Oxfordshire Minerals and Waste Plan
Minerals and Waste Core Strategy

Background Paper revised April 2012

Flooding and Minerals Development

Note: This background paper was largely prepared prior to publication of the government's National Planning Policy Framework on 27 March 2012 and it has only been partially updated to reflect this new national policy document.

1. Introduction

1.1 This background paper is one of a series which together forms part of the evidence base for the preparation of the Minerals Core Strategy. The Core Strategy is part of the Minerals and Waste Plan that will help decide how and where waste should be managed and where minerals will be worked in Oxfordshire over the period to 2030. More information about the plan can be found on the Council's website: www.oxfordshire.gov.uk

1.2 The background papers have been used to identify baseline data and inform the preparation of policies for inclusion in the Core Strategy. The papers are intended to present evidence as it stands at this stage. They build on work carried out at the previous preferred options stage, incorporating feedback from that consultation and addressing areas that require further discussion. They also provide an opportunity for stakeholders to check the information to ensure the Council's knowledge and understanding is up to date and robust.

1.3 The background papers are 'living draft' documents and may continue to be revised throughout the process of preparing the Core Strategy.

1.4 The County Council has drafted options for where mineral extraction may take place during the period to 2030. This paper describes the application of the sequential test to these strategy options. The paper:

- Describes the characteristics of the areas of Oxfordshire which are being considered for minerals development and identifies their vulnerability to flooding from different sources;
- Reviews planning policy on flooding, particularly with reference to minerals planning; and
- Applies the sequential test to the draft mineral strategy options and provides a justification for the selection of the preferred strategies, where these areas are more susceptible to flooding than others.

1.5 This paper has been informed by meetings with the Environment Agency held in 2010, and the Environment Agency will be consulted on this paper and further iterations of it.

1.6 This paper is part of the evidence base for the County Council's Minerals and Waste Core Strategy proposed submission document, which includes policies C1 on flooding and C2 on the water environment.

2. Executive Summary

2.1 Section 3 provides a brief description of the main rivers in Oxfordshire and the extent of flood zone 3 in the county. It also identifies the vulnerability of each district to flooding.

2.2 Section 4 provides definitions of the key concepts which this topic paper addresses, including the sequential and exception tests and the vulnerability of minerals development to flooding.

2.3 Section 5 provides a brief description of national and regional policy which is relevant to flooding and minerals development and to the application of the sequential test to minerals development.

2.4 Section 6 describes the provision for sand and gravel extraction which the County Council must make in the Minerals and Waste Development Framework.

2.5 Section 7 provides a brief overview of the findings from the Oxfordshire Strategic Flood Risk Assessment on each of the sand and gravel, soft sand and crushed rock resource areas. It also identifies the areas which have not been included in the draft options and justifies their exclusion from the options.

2.6 Section 8 shows how the sequential test is applied to the resource areas and to the draft mineral strategy options.

2.7 Section 9 describes the sustainability appraisal approach which has taken place to date.

2.8 Section 10 describes the areas which have been included in the preferred option for minerals extraction, provides the justification for their inclusion and assesses the deliverability of these option areas in relation to flood risk.

3. Description of Oxfordshire and vulnerability to flooding

3.1 The River Thames flows through Oxfordshire from the west to the south east. Figure 1 shows the primary rivers in Oxfordshire and the location of the sand and gravel resources, which are mostly found in the river terraces along the Thames and its tributaries. Figure 2 shows the crushed rock resources and the primary rivers.

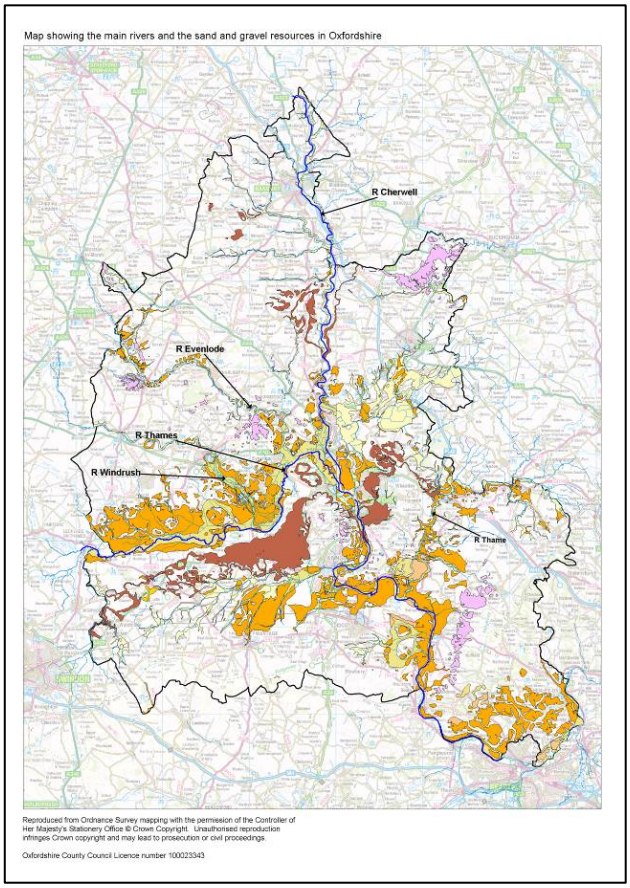


Figure 1 Rivers and sand and gravel resources in Oxfordshire

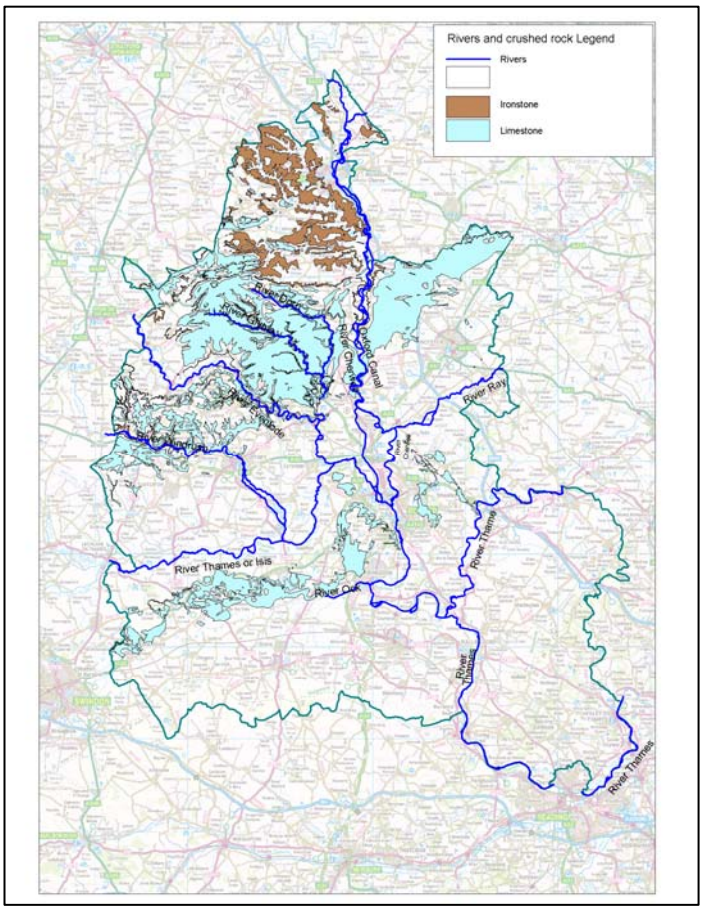


Figure 2 Rivers and crushed rock resources in Oxfordshire

3.2 Figure 3 shows the extent of flood zone 3 in Oxfordshire; this zone is created from fluvial flood risk. Extensive fluvial flooding affected parts of Oxfordshire, including Oxford, Abingdon and Witney in July 2007. The SFRA includes additional maps; these are available on the website at http://www.oxfordshire.gov.uk/cms/content/minerals-and-waste-development-framework

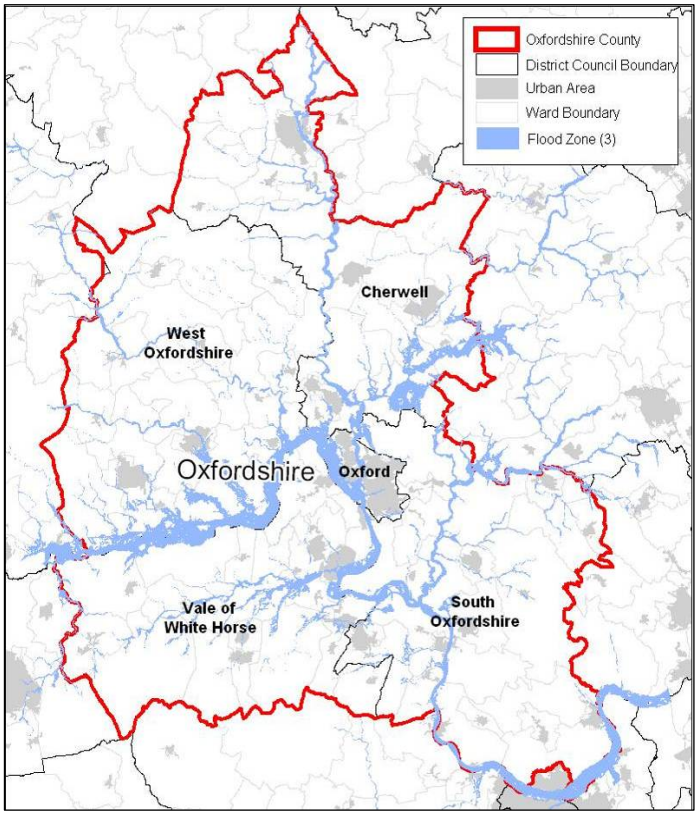


Figure 3
The extent of flood zone 3 in Oxfordshire

Source: Environment Agency http://www.environment-agency.gov.uk/subjects/flood/1217883/?version=1&lang=_e

3.3 Intense periods of rainfall over a short duration or periods of prolonged rainfall may prevent rainwater from infiltrating into the ground or into drainage systems; this causes surface water flooding. The Strategic Flood Risk Assessment (SFRA) assesses the risk from fluvial and surface water flooding, as well as from ground water flooding.

3.4 Groundwater flooding occurs when water levels in the ground rise above surface elevation. A quantified risk of groundwater flooding is difficult to undertake, especially on a strategic scale due to lack of groundwater level records, variability in geological conditions and lack of predictive tools to assess groundwater flow.

3.5 Records from Radcliffe Observatory show temperatures in Oxford in the post-1986 decade are the warmest on record by a considerable margin. This may be indicative of climate change, which could have significant impacts on Oxfordshire's environment, economy, transport, housing and health. Climate change in Oxfordshire is likely to result in warmer, drier summers, with temperatures predicted to increase by 1.0 °C to 1.5 °C by 2020 and rainfall predicted to decrease between 10 and 20% by 2020 in summers and milder, wetter winters with an increased

risk of flooding[1].

4. Key definitions

4.1 This section provides definitions of the key concepts which this topic paper addresses.

FLOOD ZONES
(from Technical Guidance to the National Planning Policy Framework – Table 1, March 2012)

Development in any flood zone would require the application of the sequential test.

Flood zone 1: Low probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). All uses of land are appropriate.

Flood zone 2: Medium probability. This zone comprises land as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%). The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate in this zone.

Flood zone 3a: High Probability. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%). The water-compatible and less vulnerable uses of land are appropriate in this zone. More vulnerable uses may be appropriate subject to the sequential and exception tests being passed

Flood zone 3b: Functional flood plain. Only the water – compatible uses and the essential infrastructure that has to be there should be permitted in this zone.

THE SEQUENTIAL TEST

The sequential approach is *'a simple decision-making tool designed to ensure that areas at little or no risk of flooding are developed in preference to areas at higher risk……The aim should be to keep all development out of medium and high flood risk areas (Flood Zones 2 and 3 and other areas affected by other sources of flooding) where possible. All opportunities to locate new water-incompatible developments in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk".*

Additionally, within each Flood Zone development should be directed to the areas of least flood risk i.e. this approach reinforces the most effective risk management measure of all, that of avoidance.

The Technical Guidance to the National Planning Policy Framework acknowledges that some areas will be at risk of flooding from flood sources other than fluvial systems. Other sources of flooding that require consideration when situating new development allocations include:

- Flooding from the Land - Surface Water;
- Flooding from Groundwater;
- Flooding from Sewers and Drains; and,
- Flooding from Manmade or Artificial Sources.

4.2 The Exception Test is required (in terms of minerals and waste development) for landfill and sites used for waste management of hazardous waste or minerals processing (i.e. more vulnerable

[1] Oxfordshire's Sustainable Community Strategy: Briefing Paper 6: Environment (August 2007).

development) located in Flood Zone 3a. The Exception Test will be required following application of the Sequential Test providing this shows that suitable alternative land at low risk of flooding is not available.

THE EXCEPTION TEST

For the Exception Test to be passed:

a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.
b) the development should be on previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and
c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

If the LPA wish to allocate an individual site which requires application of the Exception Test, the LPA should apply the exception test at the allocation stage and assess whether it is broadly feasible to deliver a safe development in line with Part C of the Exception Test. Only where it has been established that the site allocation would be delivered as a 'safe development' can the site be allocated. A further examination of the site using the Exception Test will still need to be undertaken at the detailed design stage of the planning application, using a site specific flood risk assessment.

4.3 Tables 1 and 2 show the vulnerability of different land uses to flooding and their compatibility with different flood zones. Sand and gravel working can be placed in flood zone 3b, subject to the sequential test being passed; all other types of mineral working and all types of mineral processing sites can only be located in flood zones 2 and 3a subject to the sequential test being passed.

Table 1 Minerals and Waste Flood Vulnerability Classification
(from Technical Guidance to the National Planning Policy Framework – Tables 2 and 3, March 2012)

Development Type	Vulnerability Classification	Flood Zone Compatibility
Landfill sites (hazardous, non-hazardous and inert waste – including waste used in quarry restoration)	More Vulnerable	Flood Zone 1 and 2
Waste management facilities handling hazardous waste	More Vulnerable	Flood Zone 1 and 2
Minerals working and processing (except for sand and gravel working)	Less Vulnerable	Flood Zones 1, 2 and 3a
Sand and Gravel Workings	Water Compatible	Flood Zone 1, 2, 3a, 3b

Development Type	Vulnerability Classification	Flood Zone Compatibility
Sand and Gravel processing sites (including grading and washing plant)	Less Vulnerable	Flood Zone 1, 2, and 3a
Sewage Treatment Plants	Less Vulnerable	Flood Zones 1, 2 and 3a
Waste recycling, composting and transfer uses (including recycling to produce recycled aggregate)	Less Vulnerable	Flood Zones 1, 2 and 3a
Secondary aggregate re-cycling (considered as minerals processing)	Less Vulnerable	Flood Zones 1, 2 and 3a
Waste treatment processes (including anaerobic digestion, mechanical biological treatment, incineration, gasification and pyrolysis).	Less Vulnerable	Flood Zones 1, 2, and 3a
Concrete block manufacture (considered as minerals processing)	Less Vulnerable	Flood Zones 1, 2 and 3a
Concrete batching plant (considered as minerals processing)	Less Vulnerable	Flood Zones 1, 2 and 3a

Table 2 Flood Risk Vulnerability and Flood Zone Compatibility

M&W Development Type	Use Category	FLOOD ZONE			
		1	2	3a	3b
Landfill sites or sites used for waste management facilities for hazardous waste	More Vulnerable	✓	Use only appropriate if Sequential Test is passed ⇩ ✓	Use appropriate if Sequential Test is passed **and** Use appropriate if the Exception Test is passed ⇩ ✓	× Use should not be permitted
Waste management facilities (except landfill and hazardous waste), Minerals working and processing (except for sand and gravel workings)	Less Vulnerable	✓	Use only appropriate if Sequential Test is passed ⇩ ✓	Use only appropriate if Sequential Test is passed and if exception test is passed ⇩ ✓	× Use should not be permitted
Sand and gravel workings (that exclude processing operations)	Water Compatible	✓	Sequential Test suggested as means of prioritising sites at allocation stage ✓	Sequential Test suggested as means of prioritising sites at allocation stage ✓	Sequential Test suggested as means of prioritising sites at allocation stage ✓

×: *Use should not be permitted* ⇩: *If passed proceed* ✓: *Appropriate use*

(Developed from Technical Guidance to the National Planning Policy Framework – Tables 2 and 3, March 2012

5 Policy Context

5.1 The Oxfordshire SFRA (October 2010) identifies a range of policies on flooding and the planning process, from European Directives to site management plans. This topic paper does not seek to repeat the information on the full range of policy but rather to focus on planning policy which is relevant to the application of the sequential and the exception tests to minerals and waste development.

5.2 MPS1 Planning and Minerals (November 2006), paragraph 9, states that the Government's objectives are to secure working practices which prevent or reduce as far as possible, impacts on the environment and human health arising from the extraction, processing, management or transportation of minerals.

5.3 Paragraph 15 of MPS1 adds that local authorities should identify sites and preferred areas having taken account of environmental considerations to provide greater certainty of where future sustainable mineral working will take place. In addition, its states that local authorities should consider the benefits, in terms of reduced environmental disturbance and more efficient use of mineral resources including full recovery of minerals, or extensions to existing mineral workings rather than new sites.

5.4 Paragraph 17 of MPS1 states that local authorities should ensure, in association with the EA, that in areas at risk of flooding, mineral extraction proposals do not have a significant adverse impact on flood flows or flood storage capacity. Operators should also demonstrate that mineral workings should not materially increase the risk of flooding at other properties or locations and, where practicable, should increase flood storage capacity.

5.5 MPG7: The Reclamation of Minerals Workings provides guidance on policies, consultation and conditions which are relevant to achieving effective reclamation of minerals workings. It also provides guidance on the location of storage mounds with relation to flood risk.

5.6 The following national policy documents are also of relevance when considering flood risk associated with minerals and waste development. They emphasise that every opportunity should be sought, through the development of minerals sites in Flood Zones 3a and 3b to reduce flood risk

5.7 PPS1 (2005) & PPS1 Supplement "Climate Change and Sustainable Development" (December 2007) is the Government's overarching statement on the purpose of the planning system, which identifies sustainability as a key tenet of policy formulation. Paragraph 3 of the PPS makes clear that 'sustainable development is the core principle underpinning planning'.

5.8 The PPS 1 Supplement on Climate Change sets out important objectives in order to tackle climate change, sea level rise and to avoid flood risk. The purpose of design policies should, it states, be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding.

5.9 PPS 10 Planning for Sustainable Waste Management (September 2005) provides guidance on the identification of sites and areas that might be suitable for waste management facilities. Waste planning authorities (WPAs) should assess their suitability of sites and areas against a number of physical and environmental constraints on development. Amongst these considerations, reference is made to the need to protect water resources and in particular: "…*The suitability of locations subject to flooding will also need particular care"*.

5.10 PPS 25: Development and Flood Risk (March 2010) and its supporting Practice Guide, published in December 2009, emphasise the active role LPAs should have in ensuring flood risk is considered during all stages of strategic land use planning. PPS25 sets the following minimum requirements for the appraisal, management and reduction of flood risk:

- Identify land at risk from flooding and the degree of flood risk;
- Prepare Regional or Strategic Flood Risk Assessments (RFRAs / SFRAs) as appropriate, either as part of the SA of their plans or as a freestanding assessment;
- Frame policies for the location of development which avoid flood risk to people and property, where possible and manage any residual risk, taking into account climate change;
- Reduce flood risk to and from new development through location, layout and design, including sustainable drainage approaches;
- Use opportunities offered by new development to reduce flood risk;
- Only permit development in areas of flood risk when there are no suitable alternative sites elsewhere and the benefits outweigh the risks from flooding. In these cases, it must be demonstrated that the development will be safe. Work with the EA and other stakeholders to ensure that best use is made of their expertise and information in informing planning decisions; and,
- Ensuring spatial planning supports flood risk management and emergency planning.

5.11 The government's National Planning Policy Framework (NPPF) was published on 27 March 2012 and has replaced MPS 1, MPG 7, PPS1 and PPS 25 with immediate effect. The NPPF states that local plans should take account of climate change over the longer term, including factors such as flood risk, that they should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources and that they should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property..

5.12 The government's Technical Guidance to the National Planning Policy Framework, published alongside the NPPF, provides further guidance on the sequential and exception tests and on flood risk vulnerability classifications, repeating the information which was in PPS 25.

5.13 The Regional Spatial Strategy – The South East Plan:

SFRA Position Statement **October 2010**
Regional Spatial Strategy (RSS)

The RSS published by the Communities and Local Government (CLG) provided a broad development strategy for the region for a 15 to 20 year period. It also informed the preparation of Local Development Documents (LDD) and regional and sub-regional strategies.

Following the election of a coalition government in May 2010, a Devolution and Localism Bill has been confirmed which intends to *'shift power from the central state back to the hands of individuals, communities and councils'.* This Bill includes proposed legislation to scrap the RSS**.**

While the Secretary for State for Communities and Local Government has confirmed the government intends to revoke the RSS, at the time of writing the RSS is still in place as part of the development plan; therefore the RSS will be referred to as the current planning policy document for the purposes of this report.

5.14 The Regional Spatial Strategy, the South East Plan[2], adopted in May 2009, is part of the statutory development plan for Oxfordshire and contains policies directly relating to flood risk and climate change as well as policies relating directly to minerals and waste development. The Coalition Government has stated its intention to revoke all regional strategies, and this is provided for in the Localism Act 2011.

5.15 The South East Plan includes policy NRM4 on Sustainable Flood Management – Making Space for Water. Flood risk management is of increased importance due to development in flood plains, changing patterns of rainfall, extreme weather, storms, rising sea levels and agricultural runoff accelerated by climate change. These factors will increase the probability and incidence of flooding of property and land. The South East Plan seeks to avoid an increase in flood risk through the appropriate location and design of new development in line with the principles outlined in PPS25. Policy NRM4 sets out these requirements in greater detail:
"The sequential approach to development in flood risk areas set out in PPS25 will be followed. Inappropriate development should not be allocated or permitted in flood zones 2 and 3, areas at risk of surface water flooding (critical drainage areas) or areas with a history of groundwater flooding, or where it would increase flood risk elsewhere, unless there is over-riding need and absence of suitable alternatives"

[2] Government Office for the South East (2009) The South East Plan: Regional Spatial Strategy for the South East of England

5.16 Policy NRM1 – Sustainable Water Resources also requires that: *"water supply and groundwater be maintained and enhanced through avoiding adverse effects of development on the water environment*". It also states that Local Authorities should: *"Set out circumstances where sustainable drainage solutions should be incorporated into new development"*; and *"Encourage winter storage reservoirs and other sustainable land management practices to reduce summer abstraction, diffuse pollution and run-off, increase flood storage capacity and benefit wildlife and recreation."*

5.17 South East Plan Policy CC2 – Carbon Reduction sets out cross cutting policies on resource use and sustainable design and carbon reduction. This policy highlights the need to reduce the consumption of resources and encourages: *"Guiding strategic development to locations offering greater protection from impacts such as flooding, water shortages and storms;* *"The use of sustainable drainage measures and high standards of water efficiency in new and existing building stock;* *"Increasing flood storage capacity and developing sustainable new water resources;* and *"Ensuring that opportunities and options for sustainable flood management are actively promoted."*

6. The need to identify areas for mineral extraction over the plan period

6.1 The Minerals and Waste Development Framework will make provision for a secure and steady supply of aggregates over the plan period, to 2030; these aggregates are sharp sand and gravel, soft sand and crushed rock.

6.2 The County Council has agreed that provision will be made for 1.26 million tonnes sand and gravel per year (a division of 1.01 million tonnes sharp sand and gravel and 0.25 million tonnes soft sand per year) and 0.63 million tonnes crushed rock per year. Over the plan period, 16.77 million tonnes sand and gravel will be required, further to the current permitted reserves. No provision for crushed rock needs to be made as permitted reserves will fulfil the requirement over the plan period. The areas identified in the preferred strategy option will together need to deliver the level of provision for sand and gravel.

7. Strategic flood risk assessment of minerals resource areas

7.1 A Level 1 Strategic Flood Risk Assessment (SFRA) has been undertaken to assess potential flood risk within the county and how this may affect the selection of spatial strategies for minerals and waste and the delivery of specific sites. An initial study covering the northern half of the county was undertaken in conjunction with West Oxfordshire and

Cherwell District Councils, supported by the Environment Agency. That study was published in April 2009 and is available on the West Oxfordshire and Cherwell District Council websites.

7.2 The Level 1 Oxfordshire Minerals and Waste Strategic Flood Risk Assessment was completed in October 2010, again supported by the Environment Agency. This assesses the flood risk of possible mineral and waste sites across the whole of the County. It effectively replaces the West Oxfordshire and Cherwell study; only Appendix D of the initial study (assessment of the mineral and waste sites then identified) is retained.

7.3 The Level 1 Oxfordshire Minerals and Waste Strategic Flood Risk Assessment (including Appendix D of the initial study) is on the County Council website at: http://www.oxfordshire.gov.uk/cms/content/minerals-and-waste-development-framework. A series of maps in the SFRA identifies sources of flood risk.

7.4 Level 2 studies are prepared where detailed modelling work is required to assess the impact of possible new development on areas at risk of flooding. A Level 2 SFRA would be required where vulnerable waste site allocations are located in FZ 3 or highly vulnerable waste site allocations are in FZ2. The Level 1 study has not identified a need for a Level 2 study to inform work on the Minerals and Waste Plan.

7.5 Eighteen sand and gravel, one soft sand and five crushed rock resource areas were identified as the basis for flood risk assessment in the SFRA. The SFRA provided a flood risk assessment of each of these resource areas and of each of the minerals and waste sites nominated for inclusion in the Minerals and Waste Plan.

7.6 There were 4 stages in the generation, consultation on and revision of draft mineral strategy options.

- Stage 1: stakeholder consultation on an initial set of strategy options. Statutory consultees were also asked to respond to these options and a sustainability appraisal/strategic environmental assessment was undertaken. Options were then revised, incorporating the responses received.
- Stage 2: further consultation with stakeholders and statutory consultees on revised strategy options. Further iteration of SA/SEA undertaken.
- Stage 3: interim minerals strategy agreed by Cabinet, October 2010, whilst local needs assessment for aggregates is undertaken.
- Stage 4: Preferred minerals strategy recommended to Cabinet, February 2011. (Map at appendix 2) The selection of a preferred approach minerals strategy is informed by the previous consultations and assessments and by the sequential test.

7.7 These resource areas were used as the basis upon which spatial strategy options were drafted for future sand and gravel, soft sand and crushed rock working, informed by the site nominations. All areas were considered for their potential for inclusion in the mineral strategy options, based on the extent and quality of the resource in each area. If it was found that an area was unlikely to be able to make a strategic contribution to the supply of minerals over the plan period, the area was discounted at this initial stage. Sand and gravel extraction is a water compatible use, but the sequential test is still applied to the assessment of these areas as flooding could cause damage, disruption and loss of earnings to this type of development.

7.8 Below is a brief overview of each resource area. Maps of the sand and gravel, soft sand and crushed rock resource areas are at Appendix 1.

7.9 Sand and Gravel Resource Areas (RAS):

RAS 1

The Upper Evenlode valley in the Cotswolds AONB. The sand and gravel resources here are thin and intermittent. 92.8% of this area lies in flood zone 1, but despite the low flood risk, this area is not included in any of the strategy options due to its inability to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 2

The River Cherwell runs from north to south through this resource. It has several tributaries including the Hook Norton, Bloxham and Deddington brooks. 92.7% of this area lies in flood zone 1, but the resource area has not been included in any of the strategy options because of the thin and intermittent nature of the sand and gravel here.

RAS 3

This area lies in the north east of the county and covers a glacio-fluvial sand and gravel deposit. 97.6% of this area lies in flood zone 1 but the area has not been included in any of the strategy options due to its distance from the main markets in the county and the thin and localised deposits which are unlikely to be able to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 4

This extensive area in W Oxfordshire contains some significant resources of sand and gravel. It is bordered to the south by the Upper Thames. Many tributaries flow into the Thames across this resource area, including the Clanfield and Broadwell brooks. Villages such as Bampton have experienced flooding in recent years. The area was considered in the initial draft set of options; following consultation, its extent was slightly reduced for the stage 2 consultation. It is not included in the proposed preferred minerals strategy on the grounds of poor access, infrastructure and distance to markets.

RAS 5

The Lower Windrush Valley lies south of Witney. The Windrush river and Hardwick Brook flow through this resource area and the Thames flows along the southern edge of the area. There has been extensive mineral extraction in this area in the past and the Environment Agency has expressed concerns about the cumulative impact of further working on ground water flows and on the low flows of the River Windrush, which were originally caused by over abstraction but are exacerbated by the gravels adjacent to it which allow water to percolate through, away from the main channel. There are large areas of open water, the result of previous mineral extraction.

There are records of flooding associated with the Upper Thames and in Standlake with flooding associated with the Newbridge Cut. 39% of this area lies in the functional flood plain. Thames Water also has records of sewer flooding in this area.

The area still has extensive mineral resources and it has good infrastructure which links it to the A40 and to local markets. For these reasons, the area was included in the initial set of options and in the revised options, and is included in the proposed preferred strategy. Officers have balanced the potential hydrology issues with other planning criteria. It is felt that as long as extraction continues at the existing level of working and is not allowed to increase, mitigation measures can be put in place to manage the hydrological issues that extraction raises.

RAS 6

The Upper Thames flows along the south of this resource area, in the Eynsham/Cassington area. Local villages have been affected by flooding from the River Thames and its tributaries in the past. The area has extensive sand and gravel resources and good access to the A40 and to the main markets in Oxfordshire. It was included in the stage 1 and stage 2 consultations and is included in the proposed preferred minerals strategy.

RAS 7

The River Cherwell floodplain is dissected by numerous tributaries, including the River Ray which flows from east to west across this resource area. 66.9% of this area lies in flood zone 1, although 25% lies in the functional flood plain, flood zone 3b. The area has not been included in any of the draft strategy options because of its intermittent sand and gravel resources, which are unlikely to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 8

This small area of sand and gravel lies south west of Faringdon, 99.7% in flood zone 1. Both site nominations lie entirely in flood zone 1. The area was included in strategy options at the Stage 1 consultation but was not taken forward into stage 2 due to its inability to make a

strategic contribution to the supply of resources over the plan period.

RAS 9

This area lies south west of Oxford city centre. The River Thames flows from north to south through it and there are tributaries which cross the area from west to east. The area was included in the Stage 1 consultation. The northern part of this area was not taken forward into stage 2 due to its proximity to housing and issues of access, therefore no further assessment of flood risk is required. The southern part of this area, around Radley and Nuneham Courtenay, is included in the proposed preferred minerals strategy. Of the 136 hectares nominated, 66 hectares (49%) are in the functional flood plain and 36 hectares (26%) are in flood zone 1.

RAS 10

The River Thame runs from east to west and then south through this resource area. 87.6% of this area lies in flood zone 1 and 10.6% in the functional flood plain. The area has not been included in any of the strategy options because the resource here is thin and intermittent and is unlikely to be able to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 11

This resource area lies south west of Abingdon. The River Ock flows east towards the River Thames across the resource area and a number of tributaries flow into the Ock. 72.8% of the area lies in flood zone 1 and 16.2% in flood zone 3b, the functional flood plain. This area has not been included in the draft options due to its thin and intermittent resource which is unlikely to be able to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 12

This resource area lies south of the River Thames, between Sutton Courtenay and Wittenham. The R Thames runs west to east along the north side of the resource area. There are historic records of flooding along the Upper Thames floodplain. There has been previous working in the Sutton Courtenay area but there are some remaining resources in this area, which has good access to markets. This area was included in the Stage 1 and Stage 2 consultations on strategy options and is included in the proposed preferred minerals strategy. Almost half of the resource lies outside the functional floodplain, which gives potential for working to take place outside flood zone 3b.

RAS 13

This is an extensive area in South East Oxfordshire where the Thame river flows into the Upper Thames and the Chalgrove brook passes from east to west to join the River Thame at Stadhampton. Properties at Shillingford and Dorchester have reportedly been affected by fluvial flooding associated with the River Thames. There are records of groundwater flooding along the course of the Ewelme stream near

Benson and Littleworth. The majority of the sites nominated in this area are outside of the floodplains. The area was included in the stage 1 and stage 2 consultations on strategy options but is not included in the proposed preferred strategy for minerals development. The preliminary site assessment indicated that extensive archaeological assets in this area and the presence of grade 1 agricultural land would preclude development in a significant part of this area.

RAS 14

This resource area lies between Cholsey and Wallingford. The River Thames flows from north to south along the eastern edge of this area and several brooks cross the resource area such as the Mill Brook and the Cholsey brook. This area was included in the stage 1 consultation as part of the Warborough/Benson/Shillingford area but was identified as a separate option area in the stage 2 consultation and it is included in the proposed preferred minerals strategy. It has good access to the Didcot/Wantage /Grove area around the Wallingford bypass. The majority of the areas identified in the site nominations are outside flood zones; this area is likely to be able to deliver sand and gravel without increasing risk of flooding.

RAS 15

This area of glacio-fluvial resource lies along the escarpment of the Chiltern hills. Two small streams, the Chalgrove brook and the Ewelme stream cross the resource area. 97.8% of this areas lies in flood zone 1 but the area has not been included in any of the strategy options because the resource here is thin and intermittent and is unlikely to make a strategic contribution to the supply of sand and gravel over the plan period.

RAS 16

This resource area is divided into a west and an east section. Both areas are adjacent to the River Thames, north of Reading. Both areas were included in the Stage 1 and stage 2 consultation. The east area is included in the proposed preferred minerals strategy; the western area was not included due to poor access to the area, to the potential impact of working on the Area of Outstanding Natural Beauty and due to unlikely deliverability. Local villages such as Sonning Eye have been affected by flooding from the River Thames and its tributaries in the past.

RAS 17

This resource area covers the sand and gravel resources in the Chiltern Hills AONB. 97.6% of this area lies in flood zone 1 but the area has not been included in any of the strategy options because the resource here is thin and intermittent and is unlikely to contribute to the supply of sand and gravel over the plan period.

RAS 18
This area is bounded by the River Thames and has plentiful alluvial sand and gravel resources. Access to the area is constrained by the need to pass through local villages and towns. The area was included in the Stage 1 and stage 2 consultations but is not included in the proposed preferred minerals strategy.

7.10 Soft Sand Resource Areas (RASS):

RASS 1
This extensive area of soft sand extends from Oxford south west to Faringdon. A number of streams flow through the resource area and there has been some flooding of properties associated with the Marcham brook. There are records of sewer flooding near Coleshill and Highworth in the west of the resource area. 97.2% of this area lies in flood zone 1. The area was included in the stage 1 consultation and was revised and reduced in size in the stage 2 consultation. Two smaller areas within the overall resource area are included in the proposed preferred minerals strategy, based on existing working areas.

7.11 Crushed Rock

RAR 1
This resource area covers the limestone resource in the north west of the county, much of which lies in the Cotswolds AONB. The River Evenlode and River Glyme flow east and south respectively to join the Upper Thames just south of the resource area. There are records of properties affected by flooding from the Evenlode and its tributaries at Ascott under Wychwood, Shipton under Wychwood and Charlbury. There are no recorded incidents of groundwater flooding in this area. 96% of this area lies in flood zone 1. 3.6% of the area lies in flood zone 3b.

The majority of this area was discounted for inclusion in the draft options because it lies largely within the Cotswolds AONB. However, a small area south of Burford in the extreme south of the resource area was included for consultation at stage 1 and stage 2 and is included in the proposed preferred minerals strategy as an area of existing limestone working.

RAR 2
This resource area covers the ironstone resource in the north of the county and a small area of limestone. The River Cherwell flows north to south along the eastern edge of the resource area adjacent to the Oxford canal. Several brooks, tributaries of the Cherwell, flow from west to east across the resource area. 93.3% of this area lies in flood zone 1.

The ironstone resource has not been identified in the draft spatial strategy options as there are extensive permitted ironstone reserves

which will last to beyond the end of the plan period so there is no need to identify further resources. The southern part of this area where there are limestone resources was included in the initial stage 1 consultation but was not taken forward to stage 2; no further assessment of risk of flooding is therefore required.

RAR 3

This resource area covers an extensive limestone resource in the north east of the county. Despite the extensive area that is shown on the BGS maps, there is only one operational quarry in this area at Ardley. The River Cherwell and Oxford canal are located in the western part of the resource area and flow from north to south. Other brooks flow through Bicester towards the south of the resource area. There has been flooding historically along the floodplain of the River Cherwell. 92.6% of this area lies in flood zone 1.

The north western part of this area was included in the initial stage 1 consultation on options for limestone and a smaller area around Ardley was identified in the stage 2 consultation and is included in the proposed preferred minerals strategy.

RAR 4

This resource area covers the extensive, though intermittent limestone resource which extends south west from Oxford to Faringdon. The river Ock and associated tributaries flow west to east along the south of the resource area. The Upper Thames River flows west to east to the north of the Resource Area and around the eastern end. Properties in Charney Bassett have been affected by fluvial flooding from the River Ock and Charney Wick ditch. Properties in Marcham have been affected by flooding from the Marcham brook. 91% of this area lies in flood zone 1 and 5.7% of the area in flood zone 3b.

A small part of this resource area in the west of the area around existing quarries was identified in the Stage 1 and stage 2 consultations, and is included in the proposed preferred minerals strategy. Two minor, unnamed tributaries of the River Ock flow south east through the area.

RAR 5

This small resource area covers an area of intermittent limestone resource north east of Oxford. The upper reaches of the Bayswater brook are located within the resource area close to Sandhills. The limestone resource here is thin and there are currently no active working quarries in this area, which has not been identified in the draft options. 99% of this area lies in flood zone 1. This area has not been included in the preferred strategy as there is insufficient resource to be able to contribute to supply over the plan period.

8. Applying the sequential test to the resource areas and the strategy options

8.1 The boundaries of the resource areas and the strategy option areas do not correlate exactly, but they contain the same groups of nominated sites. The flood risk assessment has therefore been carried out on the relevant groups of sites within each resource area and this information can be used as an assessment of the relevant strategy options.

8.2 Table 3 shows the process of applying the sequential test to the strategy options. Column 1 of tables 3 and 4 identify each resource area and column 2 shows which strategy option area this relates to.

8.3 The third column of tables 3 and 4 show the percentage of the resource area in the flood zones. This column is for information only and provides the context within which the flood risk assessment of the deliverable sites takes place. The fourth column refers to the percentage of the deliverable areas in the flood zones. These areas are sites nominated for inclusion in the Minerals and Waste Plan by operators or land agents. Column 5 provides a flood risk assessment of the nominated sites using criteria in the key below. Each group of sites is given a RAG (red, amber, green) status according to the proportions of the total area of the nominations which fall within flood zone 1 and flood zone 3. The comments column (column 6) demonstrates how the flooding risk has been balanced against other planning criteria which were used in the Preliminary Site Assessment report (January 2011)

Key for column 5 for table 3

	Up to 25% deliverable area in FZ 1 and more than 75% deliverable area in FZ 3
	20-50% deliverable area in FZ 1 and 30-75% deliverable area in FZ 3
	More than 50% in FZ 1 and less than 30% in FZ 3

8.4 Site allocations within areas identified in the Core Strategy will undergo further sequential testing through the site allocations DPD. This is in order to ensure areas at lowest flood risk are worked in preference to sites at high flood risk where possible, taking account of other planning considerations. Once individual sites are allocated within the site allocations DPD they will be considered to have been already sequentially tested and therefore planning applications coming forward within allocated sites would not be expected to undergo a further sequential test. However, a site specific flood risk assessment will be required to ensure flood risk is not increased as a result of the workings, which may involve the identification of mitigation to achieve this. A sequential approach to site layout should also be applied, for example locating ancillary facilities such as plant and building in areas of the site at the lowest risk of flooding where possible.

Table 3: The sequential test and sand and gravel resource areas

1	2	3			4			5	6
Resource area Sand & Gravel (RAS)	Strategy Option area	% of the whole area in flood zones			% of deliverable area (nominated sites)			RAG status based on % in FZ 1 & FZ 3	Assessment of the area based on flood risk and other planning criteria
		FZ 1	FZ2 & 3a	FZ 3b	FZ 1	FZ2 & 3a	FZ 3b		
1	None	92.8	1.0	6.2	No noms	No noms	No noms		Area rejected; insufficient resource
2	None	92.7	1.9	5.4	No noms	No noms	No noms		Area rejected; insufficient resource
3	Finmere	97.6	2.4	0	No noms	No noms	No noms		Area rejected; insufficient resource
4	Clanfield/ Bampton	56.7	7.1	36.2	50.0	10.7	39.3		Area rejected on grounds of distance from markets, poor access & infrastructure & archaeological assets.
5	Lower Windrush Valley & Sutton/ Stanton Harcourt	48.4	11.8	39.8	52.7	9.8	37.5		Although there is a flood risk in this area, this is outweighed by: the need to work minerals efficiently using existing sites and infrastructure, good location for proximity to markets, road infrastructure is good, few other environmental constraints such as archaeology or designated areas. More detailed assessment of ground water flows will be required at planning application stage.
6	Eynsham/ Cassington/Yarnton	72.2	4.3	23.5	27.5	5.0	67.5		Although there is a flood risk in this area, this is balanced against by: the need to work minerals efficiently using existing sites and infrastructure, good location for proximity to markets, road infrastructure is good, few other environmental

									constraints such as archaeology or designated areas.
7	None	66.9	8.1	25.0	No noms	No noms	No noms		Area rejected; insufficient resource
8	Faringdon	99.7	0	0.3	100	0	0		Area rejected; insufficient resource
9	Radley/ Nuneham Courtenay	68.9	10.7	20.4	26.1	25.3	48.6		Area rejected due to unlikely deliverability due to poor access and presence of archaeological assets & historic environment.
10	None	87.6	1.8	10.6	No noms	No noms	No noms		Area rejected; insufficient resource
11	None	72.8	11	16.2	No noms	No noms	No noms		Area rejected; insufficient resource
12	Sutton Courtenay	67.3	16.3	16.4	40.2	18.9	40.9		Flood risk in this area is outweighed by: the need to work minerals efficiently using existing sites and infrastructure, good location for proximity to markets, road infrastructure is good, few other environmental constraints such as archaeology or designated areas.
13	Warboro'/ Shillingford/ Benson	76.7	8.6	14.7	25.0	26.0	49.0		Area rejected on grounds of archaeological assets and presence of Grade 1 agricultural land.
14	Cholsey	80.1	9.2	10.7	64.0	28.0	8.0		Area included in preferred strategy on basis of low flood zone risk, good access, few other environmental constraints
15	None	97.8	0.2	2.0	No noms	No noms	No noms		Area rejected; insufficient resource
16	Caversham	47.5	8.3	44.2	0	9.5	90.5		Area included on grounds of flood risk outweighed by: the need to work minerals efficiently using existing sites and infrastructure, good location for proximity to markets in Reading, road infrastructure is good, few other environmental

									constraints such as archaeology or designated areas.
17	None	97.6	2.4	0	No noms	No noms	No noms		Area rejected; insufficient resource
18	Clifton Hampden	65.6	14.5	19.9	20.0	45.7	34.3		Area not included in preferred strategy due to medium flood risk and poor access
Soft sand areas									
RASS 1		97.2	0.7	2.1	99.2	0	0.8		Nominated sites lie almost completely outside the flood plain.

Table 4: The sequential test and crushed rock resource areas

1	2	3			4				5 6
Resource area	Strategy option area	% of whole area in the flood zone			% of deliverable area in the flood zone			RAG status based on % in FZ 1 & FZ 3	Comments
		FZ 1	FZ 2 & 3a	FZ 3b	FZ1	FZ 2 & 3a	FZ 3b		
Crushed rock areas									
RAR 1	Burford area	96.0	0.4	3.6	100	0	0		Low flood risk. Established area of working. Good access, plentiful resource, few environmental constraints.
RAR 2	None	93.5	1.3	5.2	-	-	-		Area rejected; insufficient resource
RAR 3	E of R Cherwell	92.6	2.2	5.2	-	-	-		Low flood risk. No nominations but established resource in this area. Individual site nominations will need to be subject of further appraisal
RAR 4	Hatford	91.5	2.8	5.7	100	0	0		Low flood risk, established area of working, good access
RAR 5	None	99.1	0.5	0.4	99.1	0.5	0.4		Area rejected; insufficient resource

Key for column 5 for table 5.

	Any of the deliverable area in FZ 3b
	Deliverable areas in FZ 2, 3a
	Deliverable area in FZ 1.

Crushed rock extraction is not water compatible development; it should take place in flood zones 1, 2 and 3a.

9. Sustainability Appraisal (SA) and Strategic Environmental Assessment (SEA)

9.1 Stage 1 SA/SEA:
Consultants carried out a SA/SEA of the initial minerals spatial strategy options, using the objectives from the SA Scoping report (2009). The SA did not identify flooding as a potential issue for mineral extraction although it recognised the potential cumulative impacts of working on the landscape and amenity.

9.2 Stage 2 SA/SEA:
Option 1 and option 3 of the revised strategy options included the existing working areas of Lower Windrush Valley, Eynsham/Cassington/Yarnton, Radley and Sutton Courtenay. The stage 2 SA/SEA identifies some potential negative impacts on flooding of mineral extraction in these existing working areas. It notes that:
'Some areas within the Lower Windrush Valley, the Eynsham, Cassington, Yarnton area, Radley and Sutton Courtenay option areas lie within flood risk zones 2 and 3. The Environment Agency (EA) requires that development should be avoided in the floodplain where possible and would require the sequential and (where appropriate), the exception tests as required through Planning Policy Statement 25 (PPS25). There is potential for cumulative negative effects on ground water flow as a result of concentration of mineral workings within one area and in particular in the Lower Windrush Valley and the Cassington areas.'
Option 2 of the revised strategy options included new working areas; Clanfield/Bampton, Warborough/Shillingford/Benson, Cholsey, Sutton/Stanton Harcourt; and Culham/Clifton Hampden/Dorchester (CCD). The SA/SEA did not identify flooding as a potential issue in these areas.

9.3 Stage 3 – SA/SEA of the interim strategy:
No SA/SEA was undertaken of the interim minerals strategy which was agreed by Cabinet in October 2010 because this strategy was based on the options which were the subject of the SA in August 2010.

9.4 Stage 4 – SA/SEA of the preferred approach document:
This iteration of the SA will appraise the preferred minerals spatial strategy, the draft minerals policies and the agreed level of need for sand and gravel, soft sand, crushed rock and secondary and recycled aggregates.

10. Conclusions on sequential test on mineral strategy options

10.1 Five option areas have been selected for inclusion in the preferred strategy for sand and gravel extraction. These are:

- Lower Windrush Valley,
- Eynsham/Cassington/Yarnton
- Sutton Courtenay
- Caversham
- Cholsey

These areas have been selected on the basis of balancing all the planning criteria and the flood risk assessment.

10.2 Areas in low flood risk zones:
Nine areas are in the lowest flood risk zone, but they have not been included in the preferred strategy as they have insufficient resource to be deliverable. The Cholsey area is in the lowest flood zone risk and has been included in the preferred strategy.

10.3 Areas in medium flood risk zones:
Four areas are in medium flood risk zones but have not been included in the preferred strategy. These areas have been excluded on the following grounds: Clanfield/Bampton - poor access, distance from markets and archaeological assets; Radley - poor access, historic environment and archaeology; Warborough/Benson/Shillingford - archaeological assets and the presence of Grade 1 agricultural land; Clifton Hampden – poor access and archaeological assets.

Three areas in medium flood risk zones have been included in the preferred strategy; the Lower Windrush Valley, Eynsham/Cassington/Yarnton and Sutton Courtenay. These areas have been identified because when flood risk is weighed against other planning criteria, on balance these areas should be included due to their access, proximity to markets, and to work efficiently using existing infrastructure. The sequential test should inform the site allocation process in each of these areas to ensure that sites with lower flood risk are worked within this area in preference to sites with higher flood risk.

10.4 Area in high risk flood zone:
The Caversham area is located in a high risk flood zone but has been included in the preferred strategy. It has not been possible to steer development from this area because it is considered that this area meets a need for high quality, flinty sand and gravel in the Reading area and is in a sustainable location because of its proximity to the markets it serves in Reading. There is only one site in this area and a draft planning application has been received by the council for that site; therefore the findings of the sequential test in this document apply and the sites can be allocated. However, the planning application will need to be accompanied by a flood risk assessment to ensure that flood risk is not increased as a result of the proposed workings and a sequential approach to the site layout should also be applied.

10.5 Delivery of the options: Site nominations

This section describes the number of site nominations in each sand and gravel option area, the extent of them in the functional flood plain, and the net yield available from sites which have the smallest areas in the flood plain. This information provides an indication of likely deliverability of each area from the lowest risk flood zones:

- The anticipated rate of supply from each of the preferred option areas is: Lower Windrush Valley – 500,000 tonnes per annum
- Eynsham/Cassington/Yarnton – 180,000 tonnes per annum
- Sutton Courtenay – 330,000 tonnes per annum (this area will be exhausted at this rate by 2020)
- Caversham – 130,000 tonnes per annum
- Cholsey – 200,000 tonnes per annum(to be developed when Sutton Courtenay is exhausted)

10.5.1 In the Eynsham/Cassington/Yarnton area, there are seven site nominations. Four of them have more than 90% of their area in flood zone 3b. Three sites have less than 55% of their area in flood zone 3b. Together, these three sites have a yield of 3.82 million tonnes, which at the current rate of working (180,000 tonnes per annum) would last for 21 years.

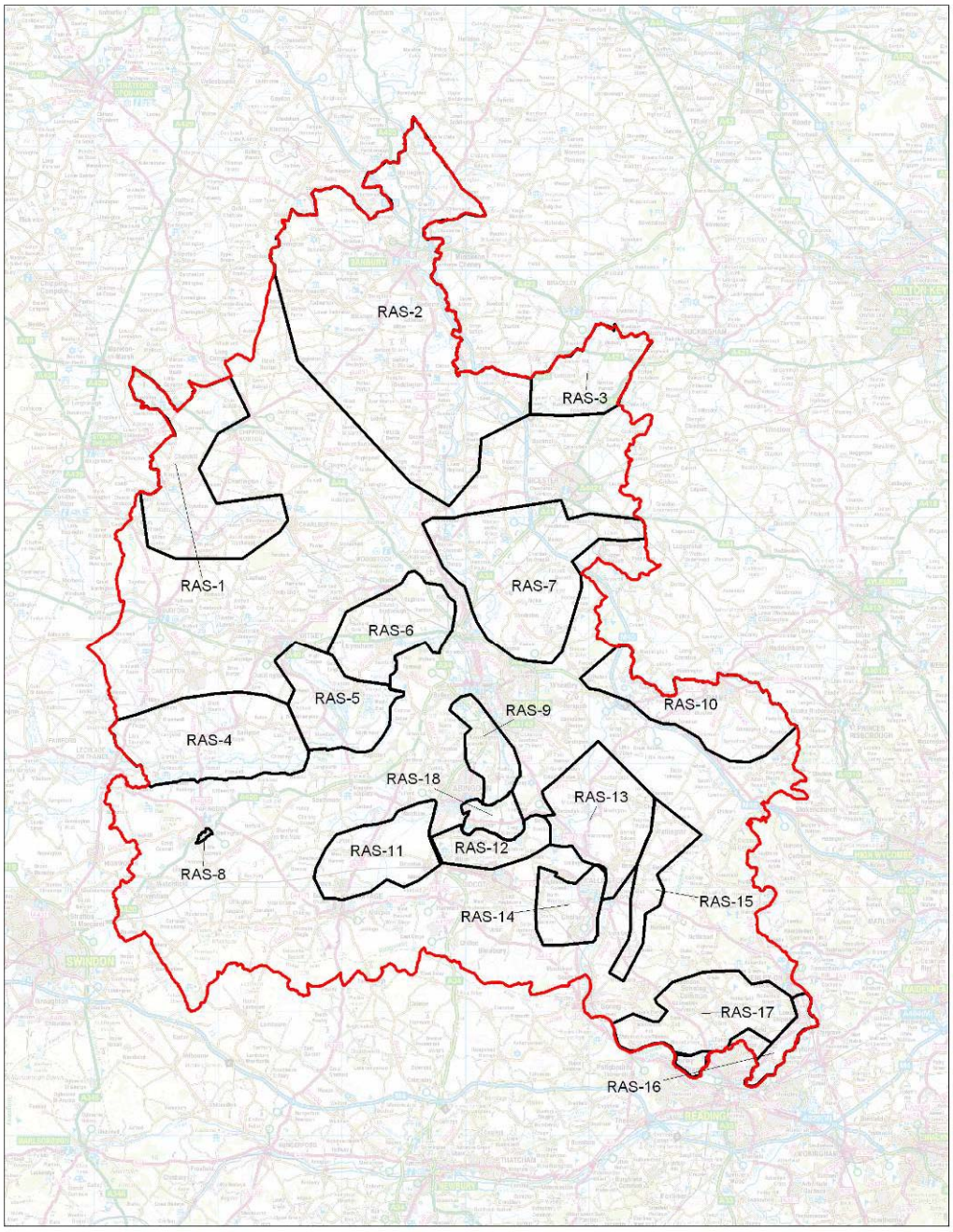
10.5.2 In the Lower Windrush Valley, there are twelve site nominations. Of these, two sites have more than 80% of their area in the flood zone 3b; in each of the remaining sites, less than 16% of the site area is in flood zone 3b. Together, these ten sites have a potential yield of 14 million tonnes, which at the current rate of working (500,000 tonnes per annum) would last for 28 years.

10.5.3 In the Sutton Courtenay area, there are four site nominations, the area of one of which is more than 76% in the functional flood plain. The other three sites have less than 21% of their area in flood zone 3b. These three sites together have a potential yield of 2.05 million tonnes, which at the current rate of working (330,000 tonnes per annum) would last for 6.2 years.

10.5.4 In the Cholsey area, there are three site nominations, the area of none of which is more than 27% in flood zone 3b. Together these three nominations have a potential yield of 4.86 million tonnes, which at the proposed rate of working would last for 24 years.

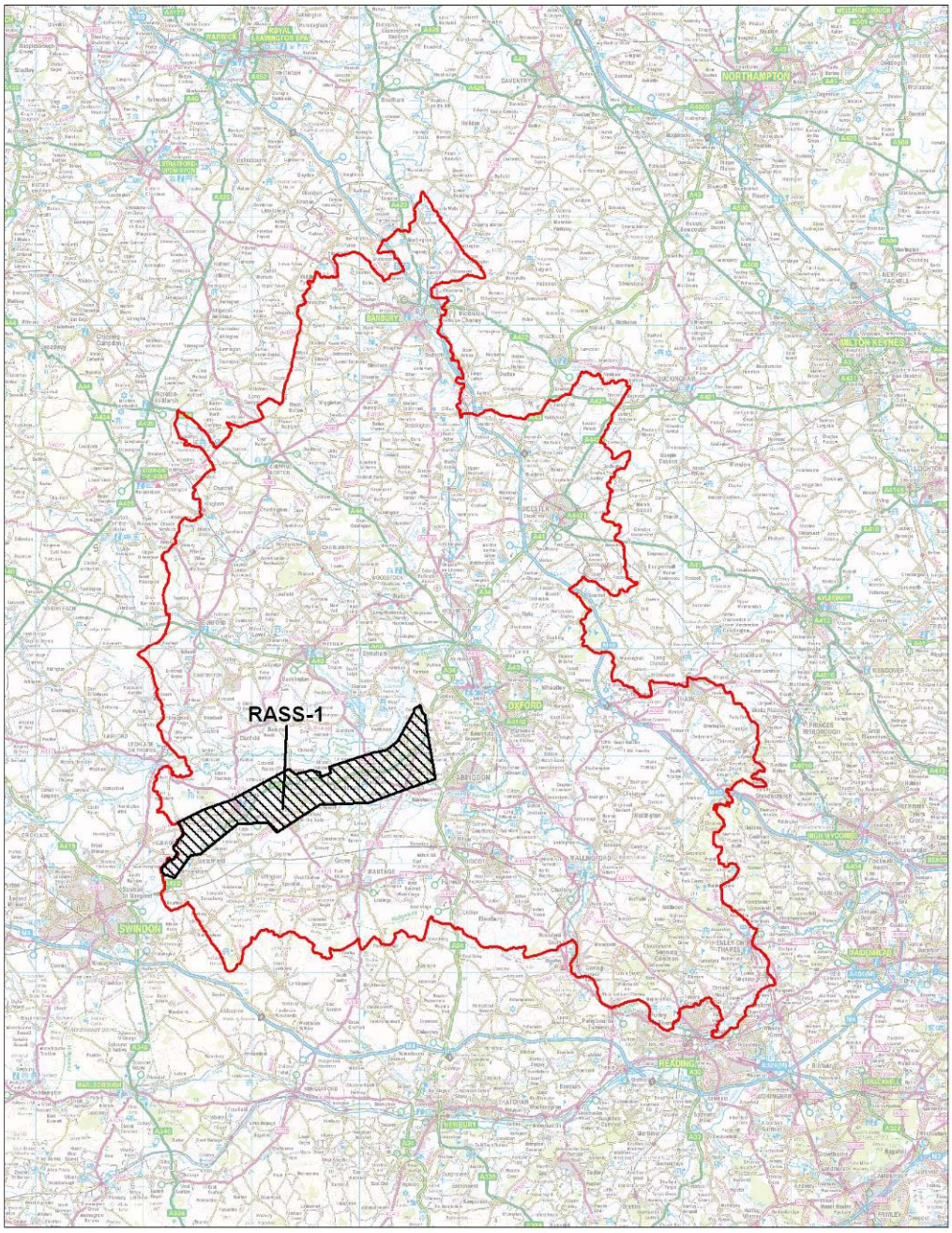
10.5.5 In the Caversham area, there is one site nomination, the area of which is 92% in flood zone 3b. This site has a potential yield of 4 million tonnes, which at the current rate of working would last for at least thirty years. There is therefore the potential to significantly reduce the area proposed for extraction and for the site to still be able to supply sand and gravel throughout the plan period, should the flood risk assessment at planning application stage be deemed unacceptable.

Appendix 1: Resource Areas Sand and Gravel



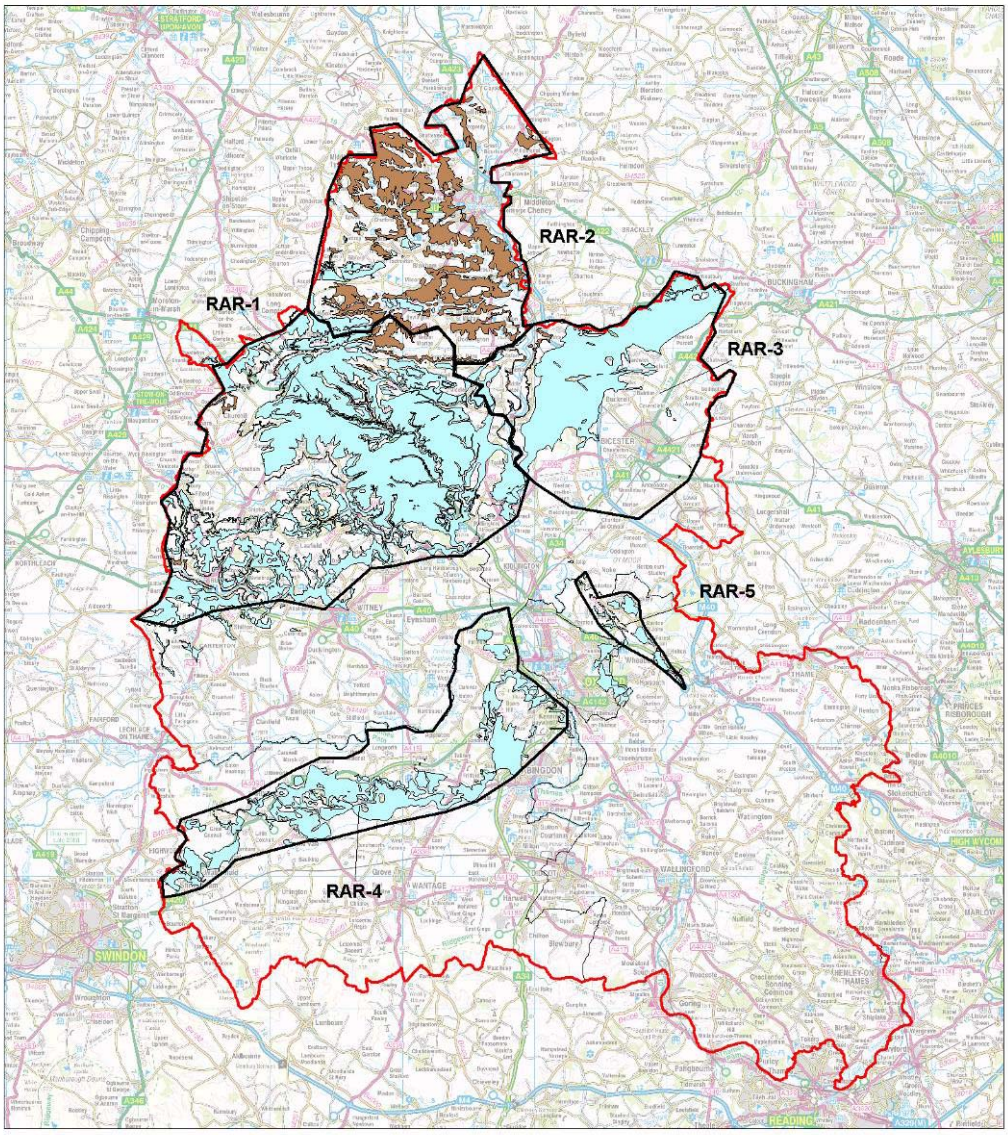
Resource Area Soft Sand

Soft Sand - Spatial Strategy Option



Resource Areas Crushed Rock

Crushed Rock - Resource Areas



Appendix 2: Proposed strategies for sand and gravel, soft sand and crushed rock.

Preferred strategy for crushed rock, soft sand and sharp sand and gravel