimental effect on the environment, the landscape and recreational opportunities and the extent to which it could be moderated.

The effect of applying this legislation will be a progressive decline in the volume of aggregates from environmental designations as existing quarries become worked out.

This paper describes the contribution aggregates workings in National Parks and AONBs makes to national supply. It also presents the results of a spatial assessment of aggregates resource availability before summarising both the future potential, and issues surrounding, possible alternative supply options for meeting the quantity of aggregates currently supplied from these two national environmental designations.

The interaction between aggregates quarries, resources and environmental designations

Resources of material suitable for use as primary aggregates in England comprise land-won sand and gravel, and crushed rock (primarily limestone, igneous rock and, in more minor amounts, sandstone). England is fortunate in having large resources of primary aggregates, all of which make an important contribution to supply. Aggregates extracted from quarries within National Parks and AONBs contribute to land-won supply. In 2005 they accounted for 24% (987.6 Mt) of total permitted reserves and 16% (22.6 Mt) of sales (BGS, 2007). Table 1 shows the breakdown of sales and reserves by mineral type.

Aggregate types	% of sales affected	% of reserves affected	% of resource affected	% of quarries affected
Sand and gravel	4	7	10	6
Crushed rock	25	27	44	26
of which limestone	*32*	*30*	*36**	*25*
of which igneous	*8*	*21*	*83*	*26*

*Sixty one percent of carboniferous limestone resource is affected.

Table 1 . *Interaction between National Parks and AONBs with England's Aggregates supply.*

By combining the BGS mineral resource data with data delineating the extent of National Parks / AONBs in England and larger settlements where surface mineral extraction is unlikely to be possible analysis was undertaken to calculate levels of interaction. The impact by main aggregate type are summarised in Table 1. In total 22% of sand and gravel resources and 43% of crushed rock resources are covered either by a National Park, AONB and / or urban area. For all limestone resources the proportion covered is 36%. However, for the Carboniferous limestone and igneous rock resources, the most important sources of crushed rock aggregates in England, the proportions covered are 48% and 62% respectively. (If the internationally designated Natura 2000 sites and nationally designated Sites of Special Scientific Interest are also included in the analysis the proportions covered rise to 27% and 52% respectively for sand and gravel and total crushed rock resources and 65% and 84% for the Carboniferous limestone and igneous rock resources).

There are 767 active quarries in England extracting aggregates either as the main product from the quarry or as a by-product of other quarrying (for example, building stone). Of these, 468 are sand and gravel and the remainder are crushed rock quarries. Seven percent of sand and gravel quarries and 26% of crushed rock quarries are located either inside a National Park or an AONB (Table 1 and Figure 1).

Assessing the decline in aggregates output from land with major environmental designations

Depending on reserves and outputs, individual quarries in designated areas will become exhausted at different times and the decline in sales from these quarries will have to be met from elsewhere. This will either mean the quarries themselves receiving planning permission for extensions to increase their reserves and allow continued production, or require a take up of the shortfall by other quarries within or outside the environmental designation, thus increasing the rate of depletion on their own permitted reserves. Replacement of the resource in the designated areas by one means or another is important for long-term supply. Of the 102 currently active quarries in National Parks and AONBs, only 53 will remain in production in 2020, and only 40 have permissions that run to 2042 - the statutory end-date set in 1982 for all minerals permissions of indeterminate length at that time. To operate beyond this, a permission with a later end-date is required. The effect of 2042 is not limited to the designated areas of constraint in minerals working, but adds generally to the long term need for new supplies to meet future demand. Only three quarries have permission end dates beyond 2042. In order to obtain an indication of the effects of this decline on aggregates supply, an analysis was undertaken for limestone extraction in the Peak District National Park (PDNP).

The Carboniferous limestone is by far the largest source for crushed rock aggregates in England. However, it is also associated with high quality landscapes and as such much of the resource lies within designated areas. The limestones of the Peak District, in the East Midlands Region, possess good geological qualities for use as crushed rock aggregate, but more importantly they are in a central location that means they help to meet the demand for aggregates from the surrounding regions.

The PDNP was chosen for analysis because 58% of total sales of aggregate from National Parks are extracted from quarries associated with it. The PDNP also contains the largest permitted reserves of crushed rock of any single designation (22% of total reserves for all designations and 61% of National Park reserves).

Figure 2 shows the predicted decline in sales (for aggregate uses) from limestone quarries in the PDNP Mineral Planning Authority as a result of assumed depletion of reserves. The chart is based on sales and reserves data for active quarries as they were in 2006. It assumes that sales remain at 2006 levels and that no additional reserves are released.

Such an analysis is useful in that it provides an indication of the decline in sales of aggregates from the National Park. The analysis indicates that existing quarries in the PDNP will continue to make a substantial contribution to the supply of aggregates into the future. As reserves are worked out or permissions expire, sales from the PDNP will gradually decline over the years, beginning in 2009. By 2011 sales from the PDNP are predicted to be around 80% of current levels. This equates to a decline in sales of around 1 Mt. By 2014 the decline increases further and then remains constant until 2030 when the decline in output from 2006 levels will be over 2 Mt (~45% of current sales). As sales from the PDNP decline they will need to be met from alternative sources (assuming no further aggregates permissions within the National Park).

Figure 3 depicts the predicted decline in permitted reserves over the same period. It also assumes sales remain constant at 2006 levels and no additional reserves are granted.

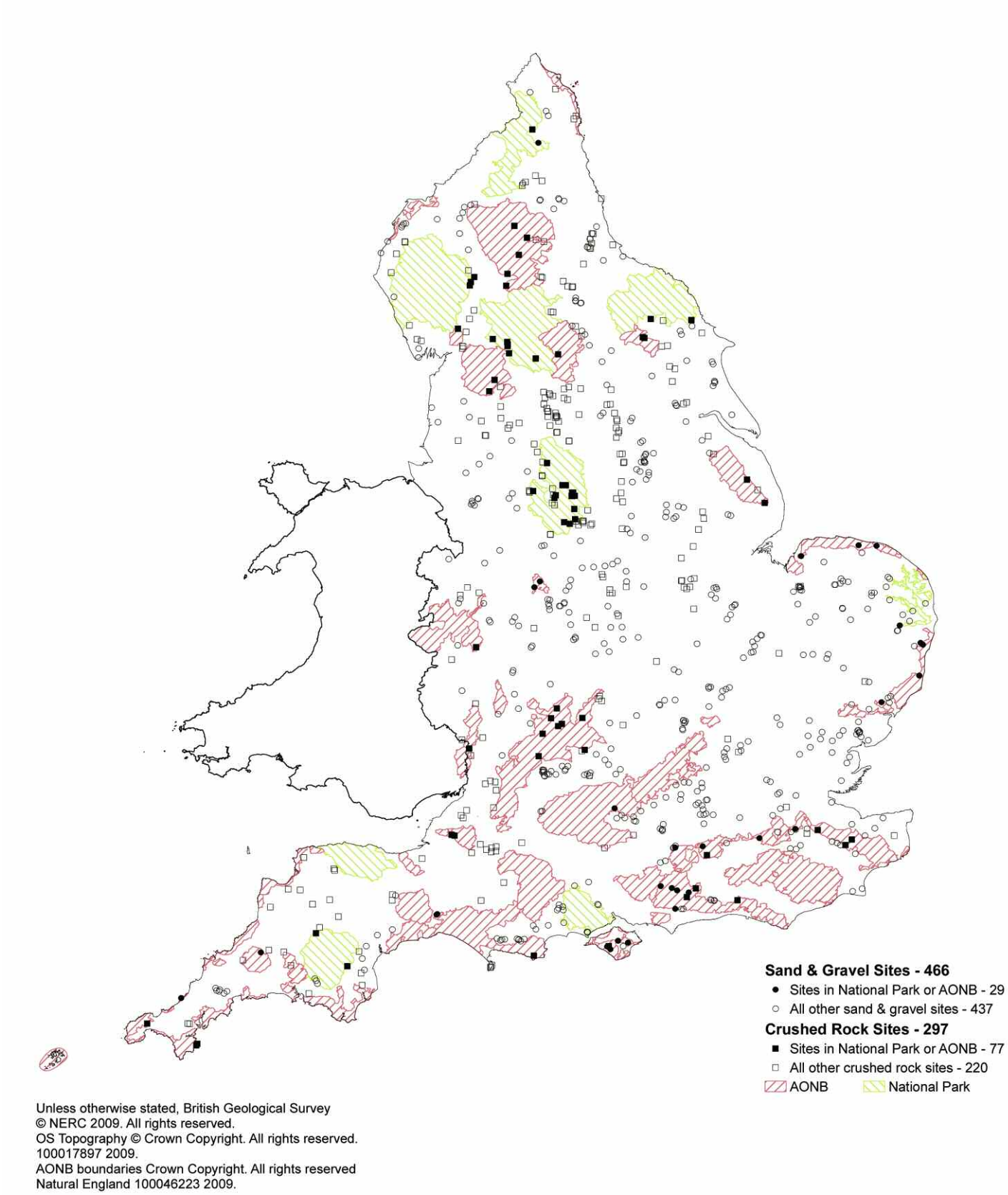

Figure 1. *Active aggregates quarries in relation to National Parks and AONBs.*

Such an analysis allows the conclusion to be drawn that the need for reserves in designated areas to be replaced by some kind of alternative supplies will be spread over many years. In practice, areas outside designated areas face a similar issue of the need to find additional reserves to replace those worked out (Thompson *et al.*, 2008). Due to the large reserves within designated areas, there is already a somewhat more pressing issue outside the designated areas in addition to making up for the decline within designated areas.

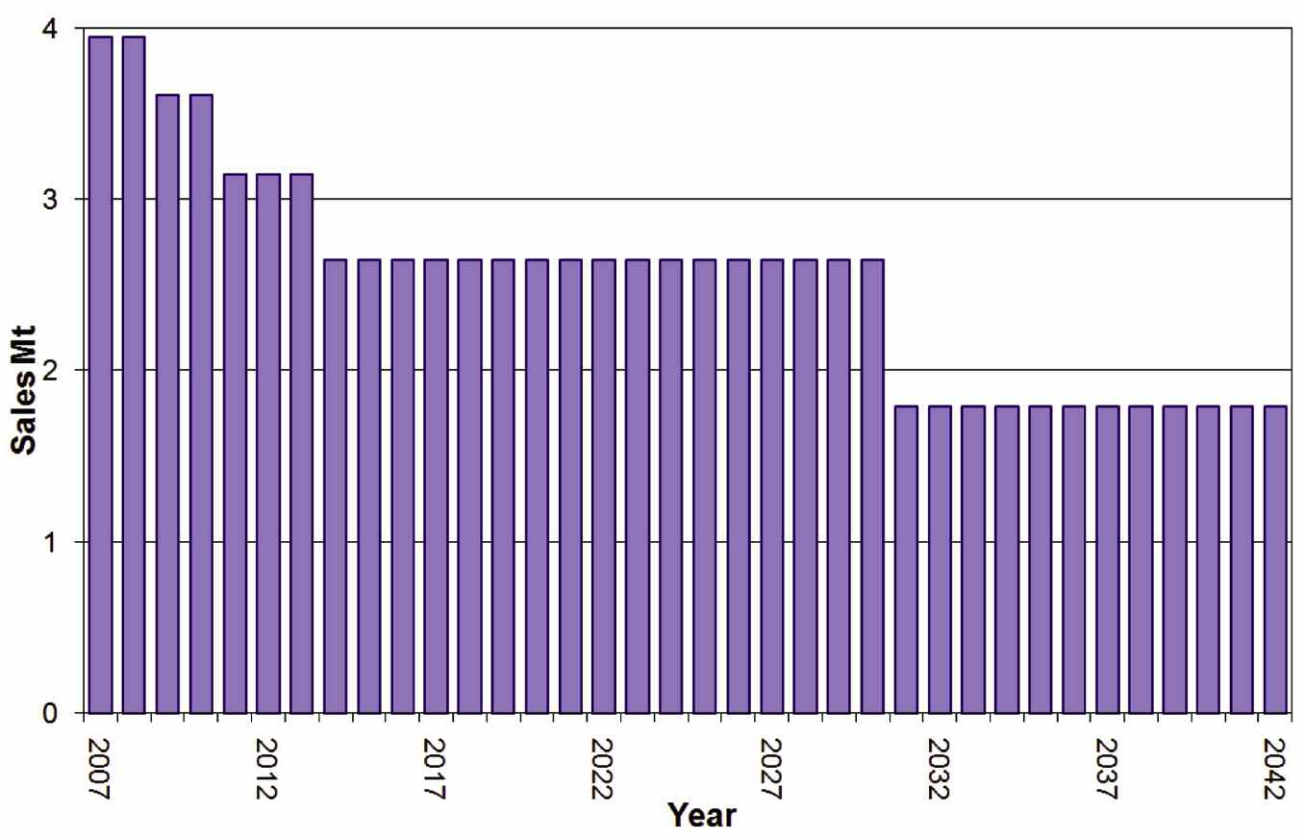

Figure 2. *Predicted decline in limestone aggregate sales for the Peak District National Park. (Assuming sales remain constant at 2006 levels and no additional reserves are released).*

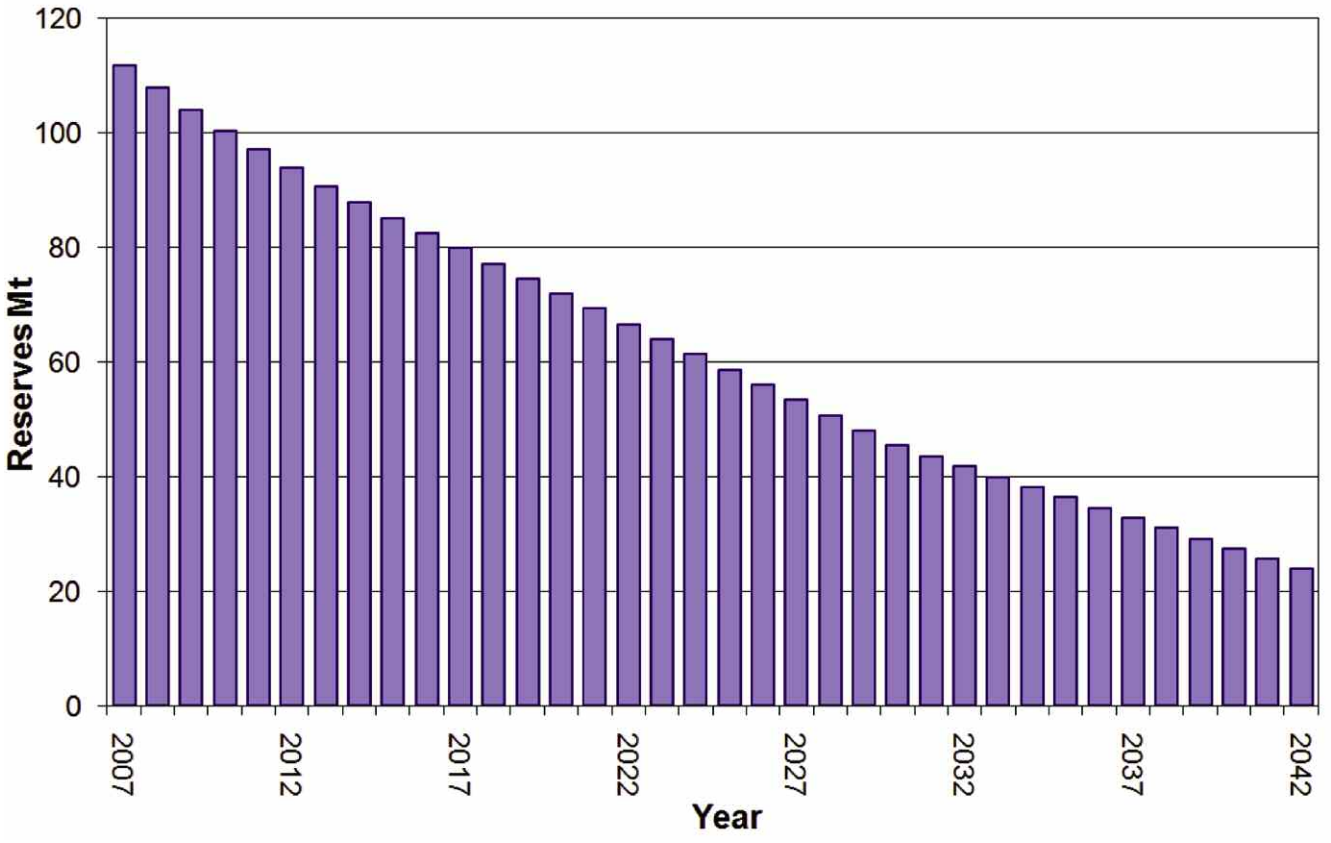

Figure 3. *Predicted decline in limestone aggregate permitted reserves for the Peak District National Park. (Assuming sales remain constant at 2006 levels and no additional reserves are released).*

Options for future supply

A managed aggregates supply system is operated in conjunction with the planning system to ensure a steady and adequate supply of aggregates that meets anticipated need. A diverse mix of aggregates sources contribute to overall supply in England. Supply from indigenous primary aggregates sources – crushed rock, land-won sand and gravel and marine sand and gravel has fluctuated with demand. Sales of primary aggregates from National Parks and AONBs contribute to England's supply of aggregates. As these traditional supply sources become run down, then other sources within the region or further afield will be required to contribute the extra supplies. Any alternative source of aggregates would ultimately need to be able to meet the existing consumption patterns. This section summarises both the potential and issues surrounding possible alternative sources of aggregates should the traditional supply sources from National Parks and AONBs become curtailed once current permissions expire.

Land-won aggregates from outside environmental designations

Land won primary aggregates extracted from quarries located outside National Parks and AONBs make the largest contribution to the supply of aggregates in England, 118 Mt in total (in 2005). Quarries work at a rate closely related to market requirements and therefore output will fluctuate with time. Historically, total sales of aggregates from within and outside designations have been higher, reaching a peak in 1989 (220 Mt, total land-won). Thus if quarries located outside designations increased production to previous levels, would it be sufficient to meet any decline in output from National Parks and AONBs? Within England there are 767 quarries producing aggregates. Around 30 of these quarries currently produce (or are capable of producing) one million tonnes, or greater, every year. Between them they account for around 50 Mt of aggregates. A survey of these quarries has indicated that there is generally extra capacity to increase supply. Outputs for individual quarries could be increased by between 10 and 60% without extra investment in additional plant and machinery (but maybe with the requirement to invest in more labour / additional shifts). However, several quarries also indicated that there was no spare capacity to increase output. Using the information obtained it would appear that there is potential to provide (from the large quarries located outside of National Parks and AONBs) an additional 10 to 12 Mt/y over current output levels. This increased output may not necessarily be across the full product range and, in particular, additional production of premium products may be constrained.

If the market justified further investment in plant, machinery and, where appropriate, rail infrastructure then outputs could increase further. However for this to occur, industry requires certainty about the life of such facilities. In addition, any investment in these quarries to raise outputs higher would have to undergo an assessment of the cost and benefits between the additional revenue that would become available from higher output versus the reduced lifetime of the quarry. In the absence of additional reserves, this would affect any decisions to invest.

Recycled and secondary aggregates

Secondary and in particular recycled aggregates make an important contribution to the supply of aggregates in England and help reduce the rate at which primary aggregate resources are depleted. The uses to which such alternative aggregates can be put has generally been restricted to low quality applications (e.g. fill). Whilst recycled materials are not prohibited in the various specifications (for example BS, CEN and ISO standards), historically overspecification often resulted in the unnecessary exclusion of materials. However, over recent years the range of recycled aggregate products has grown and expanded from low performance fills to landfill capping and road sub base (WRAP, 2006). Investment by recycled aggregate producers is further increasing this quality product range into materials for concrete and even decorative aggregates.

With policies of promoting and maximising the use of secondary and recycled aggregates there has been an increase in the total quantities utilised. In England, 48.9 Mt of recycled aggregates and 6.9 Mt of secondary aggregates were utilised in 2005 (Capita Symonds, 2006). Recycled and secondary aggregates contributed 26% of the total aggregates supply in England; the majority of which was recycled aggregates. This is the highest rate in Europe. Any increase in the supply of recycled and secondary aggregates will be dependent on the identification of additional sources of supply (the principal limiting factor affecting future supply), MPAs allocating sites for recycling facilities, and further planning permissions for recycling facilities being granted. With these limitations the amount of potentially available secondary and recycled aggregates being utilised is likely to be reaching its maximum. Additional secondary and recycled aggregates that could be supplied in the future has been estimated to be around 7 Mt/y (based on 2005 sales rates).

Marine-dredged sand and gravel

Marine aggregates have made an important contribution to aggregates supply in England. They currently contribute 9% (13.7 Mt) of total primary aggregates supply. Permitted reserves of coarse marine aggregate in 2005 were 114 Mt (Crown Estate, 2006) which was equivalent to around eight years production, thus limiting supply in the medium to long term. These concerns have been reduced with the award of 11 new dredging permissions during 2006/07. Permitted reserves of coarse aggregate in these new licences are 47 Mt (Highley et al., 2007). This represents the maximum permitted during the first five years of the licence only. The total volume of workable aggregate within these licensed areas is very much larger, but whether this is permitted to be worked will depend on the outcome of the five-year review of licence areas.

The marine aggregates industry makes a crucial regional contribution to sand and gravel supply in London, South East England and North West England. London (41% of total primary aggregates consumption) and the South East (27% of total primary aggregates consumption) have the highest dependency on marine aggregates and about 70% of total England sales of marine sand and gravel are landed in these two regions. In addition 6 Mt/y of aggregates are exported to Europe. Both England and export landings have been relatively

uniform over the last 10 years which is a reflection of both market needs and, more recently, the capacity of the dredging fleet.

The UK Government's vision of improving the way in which the marine environment is planned, managed, regulated and protected is demonstrated by the development of a new Marine Bill (Defra, 2008). The proposed Bill will introduce a new system of marine spatial planning that is considered essential for sustainable use of the seas and to deliver an effective and coherent approach to the management of the marine environment. Therefore, the policies within which the marine aggregates industry operates will be changing.

Notwithstanding the uncertainty surrounding the new Marine Bill (Defra, 2008) marine sand and gravel dredging has the capacity to continue to make a vital contribution to supplies of aggregates in England for the medium term. Wharves have some spare production capacity and providing that the aggregates can be distributed from the wharves quickly enough, are able to increase their throughput by continuous processing and extending working hours. In this respect, the industry considers that capacity at sand and gravel wharves will not limit its ability to supply additional marine aggregate in the short to medium term (Highley et al., 2007). One key constraint on the ability of the industry to deliver more aggregates, however, is the dredging fleet which, today, is operating to capacity. In the short term the hiring of vessels (working under contract to dredge aggregates from a third party's licence area) would allow an increase in capacity and thus the volume of aggregates delivered. There could also be an immediate boost to domestic supplies if the 6.5 million tonnes exported to Europe in 2005 was diverted to English ports. Any such move is heavily dependant on relative prices and operators' market strategies. For example, prices in England would need to be sufficient to compensate for the potential loss of long-term continental markets. If indications were that the market share for the marine industry could increase then the required long-term investment in new (additional) fleet capacity would occur.

Importing aggregates

England currently imports 5% of its aggregates needs (10.7 Mt in 2005). The principal source of these imports is Wales (6 Mt) with more modest amounts coming from Scotland (1.5 Mt), Norway (1.8 Mt) and (as a source of high PSV roadstone) Northern Ireland (1 Mt). There is no presumption in planning against increasing imports of aggregates from Wales or Scotland should the market demand it. Although for Wales it is constrained by the capacity to supply within limits stated in policy. However, applications for extensions and new permissions primarily aimed at meeting the English market where home demand is already being met is likely to lead to sensitivities.

The major constraint on the ability of overseas sources on exporting more aggregates to England is not the ability to supply, but more the capacity of the receiving crushed rock wharves to unload, stockpile and distribute the aggregates. There are fewer wharves with the capacity to land large volumes of crushed rock when compared with the number of large sand and gravel wharves. Berth side depth for the ships required to make importing crushed rock economical and land available for storage is limited. Although, if demand were sufficient, an element of double handling of aggregates (unloading from a large transport ship onto a smaller barge or ship for final delivery into a wharf) could contribute. This is further exacerbated as the cost of a bulk item such as aggregates is very sensitive to both transport logistics (overseas sources of crushed rock are further from the market) and to competition for wharf space from higher value commodities such as coal, liquefied natural gas and container freight. As for marine sand and gravel, with the high costs associated with investments in new ships the industry requires a guaranteed long term market to justify such investment. Unless they are carrying higher value aggregates (e.g. high PSV roadstone) ships with a capacity in excess of 15,000 tonnes are required for it to be economical to import crushed rock aggregates. The principal overseas source of aggregates is Norway where the trend in the amount imported into England has increased since the early 1990s (albeit that the volumes are small). With investment and favourable prices this could be increased. However, Brown et al., (2008) note that there would be considerable difficulties in expanding large port capacity to handle even a proportion of mainstream English aggregate requirements.

With current infrastructure / number of wharves and concerns over maintaining aggregates quality the maximum additional amount of crushed rock aggregates that could be landed is estimated at an additional 2 – 3 Mt/y.

Underground mining

Currently not utilised as a source for aggregates in England, the underground mining of aggregates need not be discounted as a potential supply option. The Verney Committee recommended the possibility of underground mining of aggregates in 1976 (Verney Committee, 1976). To date there has been no underground production of aggregates in England, but it remains a long term option and one that is currently under consideration.

Given the restricted outcrop extent for certain strategically located quarries in England (if both economic and geological conditions were favourable), as existing reserves become depleted their extension / conversion to underground extraction may become a realistic option in order to meet a proportion of future demand requirements. If the amount of overburden exceeds 25 metres then underground mining becomes more of an attractive proposition (McCraig, 2003). Such sites would also benefit from the existence of aggregate processing plants, transportation infrastructure and established markets. However, the possibility of completely new mines need not be discounted. The concept is adopted policy in Kent as a means of securing long term supplies of construction aggregates and some feasibility work is continuing.

The economic feasibility of underground mining of aggregates is less clear with varying estimates of the costs of extraction by surface quarrying and underground mining. Indications are that even with easy mining conditions the likely costs of underground mining would be at least 20% higher than surface quarrying. Therefore,

underground mining does have implications on the costs of aggregates. If increasing scarcity drives up prices sufficiently, underground mining could become economically attractive. But major new investment will be needed if it is to make a significant contribution to future supply. As there is, as yet, no practical experience in this country of the potential contribution underground mining of aggregates could make to meeting future demand for aggregates, it would need to be tested.

Conclusions

England is fortunate that a wide range of aggregate sources contribute to overall supply and this diversity, in turn, helps to provide security of supply. England provides over 90% of its primary aggregate needs, with the remainder being made up from imports. Adequate production capacity, i.e. sufficient quarries to extract and process aggregates in the right quantities, qualities, at the right locations and at the right time to meet demand, is clearly crucial. Fundamentally, this depends on the availability of land with workable deposits, with the necessary planning permissions for minerals extraction and with the ability to deliver to the market.

Meeting society's needs for aggregates while protecting designated areas will certainly not become an easier task. Even without any changes in policy or opinion, the continued working of the 'more acceptable' sites for aggregates will necessitate a move over time into the 'less acceptable' sites. Policies contained within MPS1 look to ensure an adequate supply of aggregates whilst limiting the amount of environmental damage and the quantity extracted in environmental designations.

National Parks and AONBs collectively possess large permitted reserves of aggregates. The 987.6 Mt of permitted reserves in 2005 represents 44 years worth of working at 2005 rates. The exact timing of the rundown of supplies from these designated areas depends on the rate at which individual quarries are worked out or their permissions expire. A case study in the Peak District National Park indicates that in 2042 the National Park would still be supplying about half its current output (assuming no further replenishment of reserves). Therefore, the need for reserves in designated areas to be replaced by some kind of alternative supplies will be both at a slow rate and spread over many years. This means that, currently, there is a long window of opportunity to achieve this. Each of the alternative sources of aggregates summarised in this report have some potential and capacity to increase their share of supply of aggregates. However, in order to do this there are issues within each that limit any additional contribution that they may make. Of overarching significance is the confidence of the industry in long term market share to make the large capital investments required to maintain continuity of supply.

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