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Mineral Safeguarding Areas for the City of York

Minerals and Waste Programme

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BRITISH GEOLOGICAL SURVEY

MINERALS and Waste PROGRAMME

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Mineral Safeguarding Areas for the City of York

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List of abbreviations

BGS	British Geological Survey
BRITPITS	BGS's database of mines and quarries
CYC	City of York Council
DCLG	Department for Communities and Local Government
DIGMAP	BGS's digital onshore geology maps
DPD	Development Plan Documents
ESRI	Environmental Systems Research Institute (company which supplies the GIS software used in this project)
GIS	Geographical Information System
MPA	Mineral Planning Authority
MSA	Mineral Safeguarding Area
NERC	Natural Environmental Research Council
NPPF	National Planning Policy Framework
NYMNPA	North York Moors National Park Authority
NYCC	North Yorkshire County Council

Foreword

This British Geological Survey (BGS) report presents the results of an exercise that defines recommended Mineral Safeguarding Areas for the City of York Council. The exercise is based on published BGS mineral resource maps and expert geological knowledge. Resources that are proposed for safeguarding are described and presented, together with a justification for their inclusion. Consultation on the draft report and maps took place in autumn 2013 and has informed this final report.

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Summary

This report describes work carried out by the British Geological Survey (BGS) on behalf of the City of York Council (CYC) to delineate draft Mineral Safeguarding Areas (MSAs), the results of which will be used to undertake a mineral consultation safeguarding exercise. The approach taken is in accordance with the methodology outlined in 'Mineral safeguarding in England: good practice advice' (Wrighton *et al*., 2011). National policy for minerals safeguarding, at the time of the study, is contained within the National Planning Policy Framework, which was published in March 2012.

The work involved in this study included the provision of maps showing the extent of mineral resources in the City of York and providing a recommended safeguarding methodology for each mineral resource informed by consultation. This report will be used to inform the establishment of MSAs through minerals planning policy, MSAs themselves are not finalised until relevant planning policy is adopted. Data depicted on the maps have been provided in digital format to the council for use within a Geographical Information System.

1 Introduction

With increased pressure on land-use in the UK, there is a need to ensure mineral resources are not needlessly sterilised by other forms of development, restricting access for future generations. 'Mineral safeguarding' is the term that encompasses the process necessary to ensure that outcome.

There are two stages to the safeguarding process: (i) the identification of mineral resources and the definition of Mineral Safeguarding Areas (MSAs) where mineral sterilisation should be considered in the planning process; and (ii) the development of associated policies that guide the management of development proposals that are submitted in these areas. The City of York Council (CYC) commissioned the BGS to delineate recommended MSAs to inform the Minerals and Waste Joint Plan (which they are producing with North Yorkshire County Council and The North York Moors National Park Authority). This work does not include the development of suitable policies that will guide development decisions in these areas. This will be undertaken by CYC during their plan making process. MSAs are based on BGS geological linework, and amended where appropriate based on expert geological knowledge.

1.1 PLANNING CONTEXT

National policy for minerals safeguarding, at the time of the study, is contained within the National Planning Policy Framework published in March 2012. Box 1 outlines the general policies for the safeguarding of minerals. The presence of mineral safeguarding areas gives no presumption for working and planning polices for the extraction of minerals apply regardless of the presence of MSAs. Mineral safeguarding areas indicated the presence of potential mineral resources and do not take into account any designations or policies which may have a bearing on the likelihood of extraction being acceptable.

Box 1 Key instructions in planning policy and available advice

National Policy

The *National Planning Policy Framework* (March 2012) outlines the national policy for safeguarding mineral resources. It requires Mineral Planning Authorities in England to define MSAs in their local plans and adopt appropriate policies.

'In preparing Local Plans, local planning authorities should: ...

...define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas...

... set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place' [para 143].

'When determining planning applications, local planning authorities should: ...

... not normally permit other development proposals in mineral safeguarding areas where they might constrain potential future use for these purposes' [para 144].

'Minerals planning authorities should plan for a steady and adequate supply of industrial minerals by: ...

... encouraging safeguarding or stockpiling so that important minerals remain available for use' [para 146].

The definition of minerals of local and national importance is provided in Annex 2:

'Minerals which are necessary to meet society's needs, including aggregates, brickclay (especially Etruria Marl and fireclay), silica sand (including high grade silica sands), cement raw materials, gypsum, salt, fluorspar, shallow and deep-mined coal, oil and gas (including hydrocarbons), tungsten, kaolin, ball clay, potash and local minerals of importance to heritage assets and local distinctiveness.'

Key documents
Mineral safeguarding in England: good practice advice (Wrighton *et al*., 2011).

1.2 KEY DEFINITIONS

Box 2 provides some background to the terms used in the report.

Box 2 Mineral Safeguarding Areas
'Mineral resources are natural concentrations of minerals in or on the Earth's crust that are or may become of economic interest because they are present in such form, quality and quantity that there is the potential for eventual economic extraction. Mineral resources are thus defined by economic as well as physical parameters' [para 2.1.1]. *'The definition of MSA boundaries requires up-to-date, factual information on the physical location of mineral resources and should be based principally on the best available mineral resource information at the time MSAs are defined. In the context of the plan making process, geology, unlike many other factors that influence planning, does not change with time'* [para 4.1.1]. *'There is no presumption that areas within a MSA will ultimately be allocated for extraction. If an application is submitted for mineral extraction within a MSA, the MSA designation itself does not provide any support for a grant of consent. If a MPA wishes to define future allocations for extraction then such areas must be identified as Areas of Search, Preferred Areas, and Specific Site allocations. Equally, there is no presumption that non-mineral development within a MSA is automatically precluded. MSAs alert those proposing sites for future development to the presence of valuable mineral resources which they otherwise might not have considered'* [para 2.3.3]. *'The MSAs indicate where local mineral safeguarding policies, formulated specifically to suit local circumstances, may apply. The process should ensure that minerals are not unnecessarily sterilised whilst allowing competing development to proceed if there is an overriding need for it. In those circumstances extraction of the mineral ahead of the development (prior extraction) should always be considered'* [para 2.3.3]. Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011).

1.3 LIMITATIONS

The identification and delineation of mineral resources (the first step in the mineral safeguarding process) is imprecise as it is limited by the quantity and quality of data currently available and involves predicting what might or might not become economic to work in the future. The pattern of demand for minerals is continually evolving due to changing economic, technical and environmental factors. The economic potential of mineral resources is not static, but it changes with time.

The mineral resource maps which informed the current work are derived from geological linework forming part of the national 1:50 000 scale digital geology coverage, DiGMapGB-50, from the BGS. This dataset is based on surveys carried at 6-inch or 1:10 000 scales, and acquired at different times. Whilst every effort has been made to ensure consistency of approach across the unitary authority, the level of detail reflects in part the variation in the age of the mapping.

2 Methodology

Mineral resources and a recommended safeguarding methodology have been defined in the CYC area in accordance with 'Mineral safeguarding in England: good practice advice' (Wrighton *et al*., 2011). The document outlines a seven-step approach to creating an effective system for mineral safeguarding. The scope of work undertaken by BGS for CYC is limited to steps 1 and 2. Steps 3-7, which include consultation on draft MSAs and drafting of the associated policies, are beyond the scope of this study.

Box 3 Step by step approach to creating an effective safeguarding system for minerals	
Step 1	Identify the best geological and mineral resource information
Step 2	Decide which mineral resources to safeguard and the physical extent of MSAs
Step 3	Undertake consultation on draft MSAs
Step 4	Decide on the approach to safeguarding in the Core Strategy[1]
Step 5	Include development management policies in a DPD
Step 6	Include safeguarding in district level DPDs
Step 7	Include mineral assessments in the local list of information requirements

Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011).

2.1 STEP 1: IDENTIFY THE BEST GEOLOGICAL AND MINERAL RESOURCE INFORMATION

The first step in the MSA process is to identify the most recent geological and mineral resource information. The mineral resources that are present in the CYC area are shown in Figure A1 whilst an overview of the geology is provided in Appendix 2.

A review of the mineral resource information held by BGS, including national updates, resulted in the selection of resources that are found in the CYC area. As part of a preceding study, CYC commissioned BGS to evaluate existing borehole records and update the sand and gravel resource linework for the area. A recent national update undertaken by BGS to crushed rock and non-aggregate resource linework provided the most recent data for brick clay in the CYC area. Deep coal data was obtained from coal resource data published in 1999. The Strategic Stone Study database (bgs.ac.uk/mineralsuk/mines/stones/EH_project.html) was used to confirm that there are not any building stone resources in the CYC area. The BGS mines and quarries database 'Britpits' was used to provide information on the location and current activity of quarries. All of the data were integrated within a GIS in order to undertake the process of defining MSAs. Table 1 summarises all of the data utilised during the study.

[1] This terminology reflects planning practice prior to the introduction of the NPPF in March 2012. Although in some areas strategic policies may be adopted in a separate DPD to development management and site allocation policies, at the time of this study CYC is producing a joint minerals and waste local plan so there may be some deviation to the steps presented in current good practice advice.

Table 1: Available mineral resource information

Resource	Data provider	Date of publication of dataset	Any more recent geological resource information	Comments
Sand and gravel	BGS	2013	No	Updated for CYC as a precursor to this study.
Limestone (crushed rock)	No resources in the study area			
Limestone (industrial)	No resources in the study area			
Sandstone (crushed rock)	No resources in the study area			
Igneous (crushed rock)	No resources in the study area			
Chalk (crushed rock)	No resources in the study area			
Silica sand	No resources in the study area			
Brick clay	BGS	2012	No	
Building stone	No resources in the study area			
Deep coal	BGS	1999	No	
Potash / Salt	No resources in the study area			
Gypsum / Anhydrite	Gypsum and anhydrite are discussed due to safeguarding proposals put forward in the Tees Valley Joint Minerals and Waste Core Strategy			

2.2 STEP 2: DECIDE WHICH MINERAL RESOURCES TO SAFEGUARD AND THE PHYSICAL EXTENT OF MSAS

As stated in Section 1.3, the pattern of demand for minerals is continually evolving due to changing economic, technical and environmental factors. Consequently areas that are of potential economic interest as sources of minerals may change with time. Using the best available data identified in Step 1, and the BGS mineral planning factsheets that have been prepared to inform the land use planning process, a list of mineral resources that are to be excluded from or included in the safeguarding process has been made. Where mineral resources are identified for exclusion, a justification has been put forward. This list and justification can be seen in Appendix 3.

In order to define the physical extent of MSAs, it has been decided that the mineral resource information identified in Step 1, and selected as part of Step 2, should be depicted on maps created of each mineral resource and used as a basis for consultation.

In the first instance, the full extent of each resource is included within the respective MSAs. This includes mineral resources in urban areas and in environmental designations in line with the mineral safeguarding good practice advice (Wrighton *et al*., 2011). In urban areas, the definition of MSAs will help to identify opportunities for prior extraction beneath large regeneration projects and brownfield sites. It is felt that justification for any other approach would be weak at this stage as it would diverge from the best practice advice. Policies can be used to control the amount of applications which would be considered on mineral safeguarding grounds – for example householder development applications may be excluded from the need to assess mineral sterilisation, by inclusion in an exemption policy. Many of these considerations are likely to be picked up through the consultation on policy and on the adoption of detailed mineral safeguarding boundaries that CYC will undertake in the course of their plan preparation. Development is more limited in environmental designations, and so in these instances the mineral resource should be considered alongside all of the other planning factors.

In the mineral safeguarding good practice advice, the issue of sterilisation by development that is permitted on or close to the edges of the identified resource boundaries is raised, as access to mineral resources is affected by consideration of the amenities of, and nuisance to, those that live and work close to the operation. For this reason, a 'buffer' distance, i.e. the extension that should be applied to the mineral resource boundary in order to create an MSA and protect the identified 'edges' of the resource from sterilisation, should also be subject to consultation (Box 4). Buffer distances, shown in Table 2, put forward for consultation were based on those included in the Minerals Safeguarding Areas report produced for North Yorkshire County Council. No amendments were suggested to these through the consultation process.

Box 4 Buffering of MSA boundaries
'The boundaries of MSAs may be extended beyond the lateral extent of a mineral resource to avoid sterilisation by adjacent development.' [Case study 3, page 20] Source: *Mineral safeguarding in England: good practice advice* (Wrighton *et al*., 2011).

Table 2: Buffer distances for consultation

Category	Buffer
Sand and Gravel	250m
Brick clay	250m
Deep coal	700m

3 Mineral Resources

This section provides a summary of the mineral resources in CYC from an economic perspective. It provides a geological description of the resource, information regarding extraction activity and a rationale for delineation of MSAs.

3.1 SAND AND GRAVEL

Sand and gravel are defined on the basis of particle size as opposed to composition. Currently the term 'gravel' (or more correctly coarse aggregate) is used to describe material coarser than 4mm, with a maximum size of 80mm. 'Sand' (or fine aggregate) is described as material that is finer than 4mm, but coarser than 0.063mm. Material with a particle size of less than 0.063mm (i.e. clay and silt) is classed as 'fines'. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint).

The superficial or 'drift' sand and gravel deposits accumulated in a variety of geological environments but are broadly divided into:

- River terrace deposits

- Sub-alluvial river terrace deposits
- Glacial sand and gravel

3.1.1 Geological description

RIVER TERRACE DEPOSITS (INCLUDING SUB-ALLUVIAL)

Resources in these deposits take the form of extensive spreads of sand and gravel that occur in both raised river terrace sequences, flanking the modern floodplains, and underlying alluvium ('sub-alluvial terrace deposits'). River sand and gravel resources are reasonably consistent over considerable distances, their composition reflecting, in general, the geology of the river catchment from which they were reworked. Generally, they are 'clean' deposits, with low fines content.

Only exposed river terraces are depicted on the 1:50 000 scale geological maps, although inferred[2] resources in sub-alluvial sand and gravel deposits occurring beneath river floodplains may be extensive in some places and have been identified from the mineral resources map data used for this project. Where they underlie alluvium, these deposits will be water saturated and require wet-working, potentially making them less desirable as a resource. These deposits occur in the major river valleys of the Ouse and Derwent in the City of York area.

Sub-alluvial deposits tend to be thicker and have greater overburden when compared to river terrace deposits. Both show significant variability in thickness as would be expected for an extensive area containing several river systems.

River terrace deposits are limited in the City of York area. Where they do occur (near Nether Poppleton, Low Catton and Nun Monkton), sediments predominantly comprise soft interbedded silts and clays with occasionally sandy lenses reflecting the glaciolacustrine sediments across where these rivers drain. However a basal sand and gravel deposit is common underlying silt and clays.

GLACIAL SAND AND GRAVEL

For convenience and simplicity the term glacial sand and gravel is used in this report to encompass a range of sand and gravel-bearing glacial deposits such as glaciofluvial deposits, glaciolacustrine deposits and blown sand.

Some of the thickest deposits in the City of York area are water-lain sands and gravels deposited in close proximity to the ice-sheet. These deposits mainly occur within or intermixed with fine-grained glaciolacustrine deltas or sheets of till. The deposits mainly occur in well developed linear systems either as eskers, trending south-southeast deposited from channels on, within or directly below ice sheets or as moraines formed by the deposition of sediments by melting ice at the limit of the ice sheet.

The main component of the eskers is red to red-brown, fine- to medium-grained sand, with beds of coarse-grained sand although a broad range of grain sizes, from silt to boulders may also be present in places. The gravel fraction is composed mainly of Carboniferous sandstones with minor amounts of Carboniferous and Permian limestones. One of the most prominent of these eskers occurs around Crockey Hill.

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[2] An **'inferred mineral resource'** is that part of a mineral resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. This is opposed to an **'indicated mineral resource'** which is that part of a mineral resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. All resources within the CYC area are inferred resources.

Sand and gravel within glacial moraines are typically not as well sorted as that of eskers and glaciofluvial deposits. The Eskrick Moraine and York Moraine include gravelly sandy clay, clay, sand and lenses of sand and gravel. These features can be up to 38m thick.

The retreating ice sheets also deposited glaciofluvial sediments, these 'terrace' deposits occur where drainage from the glaciers in the Pennine valleys entered the west side of the Vale of York, depositing spreads of sand and gravel in front of the ice sheets. One of the most prospective for sand and gravel is known as the Pocklington Glaciofluvial Member (part of the Vale of York Formation), named after the unit's best exposure at Pocklington outside the CYC area. Within the CYC area, the Pocklington Glaciofluvial Member is present to the west of York. Here it comprises bedded sand and gravel, gravelly sand or sandy gravel with some clay horizons. It can typically range from between 2 and 9m in thickness but can be up to 20m thick. These sands and gravels display a complex geometry with surrounding glaciolacustrine sediments and often interdigitate with them.

It can also been seen from borehole records that much of the glacial succession in the City of York area is underlain by a discontinuous sheet of sand and gravel around 2m thick with clasts predominantly derived from the underlying bedrock (Sherwood Sandstone Group). These sediments are likely to be related to a fluvial system before the last major glacier incursion but are generally buried by 15-20m of other sediments meaning this can only be considered as a resource if the overlying sediment is economic to extract.

BLOWN SAND

Large areas of blown sand have been mapped in The City of York area. In general these are too fine grained to constitute economic resources for sand and gravel (although they may have applications for silica sand or mortar sand). These deposits are believed to be largely of late Quaternary age resulting from aeolian reworking of fluvial and glaciofluvial sands. The sand is red-brown-yellow in colour and well-sorted, although the deposits are generally less than 2m thick. These deposits overlie glaciolacustrine sediments which comprise predominantly silts and clays with little resource potential for aggregates.

3.1.2 Extraction activity

Sand and gravel has been extracted in the past in the City of York Area (e.g. at Askham Bryan and Grimston Borrowpit). Currently, however, all aggregates produced in the north Yorkshire sub-region are from the North Yorkshire County Council and Yorkshire Dales National Park areas, with no production from the City of York and North York Moors National Park areas (NYCC *et al.*, 2013).

3.1.3 Rationale for MSA methodology

It is recommended that all sand and gravel resources that have been identified in the recent sand and gravel report (Bide and Linley, 2013) are included on the safeguarding map (Figure A2). The original resource linework was not changed as a result of consultation and so has been used as the basis for defining MSAs

MSA buffer

Consistent with the approach utilised in North Yorkshire County Council's area, 250m is proposed as a buffer for sand and gravel resources. This should ensure the effective safeguarding of the identified boundaries of the resource area from development permitted nearby.

3.2 BRICK CLAY

'Brick clay' is the term used to describe clay in the manufacture of bricks, roof tiles, clay pipes and decorative pottery. These clays may sometimes be used in construction, such as in cement manufacture, as a source of fill and for lining and sealing landfill sites. The behaviour of a clay during shaping, drying and firing dictates its suitability for the manufacture of bricks as it affects the properties of the fired brick such as strength and frost resistance and architectural appearance (Harrison et al, 2006). Different clays are blended to achieve durability and provide a range of brick colours and textures.

3.2.1 Geological description

The laminated clays that formed in glacial lakes in the Vale of York were once a widely utilised source of brick clay. These deposits, which are widespread throughout the Vale of York, were deposited in a glaciolacustrine environment during the last major ice age where lakes built up behind dams of glacial material and fine sediments were deposited in the low energy environment. These sediments comprises silts and sands as well as clays which can display complex relationships and interdigitate however where clays are present they can be up to 20m thick and high quality.

3.2.2 Extraction activity

There are no active brick clay extraction sites within the City of York area. Historically brick clay has been extracted from a number of sites (for example Acomb, North Fields and Askham Bryan).

3.2.3 Rationale for MSA methodology

The advice in 'mineral safeguarding in England: good practice advice' (Wrighton *et al.*, 2011) suggests that where more geologically mapped subdivisions exist for geology in an area, it may be possible to reduce the extent of safeguarding areas for brick clay based on those formations that are actively worked. In the case study provided in the good practice advice, specific formations are identified that are worked by industry and Nottinghamshire County Council were consulting on the options for safeguarding. As no further subdivisions of the brick clay resource are available and there is no active industry for the CYC area, this approach cannot be taken. Therefore, it is recommended that all resources of brick clay be safeguarded and the recommended MSA map (Figure A3) reflects this. The original resource linework was not changed as a result of consultation and so has been used as the basis for defining MSAs

MSA buffer

Consistent with the approach in North Yorkshire County Council's area, 250m is proposed as a buffer for brick clay resources. This will ensure the effective safeguarding of the identified boundaries of the mineral resource from development permitted nearby.

3.3 **COAL**

Coal is a combustible rock that is formed through the alteration of dead plant material under the increasing temperatures and pressures experienced during burial. As a result of geological processes such as faulting and folding, coal seams can occur at varying depths from the surface, and be of varying thicknesses.

Depending on its quality (physical and chemical properties), coal can be used as power station fuel to generate electricity, or if it is high enough quality, it can be used to fire blast furnaces for the metallurgical industries. Its quality is ranked by its Calorific Value (CV), which is the heat energy given off by the combustion of a unit quantity of fuel. This can vary from 15 MJ/kg for peat (low rank) to 35 MJ/kg for anthracite (high rank). Impurities such as chlorine and sulphur are detrimental in coal as it causes corrosion and pollution (BGS, 2011a).

Coal is extracted by surface or underground mining, depending on its proximity to the surface. However, where conditions and quality allow it may also be suitable for Coal Bed Methane (CBM) extraction or Underground Coal Gasification (UCG). CBM extraction exploits the gas that is adsorbed onto the coal surface during coal formation, usually via boreholes. UCG is the initiation of partial combustion of the coal seams in situ in order to drive off gases and produce heat (BGS, 2011a, BGS, 2011b).

3.3.1 Geological description and coal resource areas

The City of York Area includes the concealed East Pennine Coalfield. Coal-bearing strata are principally confined to the Pennine Lower and Middle Coal Measures (Upper Carboniferous). In general the coal-bearing horizons dip from west to east under the City of York. These horizons generally occur at depths of between 50 to 1200m beneath the surface. Coal seams are widespread and many are developed on a regional scale. However, there are lateral variations in thickness, composition and the number of 'dirt' partings they contain. The seams are mainly bituminous and the calorific value and rank of the coals broadly increases eastward. Sulphur is an impurity associated with all Yorkshire coals, with the more easterly parts of the coalfield containing higher sulphur contents (Harrison *et al.*, 2006). There are no shallow coal resources within the City of York area.

3.3.2 Extraction activity

Closure of the North Selby mine in 1997 means that there are no workings for coal within the authority area. Kellingley Colliery, near Knottingley, south west of the City of York is the nearest site for coal extraction and the only remaining deep mine in north Yorkshire.

3.3.3 Rationale for MSA delineation

The CYC area is adjacent to the NYCC boundary. In the NYCC study deep coal was not originally proposed for safeguarding. However, during the consultation phase undertaken as part of the study, the issue of subsidence was raised for minerals worked underground. Although subsidence from deep coal workings does not generally affect normal development, as pillars can be left to support the surface, sensitive surface development can affect the viability of deep workings. The example of a glass factory in Selby District was provided as support for this view, where risks to the operator from working underneath such sensitive development, even if pillars were left to support the surface, were considered too great to work the mineral. Therefore, although the effects of subsidence are not necessarily an issue for all surface development, it should be recognised that some sensitive surface developments will have the potential to sterilise mineral resources at depth (Wrighton and Bide, 2011). The deep coal may also be of significance if technologies allow their exploitation, such as for Underground Coal Gasification. The safeguarding of deep coal resources against sensitive development may provide the opportunity to discuss this form of gas extraction in the future, should the practice become economic in the UK onshore. Deep coal, therefore, is shown on the mineral safeguarding map (Figure A4).

MSA buffers

It was identified in the NYCC safeguarding consultation exercise that a suitable buffer distance for deep coal would be 700m. Subsidence effects on sensitive development (such as high precision factories) is negligible (using current extraction techniques) at a horizontal distance of 0.7 multiplied by the depth of working. As current depths of working do not generally exceed 1000m, a buffer of 700m should ensure that the safeguarding mechanism is robust (Wrighton and Bide, 2011).

3.4 GYPSUM / ANHYDRITE

Gypsum ($CaSO_4.2H_2O$) and anhydrite ($CaSO_4$) are, respectively, the hydrated and anhydrous forms of calcium sulphate, which occur in beds up to a few metres thick. Anhydrite occurs at depth, becoming hydrated near surface and passing into gypsum. Anhydrite is thus much more extensive than gypsum, but in its pure form is not of economic importance because of its limited commercial application. Gypsum is soluble and often dissolves at outcrop, locally causing subsidence problems. Gypsum is used in the manufacture of plaster and plasterboard and mixed gypsum/anhydrite is used as a retarder in Portland cement.

Calcium sulphate may also be derived as a by-product of certain industrial processes. The most important is flue gas desulphurisation (FGD), a process that removes sulphur dioxide from the flue gases at coal-fired power stations. The product, known as desulphogypsum, is now an important supplement to the supply of natural gypsum. Synthetic gypsum has a higher purity (96 per cent) than most natural gypsum (80 per cent).

3.4.1 Geological description

Gypsum occurs in the Triassic Mercia Mudstone Group comparable to the Tutbury/Newark Gypsum in Nottinghamshire and Leicestershire. There is no information on the thickness and quality of any beds present in north Yorkshire. Anhydrite bearing strata also occur at depth under the City of York area within the Edlington and Roxby formations which have been mined to the south west where they near the surface.

Large quantities (the last reported figures are 0.8 million tonnes for 2012) of desulphogypsum are produced at the Drax power station and are used for plasterboard manufacture. Eggborough power station also started supplying desulphogypsum during 2005.

3.4.2 Extraction activity

Neither gypsum nor anhydrite have been extracted in the CYC area. The Sherburn Anhydrite in the Roxby Formation was formerly mined at Sherburn-in-Elmet for plasterboard manufacture (south west of the CYC boundary) (Harrison *et al.*, 2006). The mine was flooded in 1988 and abandoned. Exploration is known to have taken place into Triassic strata to the East of the CYC boundary near Fangfoss, but further consultation with industry would be necessary to understand whether the mineral in this area has resource potential.

3.4.3 Rationale for MSA methodology

Gypsum is safeguarded in the Tees Valley Joint Minerals and Waste Core Strategy which will be used to guide development decisions to the North of the area for which CYC, NYCC and NYMNPA are preparing a Joint Minerals and Waste Local Plan. The accompanying text states that *'whilst the extraction of these resources may not be currently viable for reasons of price, geology, quality and previous extractive work, this situation may change and they may be required at some point in the future'*.

It is indicated in Harrison *et al*. (2006), that the gypsum resources were not shown on the BGS county map in north Yorkshire due to their association with water-bearing strata. The Permian strata are sandwiched between aquifers and there is, judging from experience at Sherburn-in-Elmet, risk involved with working the mineral in these conditions. Permian strata are also at considerable depth underlying the City of York area and are unlikely to constituent a resource. The Mercia Mudstone Group, which crops out in the north east of the City of York area is known to contain economic thickness of gypsum within beds of calcareous mudstone elsewhere in the UK. These have been previously worked on a small scale near Scrayingham and some exploration has been undertaken near Fangfoss, the results of which would need to be confirmed in order to assess whether the mineral in the area has resource potential. Furthermore, gypsum is mined, in the main, through underground pillar and stall methods, although surface mining does occur where gypsum is close to the surface. There is a fairly low subsidence risk associated with the underground operations and impact at the surface is likely to be limited to the location of surface facilities of a mine (BGS, 2006).

Based on evidence from published sources and the advice of experts in BGS, it is not considered necessary to safeguard gypsum in the City of York area.

4 Conclusions

This study has provided the City of York Council with a clearly defined and delineated set of recommended MSA maps and proposed safeguarding methodologies for each mineral resource present in the area. The project has followed recommendations and guidance, where possible, from '*Mineral Safeguarding in England: good practice advice*' (Wrighton *et al*., 2011).

This work has addressed the first two steps involved in mineral safeguarding with step 3 being undertaken by the CYC. The relevant remaining steps (4-7), will be addressed through the development of associated mineral safeguarding policies by the CYC in the future.

Paper maps and Adobe PDF documents have been provided to CYC showing the mineral resources within the MPA these will be used to inform the establishment of MSAs through minerals planning policies. The digital data has been supplied in the form of ESRI shapefiles for integration in a GIS.

Appendix 1 Maps

Published mineral resources map

Figure A1 CYC - mineral resources

Consultation maps showing mineral resources

Figure A2 CYC - Sand and gravel resources

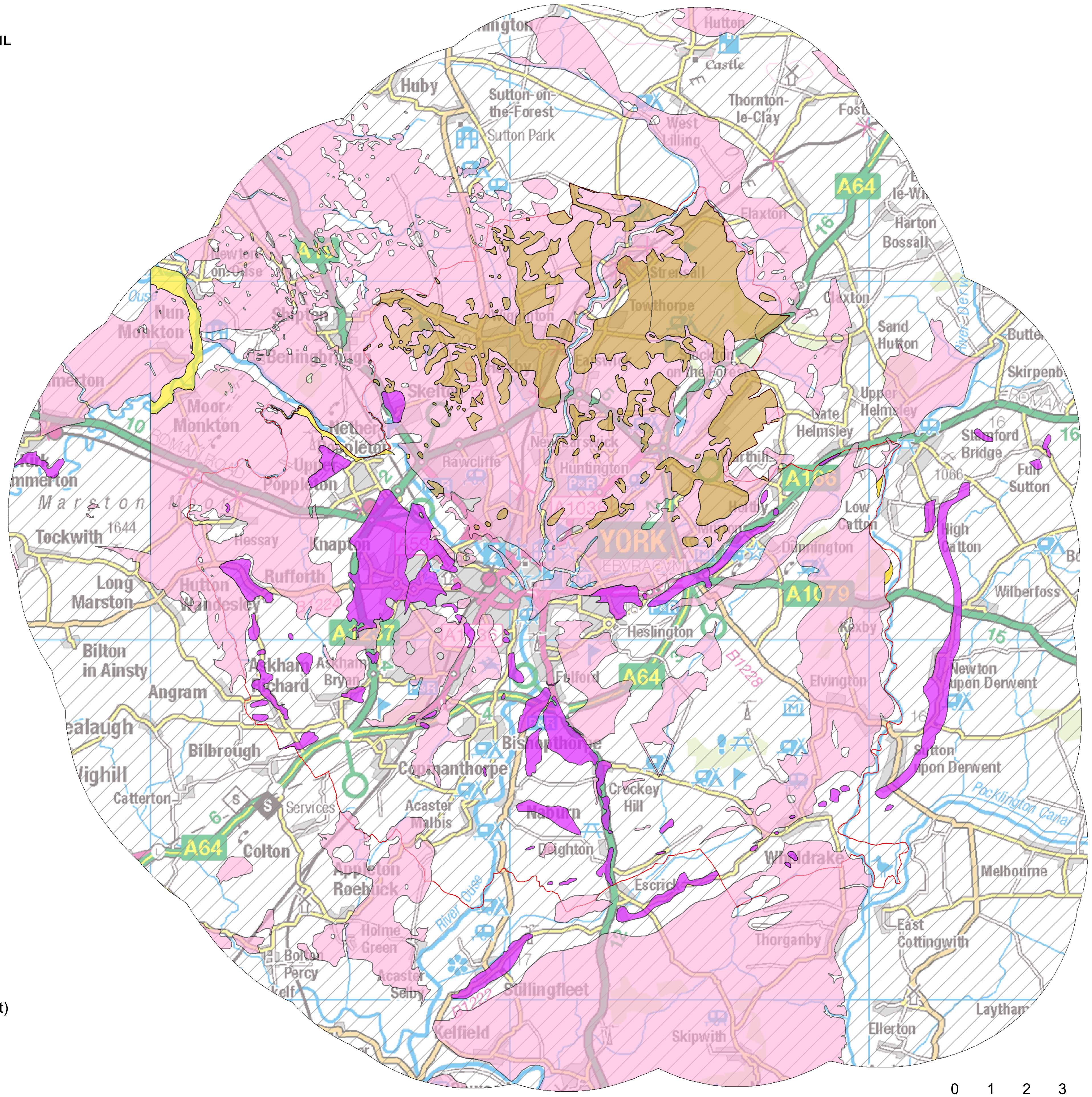
Figure A3 CYC - Brick clay resources

Figure A4 CYC – Deep coal

British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

City of York - All Mineral Resources



Consultation phase maps

These maps are part of the consultation phase that will inform the delineation of Mineral Safeguarding Areas in the City of York.

They show geological units from the 'BGS DiGMapGB-50' geological linework and the published Mineral Resources dataset.

This linework will be refined through consultation to incorporate knowledge from stakeholders in order to produce Mineral Safeguarding Area Maps.

There are no active or inactive mineral extraction sites within the City of York boundary.

The border around the administrative boundary shows the mineral resources 5km beyond the City of York boundary in order to consider the extent of the minerals straddling the Mineral Planning Authority boundary.

- Sub-alluvial River Terrace deposits
- River Terrace deposits
- Glaciofluvial deposits
- Blown Sand deposits
- Brick clay: Quaternary, glaciolacustrine deposits (clay and silt)
- Deep coal between 50m and 1200m
- City of York with 5km buffer
- City of York boundary

Figure A1: City of York Council: mineral resources

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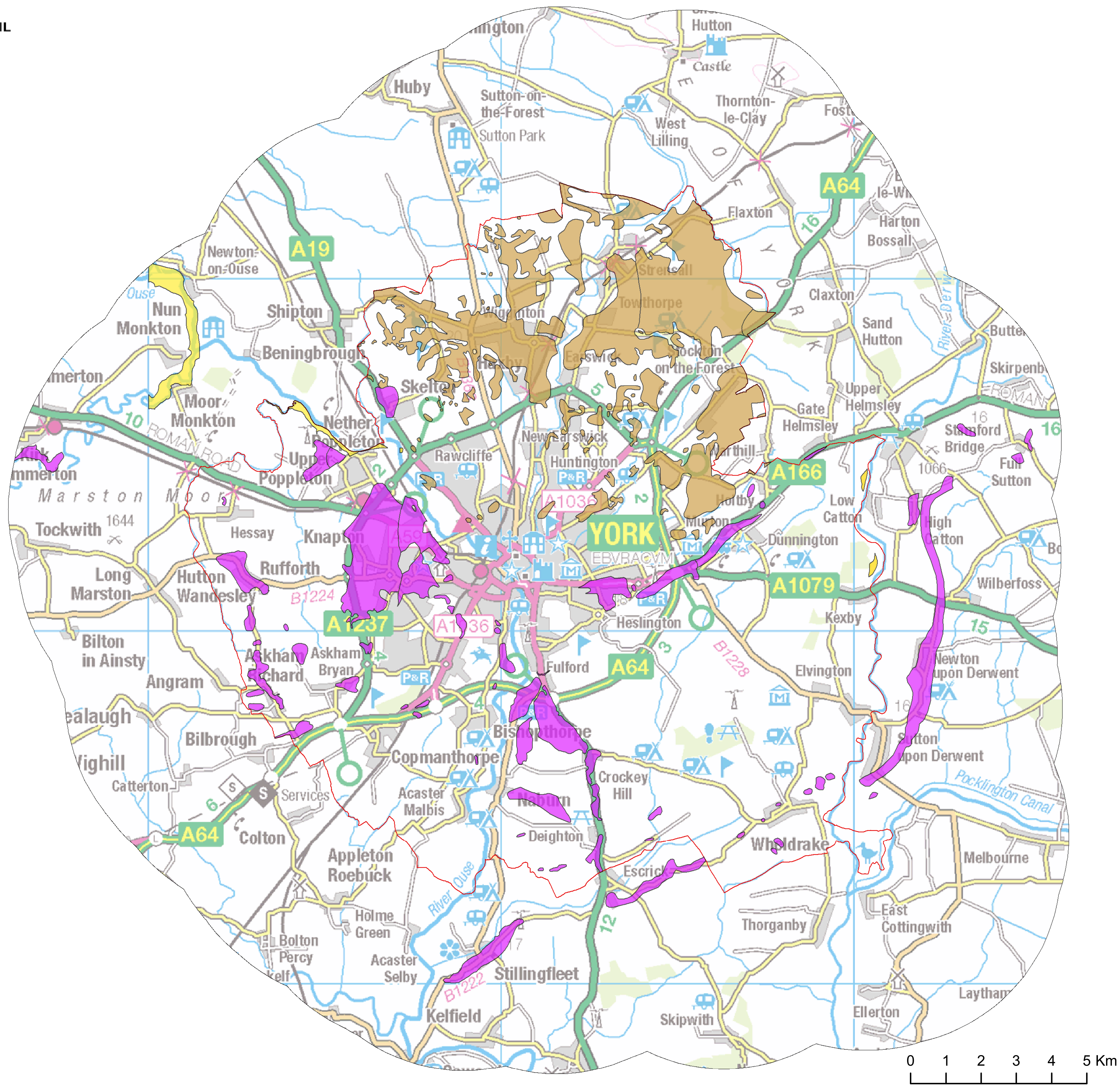
City of York - Sand and Gravel Resources



Consultation phase maps

These maps are part of the consultation phase that will inform the delineation of Mineral Safeguarding Areas in the City of York. They show geological units from the 'BGS DiGMapGB-50' geological linework and the published Mineral Resources dataset. This linework will be refined through consultation to incorporate knowledge from stakeholders in order to produce Mineral Safeguarding Area Maps.

There are no active or inactive mineral extraction sites currently within the City of York boundary.

The border around the administrative boundary shows the mineral resources 5km beyond the City of York boundary in order to consider the extent o fresources straddling the Mineral Planning Authority boundary.

- Sub-alluvial River Terrace deposits
- River Terrace deposits
- Glaciofluvial deposits
- Blown Sand deposits
- City of York with 5km buffer
- City of York boundary

Figure A2: City of York Coucil: sand and gravel resources

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Geological Survey
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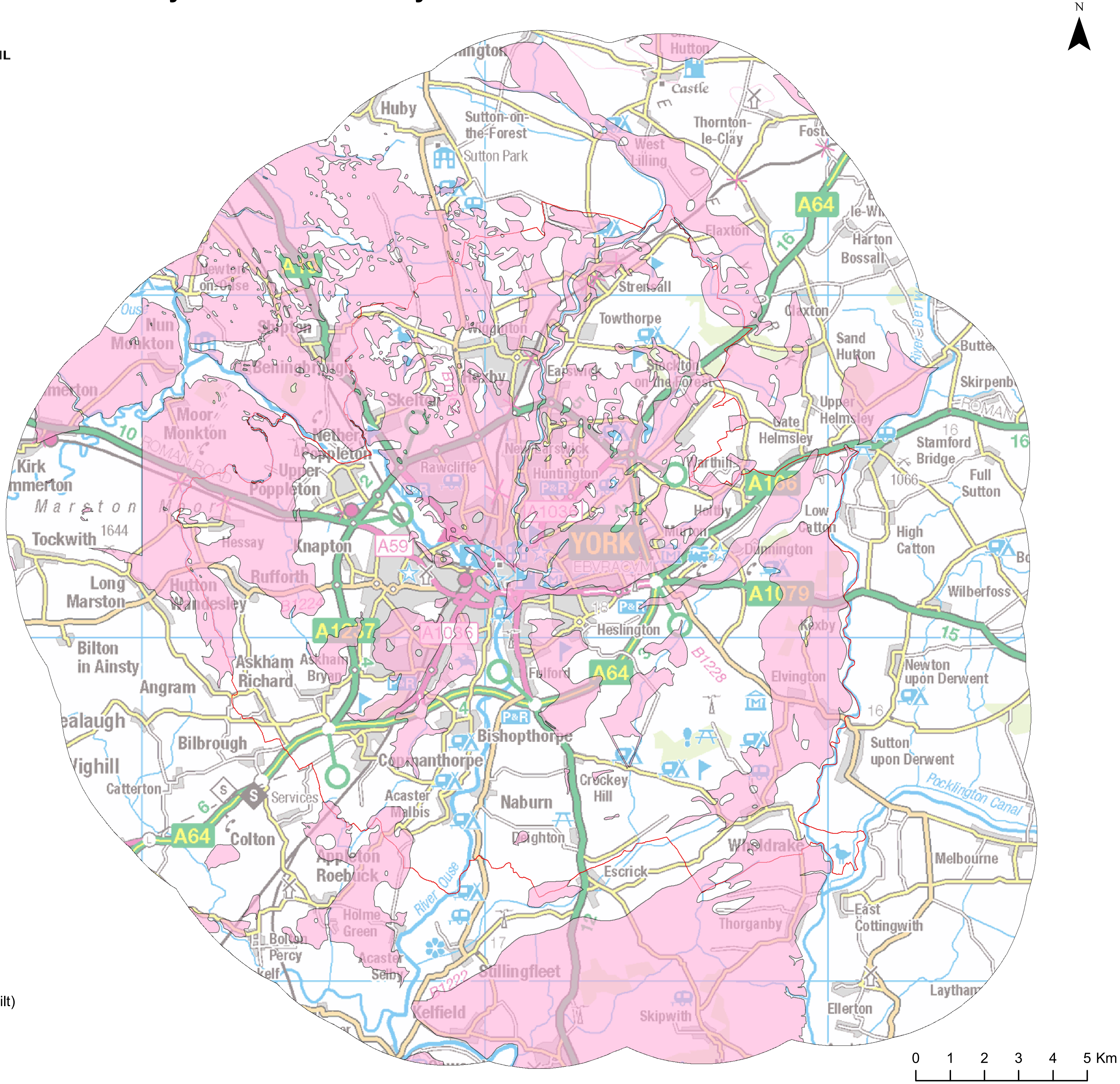
City of York - Brick Clay Resources



Consultation phase maps

These maps are part of the consultation phase that will inform the delineation of Mineral Safeguarding Areas in the City of York.

They show geological units from the 'BGS DiGMapGB-50' geological linework and the published Mineral Resources dataset.

This linework will be refined through consultation to incorporate knowledge from stakeholders in order to produce Mineral Safeguarding Area Maps.

There are no active or inactive mineral extraction sites within the City of York boundary.

The border around the administrative boundary shows the mineral resources 5km beyond the City of York boundary in order to consider the extent of the minerals straddling the Mineral Planning Authority boundary.

Brick clay: Quaternary, glaciolacustrine deposits (clay and silt)

City of York with 5km buffer

City of York boundary

Figure A3: City of York Council: brick clay resources

British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Consultation phase maps

These maps are part of the consultation phase that will inform the delineation of Mineral Safeguarding Areas in the City of York.

They show geological units from the 'BGS DiGMapGB-50' geological linework and the published Mineral Resources dataset and the proposed area for safeguarding,

This linework will be refined through consultation to incorporate knowledge from stakeholders in order to produce Mineral Safeguarding Area Maps.

There are no active or inactive mineral extraction sites within the City of York boundary.

The border around the administrative boundary shows the mineral resources 1km beyond the City of York boundary in order to consider the extent of the minerals straddling the Mineral Planning Authority boundary.

Deep coal between 50m and 1200m

City of York boundary

Figure A4: City of York Council - deep coal resources

Appendix 2 Geological overview

Overview of Geology

The City of York is almost entirely underlain by the Triassic Sherwood Sandstone Group which extends in a broad north-south trending belt on the west side of the Vale of York, the only exception to this being a small area of the Mercia Mudstone Group which occurs in the north east of the area. However the bedrock is completely obscured by thick superficial deposits that are mostly of glacial origin. These glacial sediments dominate the landscape of the area with hummocky ground around the south of York City representing coarse and unsorted sediments deposited directly from glaciers in the form of moraines, eskers and till. Whereas the land to the north of the city is flatter, predominantly arable and composed of glacial clays and fine re-worked aeolian sands.

Bedrock

The bedrock for the City of York area is very simple and comprises the Sherwood Sandstone Group and in the north east a small area of the overlying Mercia Mudstone Group (Figure 1). Both groups are Triassic in age. The Sherwood Sandstone comprises wind blown and water lain, predominantly fluvial sandstones with some mudstone layers that were deposited by a significant fluvial system in an arid environment that extended across Yorkshire and the East Midlands. This is overlain by the Mercia Mudstone Group which comprises predominantly calcareous mudstone deposited in an extensive playa lake and shallow marine environment**.**

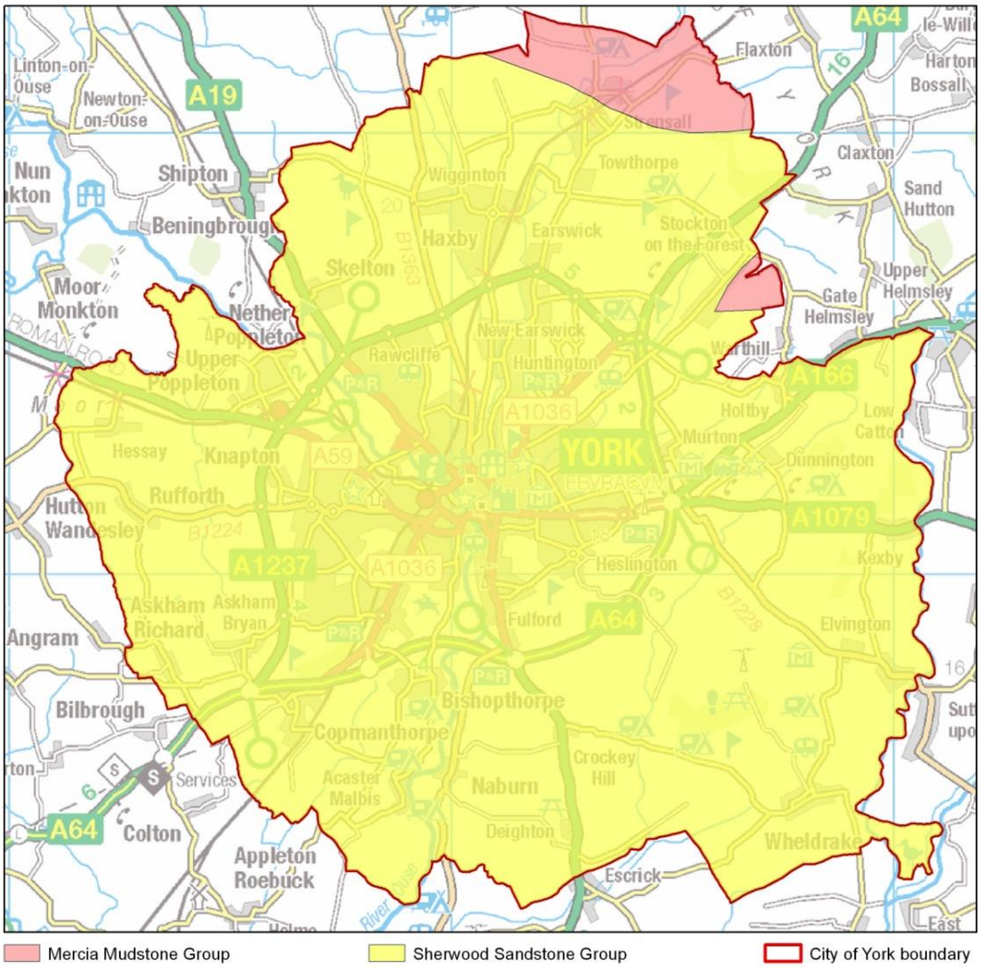


Figure 1 Simplified bedrock geology for The City of York

Superficial deposits

Superficial deposits in the county fall into three broad categories: glacial deposits, fluvial deposits and aeolian deposits

Glacial deposits dominate the area, the spatial and genetic relationships of the deposits and associated landforms are very complex; the following is a much-simplified account. There is evidence for two glaciations in the area. The first of these, the Anglian glaciation, occurred some 430,000 years ago but unequivocal deposits of Anglian age are rare. During the much more recent Devensian glaciation, which reached its zenith about 20,000 years ago, a tongue of ice from the Devensian ice sheet advanced southwards along the Vale of York eroding most of the pre-existing glacial and fluvial deposits and disrupting or diverting river systems. The southern limit of ice-advance is marked in the present landscape by the Escrick Moraine, a prominent linear landform that lies across the Vale of York (Figure 2). As the ice advanced it overrode remnants of older superficial deposits and its own sand and gravel outwash that was deposited by meltwater issuing from the ice, before reaching a 'still-stand' during which the moraines were built up. In doing so it deposited a thick and widespread layer of till, consisting essentially of stiff gravelly and boulder clay, over the pre-existing landscape.

As the Devensian glaciation waned the ice sheet 'retreated' leaving behind numerous glacial landforms that are visible today. Prominent amongst these are the York Moraine that lies across the Vale of York a few miles to the north of the Escrick Moraine. It marks the position of a temporary 'still-stand' or pause in the retreat of the ice. Also prominent are long, narrow, linear sand and gravel ridges, known as eskers, which roughly parallel the axis of the Vale (Figure 2). These represent sand and gravel deposited by meltwater flowing in channels, or tunnels, beneath, within and upon the ice sheet. Following the retreat of the ice these deposits remained as upstanding features of the landscape.

Sheet-like bodies of sand and gravel deposited in front of an ice-sheet by meltwater are termed 'sandur' (pl. sandar) whereas terrace like bodies and mounds are termed 'Kame'. Sand and gravel deposited near the ice sheet as sandar, in meltwater channels or in contact with the ice sheet as eskers or within moraines are known collectively as glaciofluvial deposits.

During retreat of the ice sheet meltwater was ponded between the moraines, the ice and the valley sides, eventually forming extensive lakes. Material of glacial origin entering the lakes was deposited as a thick, flat-surfaced, blanket of glaciolacustrine deposits (Figure 2) usually consisting of mainly of laminated clay and silt but also including some sand. The lakes subsequently drained away leaving some landforms such as eskers and moraines partly buried by the glaciolacustrine deposits.

Blown sand, probably originating as a glaciofluvial deposits where sands enough to be carried on katabatic winds (i.e. strong winds blowing from the ice) occurs extensively to the north and in smaller pockets in the south of York City area. Blown sand may also have been deposited in the glacial lakes where it was reworked into glaciolacustrine deposits.

Fluvial deposits have been deposited by late glacial river systems. River terrace deposits, comprising mainly sand and gravel, are best developed along the Derwent (significant terrace deposits are absent from the river Ouse in the area). These are typically a low 'staircase' of elongate tabular bodies that represent remnants of sand and gravel floodplain deposits left behind as fast-flowing rivers cut down to successively lower levels in response to uplift and climate change during Pleistocene times. Following the amelioration of the climate and the retreat of ice sheets from the British Isles some 11,000 ago, the middle and lower reaches of rivers became slow-flowing, meandering and muddy although, in their upper reaches they may at times be sufficiently vigorous to transport and deposit sand, gravel and boulders. The floodplain deposits of these modern rivers are known as alluvium. In the middle and lower reaches of rivers the floodplain deposits typically comprise silt and clay, possibly with a thin basal gravel. Alluvium may overlie part of the lowest (youngest) river terrace deposits. Because many present day rivers originated as meltwater channels in glacial times, alluvium and river terrace deposits may conceal older glaciofluvial deposits of considerable thickness.

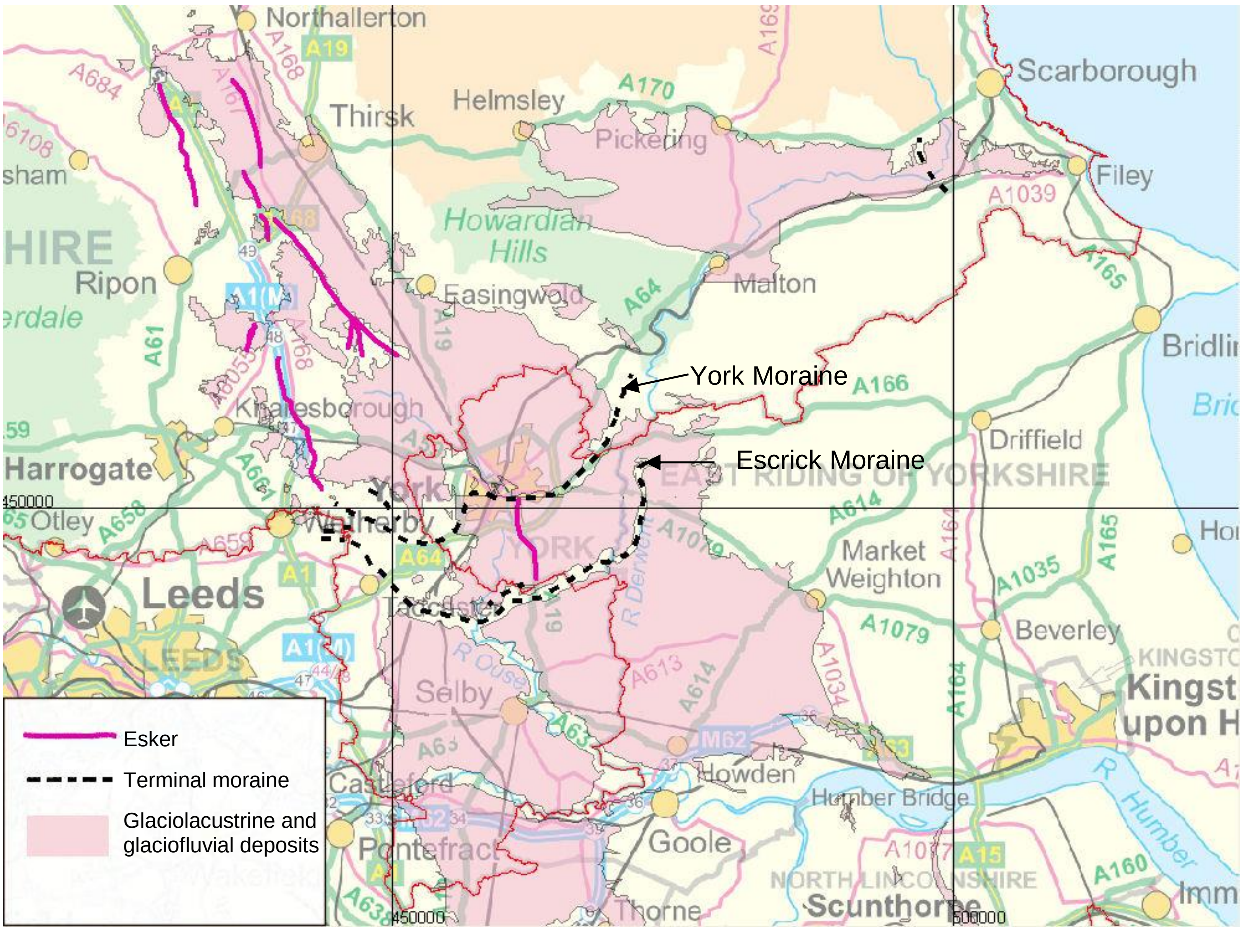


Figure 2 Major glacial landforms of north Yorkshire

Appendix 3 Economic minerals – decisions on safeguarding

	Safeguard?	Justification if not safeguarded
Sand and Gravel	Y	
Limestone (crushed rock and industrial)	N	There are no resources of this type in the area[3]'.
Sandstone (crushed rock)	N	There are no resources of this type in the area 3'.
Igneous rock	N	There are no resources of this type in the area 3'.
Chalk	N	There are no resources of this type in the area 3'.
Silica sand	N	There are no resources of this type in the area 3'.
Brick clay	Y	
Building stone	N	There are no building stone resources in the area [4].
Shallow coal (within 50m of the surface)	N	There are no resources of this type in the area 3.
Deep coal	Y (sensitive development only)	
Gypsum / Anhydrite	N	There are no resources of this type in the area 3'. Consultation may reveal further information concerning exploration results for gypsum that is known to have been undertaken to the west of York.
Hydrocarbons (conventional oil and gas, abandoned mine methane, coal mine methane potential)	N	The location of surface infrastructure to access these resources is to some degree flexible, so the resources are not as susceptible to the risks posed by sterilisation by other non-mineral development. Underground Coal Gasification may cause subsidence at surface, but there are currently no operations of this type in the UK onshore[5]. The extent of the burn area is unpredictable so boundaries would be hard to define[6].

[3] Harrison, DJ, Henney, PJ, Minchin, D, McEvoy, FM, Cameron, DG, Hobbs, SF, Evans, DJ, Lott GK, Ball, EL, and Highley, DE. 2006. Mineral Resource Information in Support of National, Regional and Local Planning: North Yorkshire (comprising North Yorkshire, Yorkshire Dales and North York Moors National Parks and City of York). *British Geological Survey Commissioned Report CR/04/228N.* 24 pp.

[4] British Geological Survey, English Heritage and the Department for Communities and Local Government. *Strategic Stone Study database* [online]. Available at: http://mapapps.bgs.ac.uk/buildingStone/BuildingStone.html

[5]coal.decc.gov.uk/en/coal/ms/publications/mining/gasification/gasification.aspx; http://www.bbc.co.uk/news/uk-wales-16567883

Shale hydrocarbons	N	This is an emerging technology that takes place deep underground. The surface impacts associated with hydraulic fracturing of the shales are felt by few people and structural damage at the surface is unlikely[7],[8]. The location of surface infrastructure to access these resources is to some degree flexible, so the resources are not as susceptible to the risks posed by sterilisation by other non-mineral development.

[6] Wrighton, C E and Bide, T P. 2011. *Mineral Safeguarding Areas for North Yorkshire County Council*. British Geological Survey Commissioned Report, CR/11/132. 48pp.
[7] Cronin, K. 2013. Drawing up well guidelines. *Mineral Planning*, 147, pg 11
[8] The Royal Society and the Royal Academy of Engineering. 2012. *Shale gas extraction in the UK: a review of hydraulic fracturing* [Online]. Available at: http://royalsociety.org/policy/projects/shale-gas-extraction/report/.

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