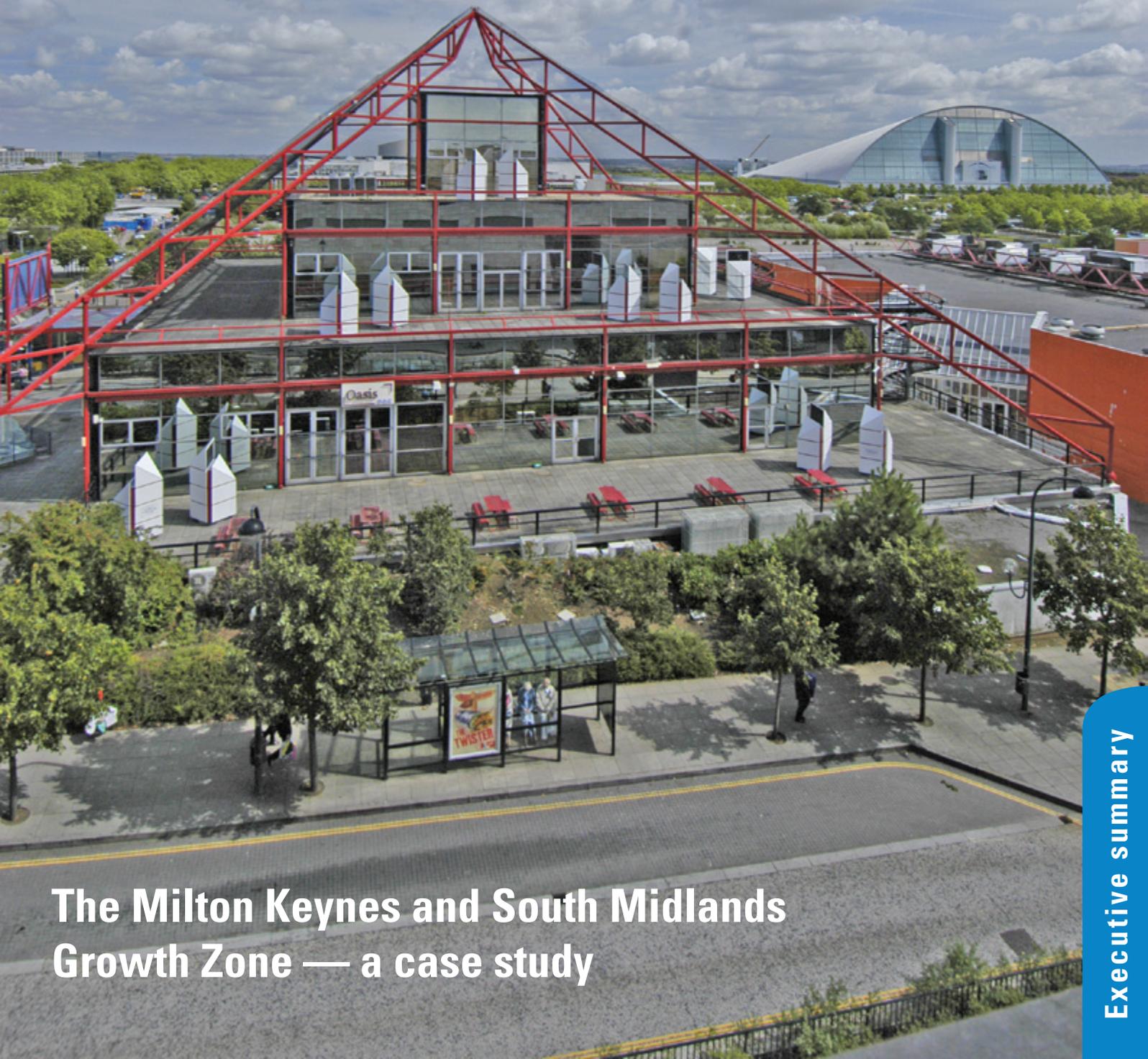




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Aggregate supply and demand for sustainable communities: a practical approach to problem solving



**The Milton Keynes and South Midlands
Growth Zone — a case study**



Introduction

Adequate supply of aggregate resources is vital for developing and sustaining our modern society. However, these resources are finite and can only be extracted from where they occur.

The Milton Keynes and South Midlands (MKSM) Growth Zone was first identified by the *Regional Planning Guidance for the South East* (RPG9, 2001). The *Sustainable Communities Plan*, published by the former ODPM in 2003, to help address the acute housing shortage in England a sustainable pattern of development, identified potential for up to 370 000 new homes within the Growth Zone by 2031. The *Milton Keynes & South Midlands Sub-Regional Strategy* (2005) provides a detailed analysis of areas with potential for development within the Growth Zone and considers factors including employment, transport links and utilities.

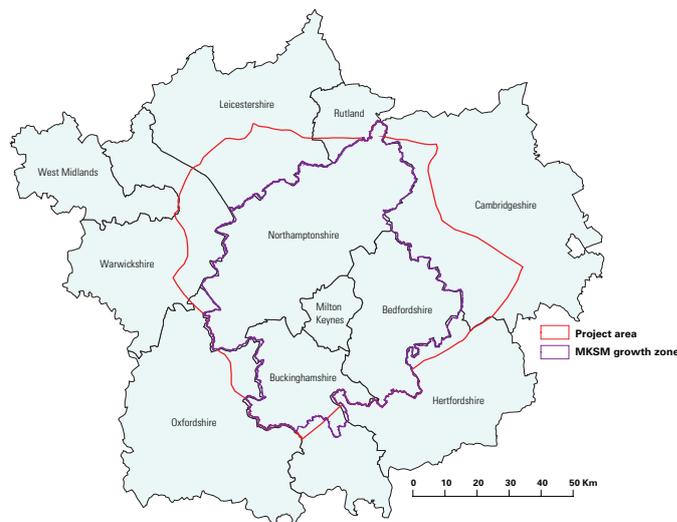
This report presents an analysis of aggregate resource availability in and around the growth zone. It also considers past and present aggregate supply and demand, environmental factors, and transport and planning issues. It aims to establish mechanisms for supplying the resources required to develop sustainable communities in designated growth zones.

The Project Area encompasses the MKSM Growth Zone and surrounding areas with potential sand and gravel resource.

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This executive summary provides a digest of a much more detailed technical report – *'Aggregate supply and demand for sustainable communities: a practical approach to problem solving'* (Harrison et al., 2007). It is intended for use principally by those involved in planning and economic development.



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BRITISH GEOLOGICAL SURVEY

REPORT OR/07/005

Aggregate supply and demand for sustainable communities: a practical approach to problem solving

Authors

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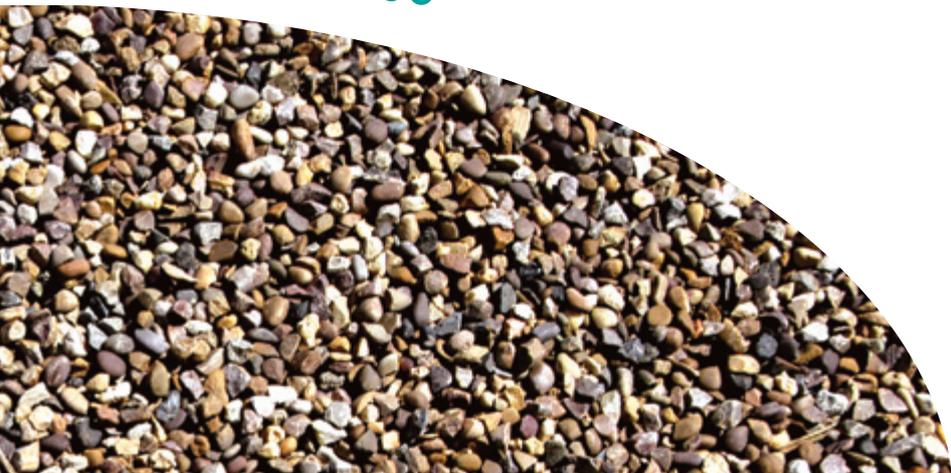
The research on which this report is based was funded through the Sustainable Land-Won and Marine Dredged Aggregate Mineral programme (SAMP) established under the Aggregate Levy Sustainability Fund (ALSF). The Mineral Industry Research Organisation (MIRO), on behalf of the Department of Communities and Local Government manages this programme.



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The growth zone

By the end of 2021 it is planned that around 200 000 new homes will be built within the MKSM Growth Zone. A further 100 000 could be completed by 2031. To provide employment for incoming residents, it is anticipated that almost 175 000 new jobs should be created by 2021.

Massive improvements to transport links are also proposed with the emphasis on sustainable modes of transport. Improvements to rail travel are to include an east–west service as far as Bedford, with enhancements to existing main-line links serving the area. Road improvements are also proposed. These include widening of the M1, a new bypass around Dunstable and improvements to the A14, including its junction with the M1/M6.

Although these plans aim to minimise the use of resources, it is clear that these levels of growth cannot be achieved without considerable additional quantities of building materials, including aggregates (sand and gravel, and crushed rock). Prior to the designation of the MKSM Growth Zone, no assessment of the quantities required were made. This project assesses what the implications for aggregate demand might be. This has been achieved by examining the following issues:

- the amount of growth that has taken place in the area in the past
- the amount of aggregate that has been used in the past
- where the aggregate has come from
- the amount of aggregate remaining in the Growth Zone
- other sources of aggregate that could be used.

Past consumption

Growth in the MKSM Growth Zone is not a new concept. Since the Second World War there have been very high levels of housing growth in Milton Keynes, Northampton, Corby and elsewhere. Supporting infrastructure added to the intensive building programme, as well as major road schemes such as the M1 and A14, the ‘dualling’ of parts of the A1, A5 and A43 and numerous local schemes. During the late 1970s and 1980s housing completions were often around 10 000 per annum with peaks of nearer 12 000. This growth was sustained by rich supplies of sand and gravel from within and close to the area, supplemented by crushed rock supplies from areas such as Leicestershire and Derbyshire. In the 1970s, sand and gravel sales were consistently around 12 Mt per annum and in the late 1980s peaked at over 14 Mt.

Known resources

Inevitably local sand and gravel supplies, especially in Northamptonshire, have become seriously depleted. Crushed rock, which until about 1980 accounted for less than half the aggregate used, now accounts for about 70 per cent in the Growth Zone. The most dramatic change to the supply pattern has been the depletion of gravel reserves in the Nene Valley in Northamptonshire. During the late 1980s, Northamptonshire produced around 2.5 Mt per annum. By 2000 this had fallen to under 1 Mt and has continued to fall. In other counties in the study area, the change in sales has been much less dramatic. County ‘landbanks’ (stocks) of permitted sand and gravel suggest that known supplies of sand and gravel in Northamptonshire are simply running out. With the exception of Milton Keynes, other planning authorities have generally maintained healthy landbanks which are comfortably above the seven years required by government. In contrast, the landbank in Northamptonshire has been under four years for at least the past 15 years.



The planning framework

Evolution of aggregates planning policy over time in the counties in and around the Growth Zone illustrates the diminishing resources in the Nene Valley. Leicestershire, Cambridgeshire and Bedfordshire all appear well placed to provide for currently anticipated demand for aggregates. Milton Keynes, which covers a relatively small land area and is expected to make a smaller contribution towards aggregate demand, also appears able to make provision for the levels expected of it. Although North Buckinghamshire has no tradition as an aggregate producing area, overall Buckinghamshire is relatively well provided for (although the aggregate worked in the south of the county is unlikely to contribute towards meeting demand in the MKSM Growth Zone since it finds ready markets in the London area). In contrast, during the 1980s Northamptonshire County Council became increasingly concerned about the ability of the Nene Valley to continue providing for the bulk of the aggregate produced in the county. Opportunities for new working were diminishing and the effect on the landscape, as a result of widespread restoration to water areas, was dramatic.

Since 1991, attempts have been made in Northamptonshire to direct more working away from the Nene Valley and into areas of glacial deposits elsewhere in the county. These attempts have met with difficulties. This includes a lack of geological information regarding the quality and quantity of the glacial deposits. As a result, the recently adopted *Northamptonshire Minerals Local Plan* shows a shortfall in sand and gravel provision over the plan period. This plan also acknowledges that it makes no specific allowance in the demand forecasts for the MKSM Growth Zone.

Summary and key findings

The planning context can be summarised as follows:

- proposed levels of growth are set to match the peaks of the 1980s
- levels of growth are expected to be the norm, year on year
- growth levels are envisaged to persist for at least 16 and up to 26 years
- most sand and gravel-producing counties are expected to be able to provide for the higher levels of demand
- areas that have no tradition of sand and gravel production or which currently produce smaller amounts are nevertheless subject to significant growth
- at the heart of the Growth Zone, Northamptonshire appears unlikely to be able respond to higher levels of aggregate demand

In addition to addressing planning issues related to aggregate supply, there are options for reducing demand for primary aggregate through sustainable practices such as:

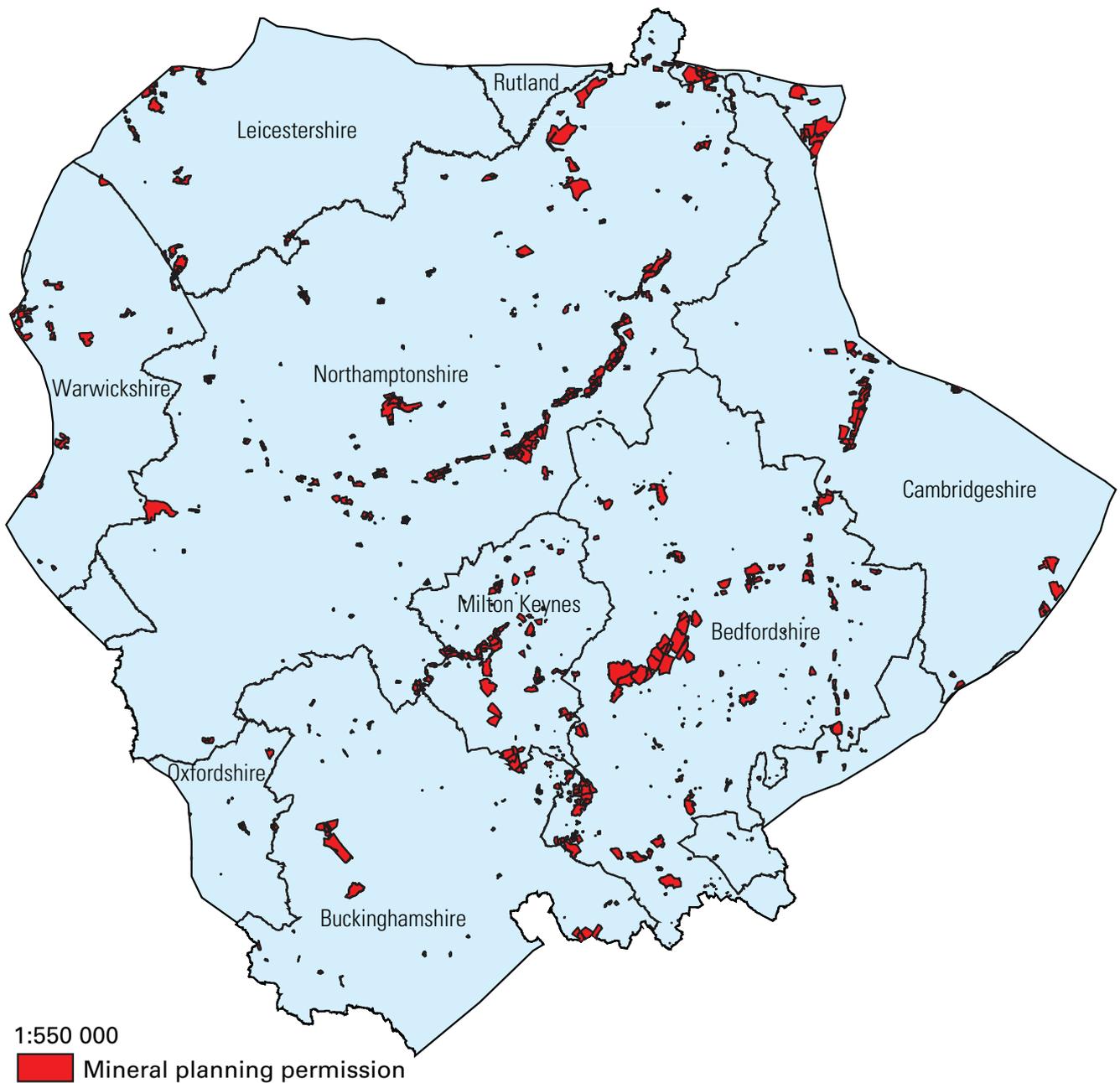
- using modern methods of production and high housing density
- maximising the use of alternative aggregates

Despite these measures, it is unlikely that existing supplies will be sufficient to provide for anticipated demand.

Additional action might include:

- encouraging development of non-traditional aggregate resources within the Growth Zone, such as glacial sand and gravel, limestone and ironstone and/or
- importing more primary aggregate from remote areas

This study has assessed the glacial sand and gravel resource in the Growth Zone and makes recommendations based on the findings.



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Map of the project area showing all existing mineral planning permissions (data collected 1995 to 2003).





Aggregate resources

Superficial deposits

The following summary of sand and gravel resources in the project area is based on expert interpretation of existing geological data, plus the information gained by the borehole drilling programme.

South-eastern Leicestershire

River terrace deposits lie within the valleys of the rivers Soar, Sence, Welland and Avon. Those in the Soar and its tributary the Sence are the most extensive, consisting mainly of flint and quartzite gravel averaging 2.4 m in thickness. The ratio of overburden to resource is 1:1 or better in the deposits of the Soar Valley and the lower part of the Sence. Although the Avon and the Welland, and the upper reaches of the Sence, appear to be largely devoid of aggregate resources, a stretch of the Welland valley in the extreme south-eastern corner of the sub-area contains sand and gravel with a mean thickness of 4.6 m. Investigations suggest that the extent of river terrace deposits in the upper reaches of the Avon and Welland is probably more restricted than is shown on the published geological maps. Where aggregate resources do occur, the variably clayey gravel comprises mainly limestone, with subordinate flint and ironstone.

Aggregate resources within the glaciofluvial deposits are very limited, do not extend significantly beneath the glacial till and are likely to be variable and of poor quality.

Rutland

Aggregate resources are confined to river terrace deposits of the Welland Valley, in the south of the area.

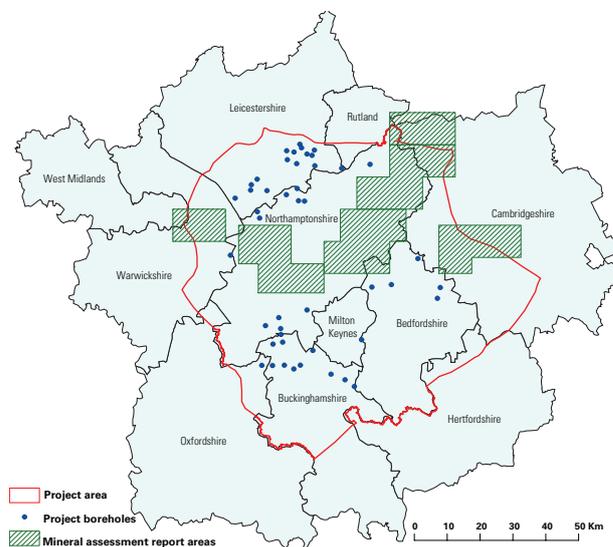
Northamptonshire

The river terrace deposits of the Nene Valley have been extensively worked for sand and gravel, but still represent a resource. The river terrace deposits have a mean thickness of about 3 m and a

favourable overburden to resource ratio. The composition of the gravel fraction is mainly ironstone and flint.

The river terrace deposits of the upper reaches of both the Avon and the Welland, and the headwaters of the River Ise, are largely devoid of aggregate resources. However, a short stretch of the Welland to the north west of Corby may contain sand and gravel resources.

Resources in the north of Northamptonshire, other than river terrace deposits, are extremely limited and confined to a narrow discontinuous strip between Brigstock and Thrapston. Quite extensive resources are indicated within the Daventry–West Haddon–Northampton triangle in the centre of Northamptonshire. They are consistently thick, up to 24 m in places, although they can be locally quite clayey and gravelly. Assessment of aggregate resources in southern Northamptonshire was precluded by lack of data.



Click on map to enlarge view.



Aggregate resources in the Milton Formation remain in the Watford Gap area, near Nether Heyford and at Milton Malsor where they average 4.8 m in thickness. They are slightly gravelly sands in which the gravel is composed largely of limestone and ironstone.

Peterborough

Despite a long history of extraction, aggregate resources remain in the River Nene river terrace deposits west of Peterborough. They have a mean thickness of 1.7 m and 3 m for respective overburden ratios of 3:1 and 1:1. The majority of aggregate resources occur within the deposits beneath the First Terrace. They typically consist of sandy gravel with less than 10 per cent 'fines' and the gravel is commonly composed of flint and limestone with subordinate ironstone and quartzite.

No significant glaciofluvial deposits occur within the area.

Cambridgeshire

Despite extensive extraction, the valley of the River Great Ouse between St Neots and Huntingdon still contains aggregate resources in the river terrace deposits with a mean thickness of 3.1 m. The deposits commonly comprise sandy gravel and gravel. Resources also occur in the River Nene valley in the north-west of the county.

Glaciofluvial deposits are of very limited extent and are probably too small and scattered to be considered of economic value.

Bedfordshire

The river terrace deposits of the Great Ouse and its large tributary, the River Ivel contain considerable aggregate resources with a mean thickness of 3 m. Glaciofluvial deposits in the southern half of the county were not

assessed. The northern part of the county contains a few isolated occurrences of glaciofluvial deposits.

Milton Keynes

Aggregate resources occur in the river terrace deposits of the Great Ouse and the River Ouzel. Although these deposits have been extensively worked around Milton Keynes, significant potential resources remain in the lower terrace deposits of the Great Ouse downstream from Milton Keynes with mean thicknesses of 2.9 m and 2.3 m for overburden to mineral ratios of 1:1 and 3:1 respectively. Resources are contained only within the lowest two terraces of both the rivers.

In the Milton Keynes area the glaciofluvial deposits are very limited in extent and many of the outcrops are too small to be of economic interest. The most extensive occur along the valley of the Great Ouse north of Milton Keynes where they have been exploited in the past.

Buckinghamshire

There are virtually no data on the river terrace deposits of the Great Ouse and its tributary Padbury Brook but, by analogy with the downstream Ouse, resources may be expected to occur within the lower terraces.

Extensive sheets of glaciofluvial sand and gravels occur in northern Buckinghamshire. The area was predicted to contain substantial potential resources but this was not supported by the results of the projects' drilling programme. The boreholes located to the east and south-east of Buckingham proved the thickest deposits of between 7 and 13 m. The deposits were extremely variable in composition. Despite this, the glaciofluvial deposits of north Buckinghamshire appear to comprise considerable aggregate resources which may warrant further detailed assessment.



Aggregate resources

Bedrock

Aggregate resources may be present in Jurassic limestone formations and the Cretaceous Woburn Sands Formation. However, the former are very variable and generally provide low quality crushed aggregate suitable mainly for use as fill, whilst the latter is predominantly fine-grained sand and largely devoid of gravel. Nevertheless, as a result of stakeholder feedback, the quantities of resources have been estimated using a simple and straightforward method previously employed for estimating resources in south-eastern England.

Summary

1. River terrace deposits are the most reliable aggregate resource.
2. Despite intensive extraction of sand and gravel from the river terrace deposits, considerable aggregate resources remain within those of the main rivers: Nene, Great Ouse and Ivel, although planning considerations may limit continued working (Table 1).
3. The terrace deposits of the Rivers Welland and Upper Avon do not contain significant resources.
4. The project boreholes suggest the glaciofluvial deposits in the south of the project area, and the sheets of glaciofluvial sand and gravels near Buckingham, could contain resource (Table 2). Due to the relatively small, targeted drilling programme carried out it is suggested that more research is required to investigate this resource further.

Methodology for identifying resources

1. Desk study

A review of the current geological knowledge of the project area, based on existing geological maps, mineral assessment reports, borehole data, and various geological publications.

2. Statistical analysis of digital data

Use of a geographical information system (GIS) as a tool to interpret digital BGS geological maps and selected borehole data. Various GIS statistical tools and interpolation methods were used to analyse the data and different methods were tested to illustrate the data.

3. Focussed drilling programme

A focussed drilling programme was devised for areas of potential resource in the project area by eliminating:

- i. all urban areas
- ii. all areas with mineral planning permissions
- iii. all areas with more than one environmental asset.

Based on resulting areas, geologists highlighted the sites to be targeted in the drilling programme, forty eight project boreholes were drilled.

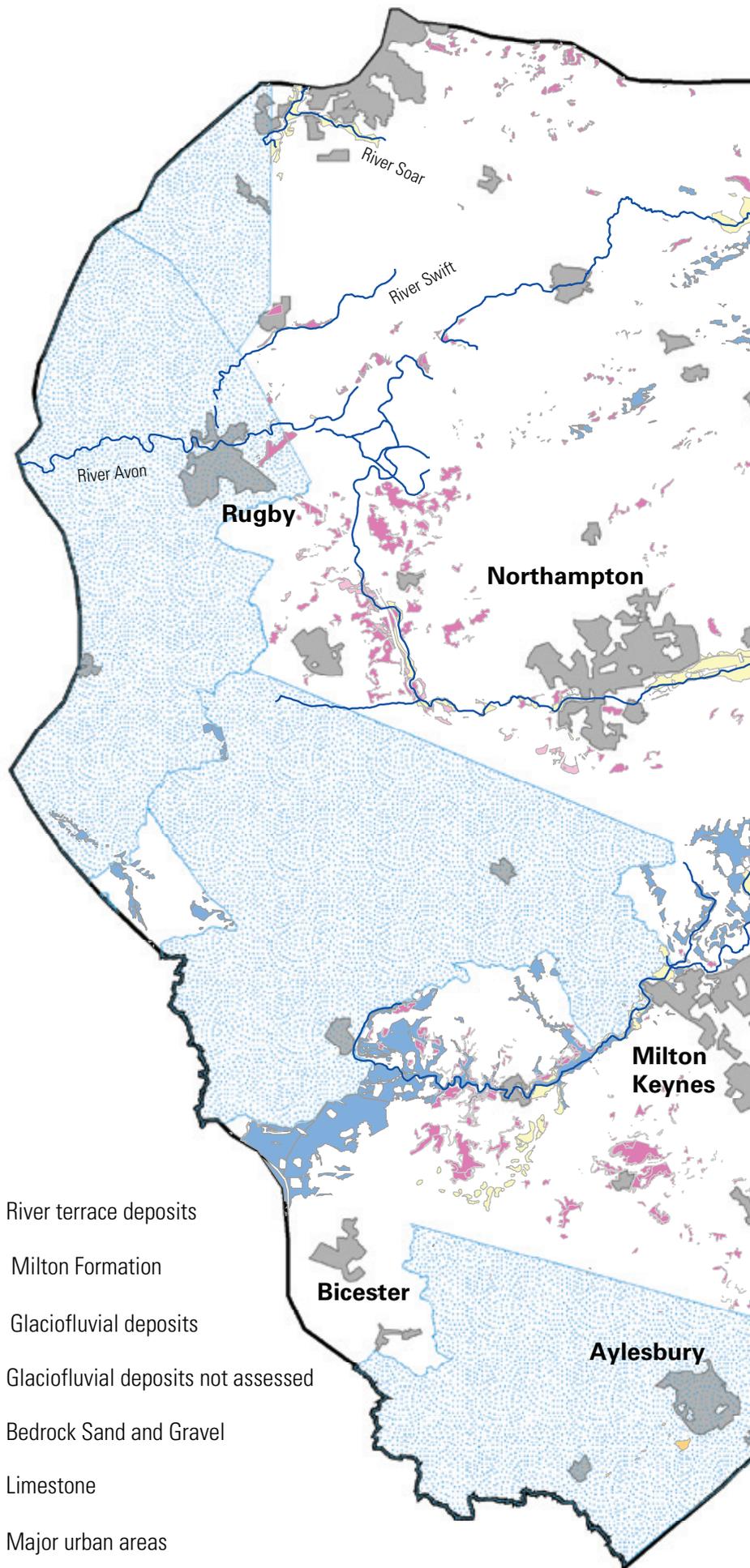


Mineral planning authority (or part thereof)	River catchment	Overburden to resource ratio (equal or better than)	Resource mean thickness (m)	Resource tonnage (Mt)	
				Unsterilised and <2 environmental assets	Total (excluding permissions)
Leicestershire	Avon	1:1	1.7	0.5	0.6
	Welland	1:1	4.6	17.1	18.1
	Soar/Sence	1:1	1.6	8.9	16.1
	Sence	3:1	2.4	4.7	4.7
Rutland	Welland	1:1	2.6	0.9	0.9
Peterborough	Nene	3:1	1.7	1.1	2.0
	Nene	1:1	3.0	30.8	50.6
Buckinghamshire	Padbury Brook	1:1	1.5	15.7	16.1
	Great Ouse	1:1	1.5	2.5	2.6
Bedfordshire	Ouzel	1:1	2.0	0.7	1.8
	(Ouzel tributary)	1:1	1.5	1.7	2.1
	Ivel	1:1	3.0	70.4	111.5
	Great Ouse	1:1	3.0	165.4	249.7
Cambridgeshire	Great Ouse	1:1	3.1	86.6	182.7
	Nene	3:1	2.9	1.3	1.4
	Nene	1:1	3.8	23.6	30.2
Milton Keynes	Great Ouse	3:1	2.3	13.2	21.4
	Great Ouse	1:1	2.9	45.3	75.1
	Ouzel	3:1	1.0	0.1	0.4
	Ouzel	1:1	2.4	9.5	19.3
Northamptonshire	Welland	1:1	3.6	15.1	15.8
	Nene	3:1	2.0	2.6	2.7
	Nene	1:1	3.2	220.2	264.1
	Ouse	1:1	2.5	7.4	11.9
Totals				745.2	1101.8

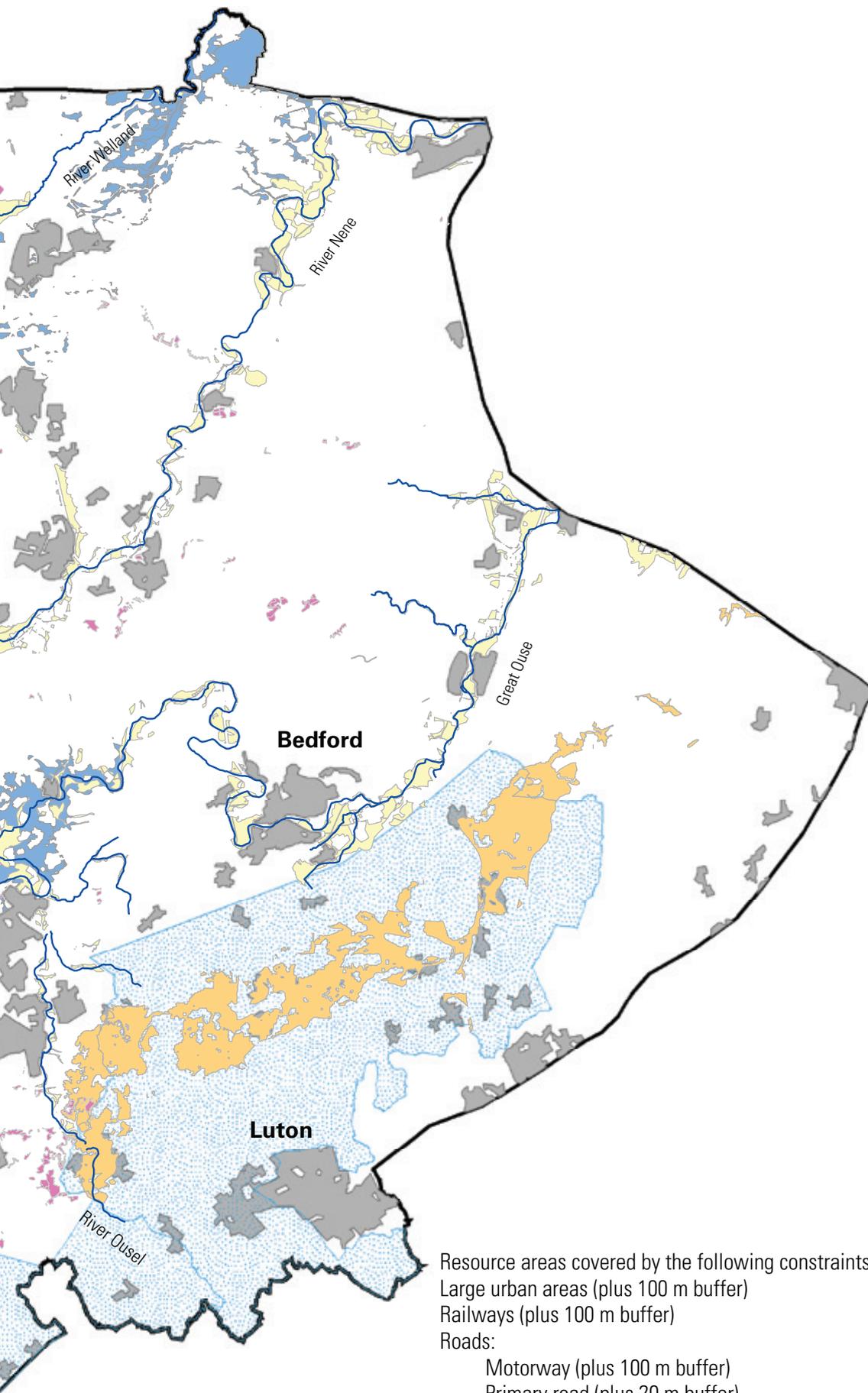
Table 1: Information on the river terrace deposits in the project area.

Mineral planning authority (or part thereof)	Sub block	Overburden to resource ratio (equal or better than)	Resource mean thickness (m)	Resource tonnage (Mt)	
				Unsterilised and <2 environmental assets	Total (excluding permissions)
Leicestershire		3:1	0.7	1.4	2.3
		1:1	5.5	98.3	217.6
Buckinghamshire		3:1	1.6	31.2	53.5
		1:1	2.9	125.8	248.5
Bedfordshire		3:1	2.5	0.8	0.8
		1:1	4.5	17.7	21.9
Cambridgeshire		1:1	6.1	4.7	15.2
Milton Keynes		1:1	1.3	1.1	2.0
Northamptonshire		3:1	5.3	7.7	13.1
		1:1	6.9	165.6	272.2
	Milton Formation	1:1	4.8	36.6	76.2
Totals				490.8	923.2

Table 2: Information on the glaciofluvial deposits in the project area.



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Resource areas covered by the following constraints have been erased:

- Large urban areas (plus 100 m buffer)
- Railways (plus 100 m buffer)
- Roads:
 - Motorway (plus 100 m buffer)
 - Primary road (plus 20 m buffer)
 - A road (15 m buffer)
- Mineral planning permissions
- More than one environmental asset

Map showing remaining resources in the project area.



Future provision of aggregate

Supply management

The study confirmed earlier concerns that there is limited potential for continued extraction of sand and gravel in key areas of the MKSM Growth Zone (such as the Nene Valley) where there is or has been aggregate production. This is because any further extraction in river valleys where restoration is to open water will compromise existing planning policy aimed at protecting attractive areas of landscape. Unless policy restrictions are relaxed, the resources in these areas will become increasingly constrained. The development of the MKSM Growth Zone will undoubtedly hasten the depletion of the unconstrained resources in and around past or present areas of working. In contrast, there is no evidence of problems in maintaining imports of crushed rock into the MKSM Growth Zone in the near future.

Future primary aggregate provision in the MKSM Growth Zone will therefore rely on:

- continued exploitation of traditional reserves within the MKSM Growth Zone, found mainly in the river valleys, where it is available and free from policy constraints
- ensuring that resources are safeguarded from other forms of development and that options for prior extraction ahead of development are investigated
- maintaining the import of crushed rock from outside the area

and coupled with the exploitation of additional sand and gravel resources:

- from new sources within the area
- imported from elsewhere.

Imports could either comprise greater quantities from existing exporting areas and/or imports from new areas.

New sources within the area

The study investigated the likelihood of additional sand and gravel resources occurring in river valleys where there has been relatively little extraction (including the River Welland) and areas of glaciofluvial deposits in the MKSM Growth Zone. Geological investigations suggested that, subject to policy constraints, there appeared to be significant potential in less exploited river valleys within and close to the Growth Zone. The study also found glaciofluvial deposits of sand and gravel in the centre and south of the project area (Northamptonshire and close to Buckingham). However, more research is required to investigate whether they could support viable mineral workings. There appears to be few or no new resources in the Welland Valley. Unless there is significant shift in local environmental protection policy to allow continued working of resource in the key river valleys, the glaciofluvial deposits in the south of the area might provide a useful additional supply source.

The Growth Zone has ample supplies of Lincolnshire Limestone. Unfortunately, there is insufficient detailed knowledge of the physical properties of the limestones to say what contribution they might make to wider aggregate supplies. However, the reality is that, despite the considerable extent of permitted reserves, current production from the Lincolnshire Limestone is very limited. This may indicate the practical limitations of this material. Further research would be necessary to test this assumption.

Ironstones are also abundant in the area and have been used traditionally as building stone. However, as with



the limestones, there is apparently insufficient detailed knowledge of their physical properties to say whether they would be capable of functioning as anything more than specialist building stones or bulk fill. A point against them is that most of the near surface material has been exhausted owing to its use in the iron and steel industry. Remaining reserves are beneath the limestones and extraction would be costly and environmentally disruptive. There is thus little prospect of them being viable as aggregate. The greatest potential therefore lies in the sand and gravels. However, finding areas which are both economically viable and environmentally acceptable is likely to present a much greater challenge in the future than it has done in the past.

Imports

This option is generally placed at the bottom of the nominal 'sustainability ladder'. Importing aggregates from outside the area amounts to transferring the environmental impact of extraction and processing to the exporting area, as well as to the areas in between which may experience the consequences of transportation. Transport of millions of tonnes of material over large distances is also costly in terms of carbon emissions. The distribution of mineral resources across the UK and the project area is uneven. Aggregates can only be worked where they occur, so transport of minerals from the point of production to the point of consumption is inevitable.

The most feasible first option for crushed rock supply to the MKSM Growth Zone is likely to be an increase in imports from areas already supplying into it since existing import facilities can be used. However, if levels of import were to rise significantly these would probably need to be supplemented by additional facilities. The need for such facilities and potential locations

should be assessed and suitable locations safeguarded as part of the sustainable development of the area

In the case of sand and gravel, a positive step towards securing sustainable supplies in the longer term would be to investigate opportunities to move materials by methods other than road, such as rail and water.

For both crushed rock and sand and gravel, the identification of sustainable transport options might open up opportunities to source material from areas that do not currently serve the MKSM Growth Zone. This could assist in spreading the environmental cost.

However, opening up more sustainable transport routes could potentially result in the greater impact on environmentally sensitive areas. On the other hand, failure to do so may jeopardise the social and economic benefits that are expected to accrue from the development of the MKSM and other growth zones.

Minimising demand for primary aggregate

There is potential to reduce aggregate demand through sustainable building techniques and increased density. Prefabrication and the use of novel materials are already contributing towards a decrease in the intensity of use of aggregates in construction. There is existing capacity in the UK to augment this contribution through an increase in the number of units constructed. The recent focus on sustainable urban drainage systems and the promotion of biodiversity also tend to promote soft landscaped solutions which require less aggregate. However, unless there are fundamental changes in building techniques and lifestyle, which are not currently anticipated, there is ultimately an irreducible minimum below which aggregate requirements cannot go.



Future provision of aggregate (continued)

Recycled aggregates can play an important role in reducing demand for primary aggregate. However, increasing recycled aggregate production is largely constrained by the amount of demolition in an area and by the fact that it can never be 100 per cent efficient. The building stock in the MKSM Growth Zone is generally newer than the average urban setting which would imply that levels of demolition in the area are relatively low and hence availability of recycled material might generally be more restricted than elsewhere.

Thus, no matter how great the emphasis on reducing aggregate demand there will always be a significant amount which will need to be supplied from primary sources.

Conclusion

The final conclusion to emerge from this study is the difficulty that might arise where one element of national policy — in this case, establishing ‘growth zones’ — is pursued without a clear consideration of all the factors (such as the availability of construction minerals, land, water and services) which govern its successful delivery within environmental and sustainability constraints.

The MKSM Growth Zone will be supplied with aggregate minerals, probably through a mix of sources, including local and remote production of newly dug material. What seems unavoidable is that the proportion of aggregate supplied from outside the area will need to increase significantly. This calls into question whether the supply of minerals to the MKSM Growth Zone can be achieved in a truly sustainable fashion.

Summary

Within the Focus Area of Northamptonshire, Milton Keynes and North Buckinghamshire, the remaining unconstrained resources are becoming scarce.

The MKSM Growth Zone proposals will only serve to hasten the rate of depletion of aggregate resources and bring forward the time when decisions upon how to provide alternatives must be made.

The findings of this project suggest that there will be no single solution available.

Planning policy should therefore ensure that a multi-pronged approach is adopted through:

- the promotion of recycling
- the economy of usage through sustainable design
- the release of local supplies where this is viable
- the safeguarding of future resource and prior extraction
- the identification and safeguarding of acceptable locations for the receipt of imports and their onward distribution.





Recommendations

1. Aggregate resources in the MKSM Growth Zone are depleted, therefore safeguarding of the remaining local resource will be critical in ensuring the sustainable development of housing and infrastructure into the future. Policies to encourage a critical examination of options for prior extraction if mineral-bearing land is to be developed will be particularly important in the MKSM Growth Zone, where the aggregate resource is in demand but depleted and where there will be intense pressure to develop land. The aggregate footprint of all significant elements within the Growth Zone should be monitored and reported regularly.
2. Further research is needed to investigate the potential resource in the glaciofluvial deposits in the south of the project area. The sheets of glaciofluvial sand and gravels near Buckingham are suggested as a focus for further investigation. Some Jurassic limestone formations may provide aggregate of useful quality but further investigation of their properties will be needed.
3. There should be a critical examination of the existing transport infrastructure and the potential to develop this further to provide sustainable transport options for imported aggregate. This should include an analysis of existing rail freight capacity on relevant routes, safeguarding existing rail depots, identifying locations for additional depots and considering novel transport. Both water transport options and the potential to develop routes to import material from areas not currently serving the MKSM Growth Zone should be considered.





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