AECOM

Derbyshire Level 1 Minerals Strategic Flood Risk Assessment Update

Derbyshire County Council and Derby City Council

March 2023

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		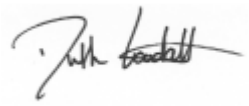	
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Executive Summary

AECOM Ltd has been commissioned to prepare an update to the Level 1 Minerals Strategic Flood Risk Assessment (SFRA) on behalf of Derbyshire County Council and Derby City Council to assess the flood risk to potential mineral site allocations.

The original Level 1 Minerals and Waste SFRA[1] was prepared by Derbyshire County Council and Derby City Council in August 2012 and provided an assessment of both minerals and waste sites. The SFRA informs the planning decision making process to consider the nature and scale of flood risk and considered measures to minimise the risk to property and life posed by flooding through sustainable development.

Given updated flood risk legislation and policies in addition to the latest flood risk datasets published by external stakeholders including the Environment Agency, the updated Level 1 SFRA utilises these datasets to assess the level of flood risk. The SFRA provides a high-level assessment solely to flood risk posed to 29 No. mineral sites. As such, an assessment of waste sites is outside the scope of the SFRA.

The aim of the Level 1 Minerals SFRA is to guide development to the appropriate Flood Zone using the Sequential Test. This document provides information required to apply the Sequential Test for identification of land suitable for development. Planning authorities should seek to allocate sites for future development within areas of lowest flood risk including Flood Zone 1, and then sequentially to Flood Zone 2 and 3 if appropriate.

The SFRA study area covers a total of eight Borough / District councils: Amber Valley, Bolsover, Derbyshire Dales, North East Derbyshire, South Derbyshire, Chesterfield, Erewash and High Peak. The western area near the Peak District National Park is mainly rural whilst towards the east is more urban nature including main towns such as Derby City.

The majority of mineral resources lies within the administrative boundary of Derbyshire County Council where the most significant mineral worked is limestone, accounting for 91% of annual mineral production within the area. There are limited unworked resources of sand and gravel in Derby City but these have not been worked for many years.

The Derbyshire County covers a geographically large and diverse area of England which contains many large Main Rivers and other smaller watercourses. As such, flooding across the county is apparent, especially within the low lying areas of the county. Future development may exacerbate problems of this nature if not carefully designed, blocking flow paths and increasing the magnitude and speed of runoff from the site.

This report forms a Level 1 SFRA and provides an overview of flood risk issues across all eight districts within the study area. The core output of this study is a production of county wide maps (Appendix A) which includes a narrative of flood risk issues in relation to the proposed mineral sites. In accordance with the NPPF, mineral workings and processing are characterised as 'Less Vulnerable' and sand and gravel workings are categorised as 'Water Compatible' development. The Sequential Test must be followed before sites at flood risk are identified as suitable for extraction. Derbyshire County Council and Derby City Council recognise that flooding will increase as a result of climate change. As such, this update to the SFRA identifies flood risk now and in the future so that actions can be taken to mitigate this risk.

The SFRA forms an essential reference tool for future strategic planning. As such, it is imperative that it is adopted as a living document to be reviewed regularly in light of emerging policy directives and an improved understanding of flood risk within the District and Borough Councils. The period between reviews should be no more than 6 years but would ideally be every 3 years. Please note, a site specific Flood Risk Assessment (FRA) must be carried out for all proposed developments that meet the NPPF criteria and submitted as part of the planning application.

[1] Derbyshire County Council (2012) Derbyshire County Council and Derby City Council Minerals and Waste SFRA Level 1 Retrieved: https://www.derbyshire.gov.uk/site-elements/documents/pdf/environment/planning/planning-policy/minerals-waste-development-framework/strategic-flood-risk-assessment-level-1-august-2012.pdf Accessed 26/01/2023

Abbreviations and Glossary of Terms

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
ASTGWF	Areas Susceptible to Groundwater Flooding
BGS	British Geological Society
CDA	Critical Drainage Area
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act
LiDAR	Light Detection and Ranging
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MLP	Minerals Local Plan
NPPF	National Planning Policy Framework
OS	Ordnance Survey
PDNP	Peak District National Park
PPG	Planning Practice Guidance
RoFfSW	Risk of Flooding from Surface Water
RMA	Risk Management Authority
SuDS	Sustainable Drainage Systems
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
TW	Thames Water
YW	Yorkshire Water

Flood Zone	Environment Agency defined zone of flood risk used for planning.
Main River	Main rivers are usually larger rivers and streams. The EA carries out maintenance, improvement or construction work on Main Rivers to manage flood risk.
Ordinary Watercourse	Ordinary watercourses include every river, stream, ditch, drain, cut, dike/dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a Main River.

1. Introduction

1.1 Background

The National Planning Policy Framework (NPPF)[2] (2021) sets out the requirement for Local Planning Authorities (LPAs) to complete a Strategic Flood Risk Assessment (SFRA) in support of Local Plans to aid in the planning process and decision making for flood risk. Derbyshire County Council and Derby City Council are currently preparing a new joint Mineral Local Plan (MLP) which will cover the period to 2038. The plan will include the administrative boundary of Derbyshire and Derby City however will exclude the boundary of the Peak District National Park (PDNP). Once adopted, the MLP will replace the 'saved' policies of the current Derbyshire and Derby Minerals Local Plan adopted in 2002. The MLP aims to deliver sustainable development and assess the proposals for mineral development in Derbyshire.

A Level 1 SFRA prepared by Derbyshire County Council and Derby City Council was published in August 2012[3] to inform the Minerals and Waste Local Development Framework. The SFRA informed the planning decision process by considering the nature and scale of flood risk and considered measures to minimise the risk to developments and life posed by flooding through sustainable development. Since 2012, flood risk legislation and flood risk datasets have been updated and as such, AECOM Ltd have been commissioned to prepare an update to the Level 1 Minerals SFRA. Please note, the SFRA provides an assessment solely to mineral sites only. An assessment for the inclusion of Waste Sites is outside the scope of the SFRA.

The Level 1 Minerals SFRA will be in accordance with the NPPF and associated Planning Practice Guidance (PPG) and will be based on the best available flood risk information at the time of writing. Data has been provided by online Environment Agency resources, publicly available external sources and hydraulic modelled outputs retrieved from the Environment Agency for 16 No. of 1D-2D fluvial models across the study area.

The updated Level 1 Minerals SFRA will include the following:

- A summary of national and local policy that has been released since the completion of the 2012 Level 1 Minerals SFRA, including commentary on which policies are now superseded;
- A summary of the new climate change guidance, released in May 2022 and provision of advice for the application of this guidance in the context of the SFRA;
- Updated methodologies for using the SFRA as a framework for applying the Sequential Test;
- A review and update of the GIS datasets previously used, including a summary of flood risk data provided by the Environment Agency for the purposes of the SFRA update;
- An update of mapping and reporting to reflect amendments to the proposed 29 No. Mineral Sites;
- Guidance for LPAs on the use of the updated SFRA mapping in assessing site allocations;
- An update and review of flood risk across Derbyshire to account for recent flooding events; and,
- An update and review of Flood Warning Areas and Emergency Planning across Derbyshire;

1.2 Aims and Objectives

The aim of the study is to produce an up-to-date Level 1 Minerals SFRA that will provide an evidence-based strategic level assessment of flood risk in Derbyshire to inform the planning process for minerals sites. The SFRA will inform planning and development policies for Derbyshire's MLP, assess and map the different sources of

[2] Ministry of Housing, Communities and Local Government (2021) The National Planning Policy Framework. Retrieved:https://www.gov.uk/government/publications/national-planning-policy-framework--2 Accessed: February 2022
[3] Derbyshire County Council and Derby City Council SFRA Level 1 for Minerals and Waste Local Development Framework (2012). Retrieved: https://www.derbyshire.gov.uk/site-elements/documents/pdf/environment/planning/planning-policy/minerals-waste-development-framework/strategic-flood-risk-assessment-level-1-august-2012.pdf Accessed: March 2022

flood risk and provide the basis for a sequential approach to development allocation. The aim of the SFRA will be met through the following objectives:

- To provide an assessment of the impact of all potential sources of flooding in accordance with NPPF using available information, including an assessment of any future impacts associated with climate change;
- Enable planning policies to be identified to minimise and manage local flooding issues;
- Provide information required to apply the Sequential Test for identification of land suitable for development in line with the principles of the NPPF;
- Enable LPA's to use the SFRA as a basis for decision making at the planning application stage;
- Provide recommendations of suitable mitigation measures including the objectives of Sustainable Drainage Systems (SuDS); and
- To provide sufficient information to allow Derbyshire County Council and Derby City Council to assess flood risk for minerals development proposals sites and set out the requirements for the site specific Flood Risk Assessments (FRAs) where they may be necessary.

1.3 Approach to Flood Risk Management

The NPPF and associated PPG for Flood Risk and Coastal Change emphasise the active role LPA's should take to ensure that flood risk is assessed, avoided and managed effectively and sustainably throughout all stages of the planning process. The overall approach for the consideration of flood risk set out in Section 1 of the PPG can be summarised in **Figure 1.**

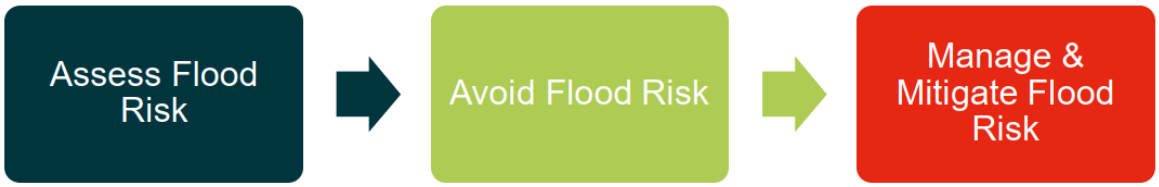

Figure 1: Approach to Flood Risk Management

1.3.1 Assess Flood Risk

The NPPF outlines that Strategic Policies should be informed by a SFRA and should manage flood risk from all sources. **Figure 1** reproduced from the PPG, illustrates how flood risk should be taken into account in the preparation of SFRA's and the MLP. As such, Derbyshire County Council and Derby City Council should use the Minerals Level 1 SFRA to inform a future Minerals Local Plan. Specific mineral sites may require a site-specific FRA as defined in the NPPF. The FRA process is described in further detail in **Section 9.**

1.3.2 Avoid Flood Risk

Derbyshire County Council and Derby City Council should apply the sequential approach for site selection so that the development is located where the risk of flooding from all sources is lowest, taking account of current and future impacts of climate change and the vulnerability of future users to flood risk where possible.

In plan-making this involves applying the Sequential Test, and where necessary the Exception Test. This is further described in **Section 8.**

1.3.3 Manage and Mitigate Flood Risk

Where alternatives sites in areas at lower risk of flooding are not available, it may be necessary to locate development or mineral sites in areas at risk of flooding. In these cases, the LPA and developers must ensure that the development is appropriately flood resilient and resistant, safe for its users for the lifetime of the

development and will not increase flood risk overall. Flood risk management opportunities should be explored (e.g. safeguarding land) to reduce the causes and impacts of flooding.

Figure 2 demonstrates how flood risk can be taken into account of the Local Plan.

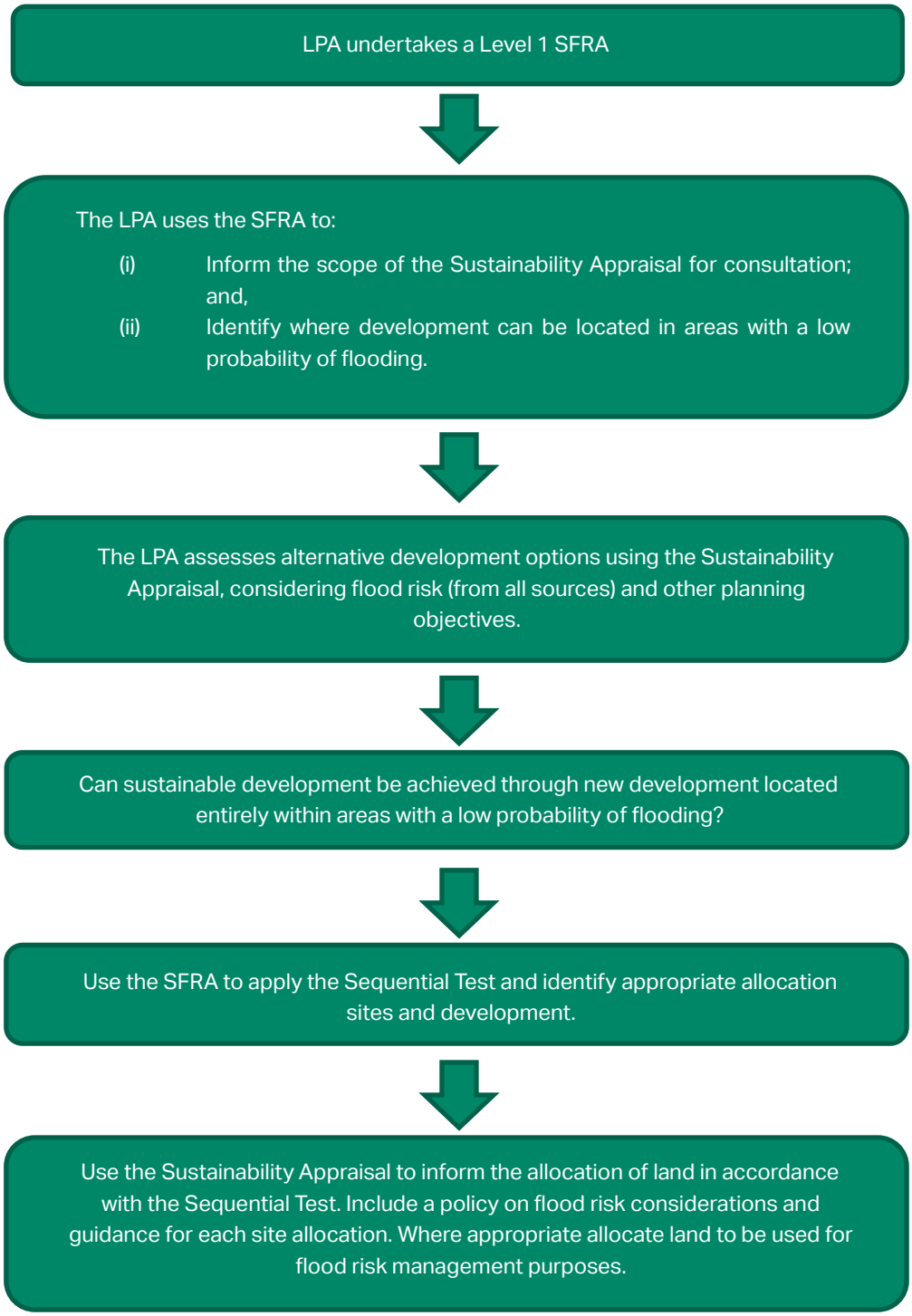

Figure 2: How flood risk can be taken into account in the preparation of a Local Plan

(Source: PPG for Flood Risk and Coastal Change)

1.4 SFRA Structure

The Derbyshire and Derby City Level 1 Minerals SFRA report is set out as follows:

- **Section 1:** Introduction
- **Section 2:** Study Area
- **Section 3:** Policy Context
- **Section 4:** Climate Change
- **Section 5:** Level 1 Minerals SFRA Methodology
- **Section 6:** Flood Risk in Derbyshire
- **Section 7:** NPPF Sequential Test Guidance
- **Section 8:** Site-specific Flood Risk Assessment Guidance
- **Section 9:** Summary
- **Appendices**
  - Appendix A: Study Area
  - Appendix B: Topography
  - Appendix C: EA Main Rivers
  - Appendix D: EA Bedrock Geology
  - Appendix E: EA Flood Map for Planning
  - Appendix E1-E19: EA Flood Map for Planning Insets
  - Appendix F: Flood Zone 3b
  - Appendix F1-F19: Flood Zone 3b Insets
  - Appendix G: Climate Change Allowance 1 in 100 year + 20% or 30% and 1 in 100 year and 1 in 1000 year flood extents
  - Appendix H: EA Flood Warning Areas
  - Appendix I: EA Risk of Flooding from Surface Water
  - Appendix I1-I19: EA Risk of Flooding from Surface Water Insets
  - Appendix J: Areas Susceptible to Groundwater Flooding
  - Appendix K: Groundwater Source Protection Zones
  - Appendix L: EA Aquifer Designation
  - Appendix M: EA Historical Flooding and National Highways Hotspot Historical Flooding
  - Appendix M1-M19: EA Historical Flooding Insets
  - Appendix N: Canals
  - Appendix O: Proposed Mineral Sites Map
  - Appendix P: Inset Overview

1.5 Living Document

The SFRA has been developed based on the most up to date flood risk data at the time of writing. New flood risk information may influence future development within these areas. Therefore, it is fundamental that the SFRA is adopted as a 'living' document and is reviewed and updated regularly in light of emerging policy directives, updated flood risk datasets and an improved understanding of flood risk within the LPA area.

2. Study Area

2.1 General Overview

Derbyshire is situated in the East Midlands of England, bounded by Greater Manchester to the north-west, South Yorkshire to the north and Leicestershire to the south-east. Given Derbyshire is surrounded by large scale urban conurbations such as Greater Manchester, South Yorkshire and the West Midlands, Derbyshire benefits from these areas and are important markets for many of the mineral resources in Derbyshire.

The combined borough and district councils cover an approximate area of 2,548 km^2 and has an estimated total population of approximately 1.05 million people in 2019[4]. Derbyshire covers a large and diverse geographic area which includes heavily built up areas predominately in the east and sparsely populated rural areas mostly to the west. As such, the main land uses comprise arable farming and urban land use. Mineral exploitation has also been popular in Derbyshire due to its rich natural mineral resources.

The study area is defined by the administrative boundaries of Derbyshire County Council and Derby City Council. Please note, this excludes the boundary of the Peak District National Park (PDNP) situated to the west of Derbyshire. The administrative county of Derbyshire includes eight district / borough councils. These are as follows:

- Amber Valley Borough Council;
- Bolsover District Council;
- Chesterfield Borough Council;
- Derbyshire Dales District Council;
- Erewash Borough Council;
- High Peak Borough Council;
- North East Derbyshire District Council; and
- South Derbyshire District Council.

Derby City Council is a unitary authority and therefore does not come under the jurisdiction of Derbyshire County Council. Derby is the only city within the Derbyshire county. Derby city covers an approximate area of 78 km^2 and has a total population of approximately 0.25 million people. The study area is presented in **Figure 3** and **Appendix A**.

[4] Derbyshire and Derby Draft Minerals Local Plan 2022. Retrieved: https://www.derbyshire.gov.uk/site-elements/documents/pdf/environment/planning/planning-policy/minerals-local-plan/consultation/derbyshire-and-derby-minerals-local-plan-part-1.pdf Accessed: June 2022

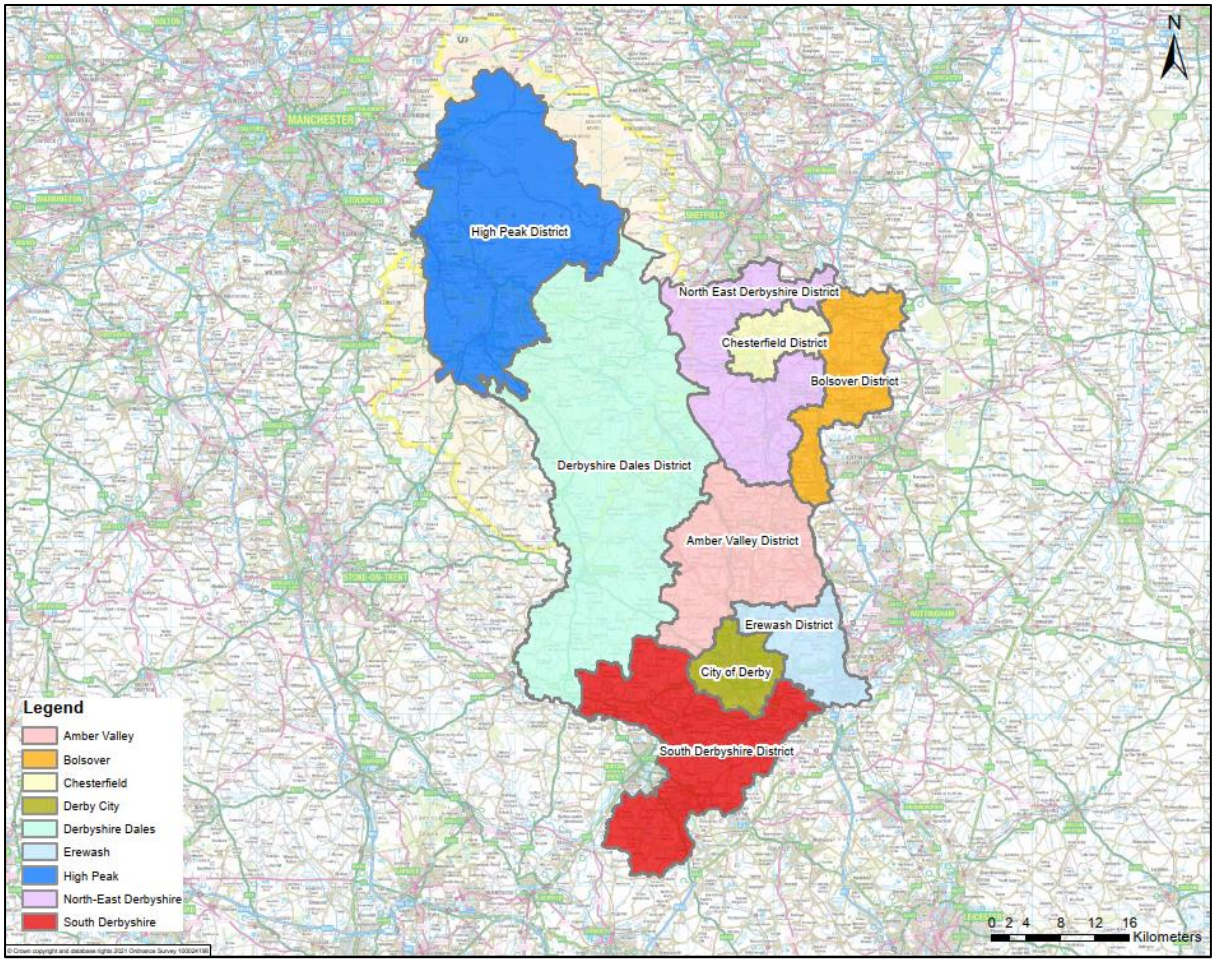

Figure 3 – Study Area of Derbyshire and Derby City and the Districts

2.2 Topography

Derbyshire has a wide variety of topography where the northern region comprises steep fast watersheds and larger catchments compared to the southern region which comprises flatter land. A review of the LiDAR Digital Terrain Model (DTM) of 50 metres (m) grid resolution, derived from the OSNI Open Data[5] shows the varied topography of the study area with mountainous regions in the north reaching elevations of approximately 630 m Above Ordnance Datum (AOD) compared to low lying land in the south reaching an approximate elevation of 35 m AOD.

Derby City predominately sits at an elevation of approximately 60 m AOD where the topography rises to the east, west and north to approximately 120 m AOD. A low topographical depression of approximately 40 m AOD is shown where the River Derwent traverses through Derby City. The topography of Derbyshire and Derby City is presented in **Figure 4** and **Appendix B**.

[5] OSNI Open Data – 50 m DTM. Retrieved: OSNI Open Data - 50m DTM - data.gov.uk Accessed: March 2022

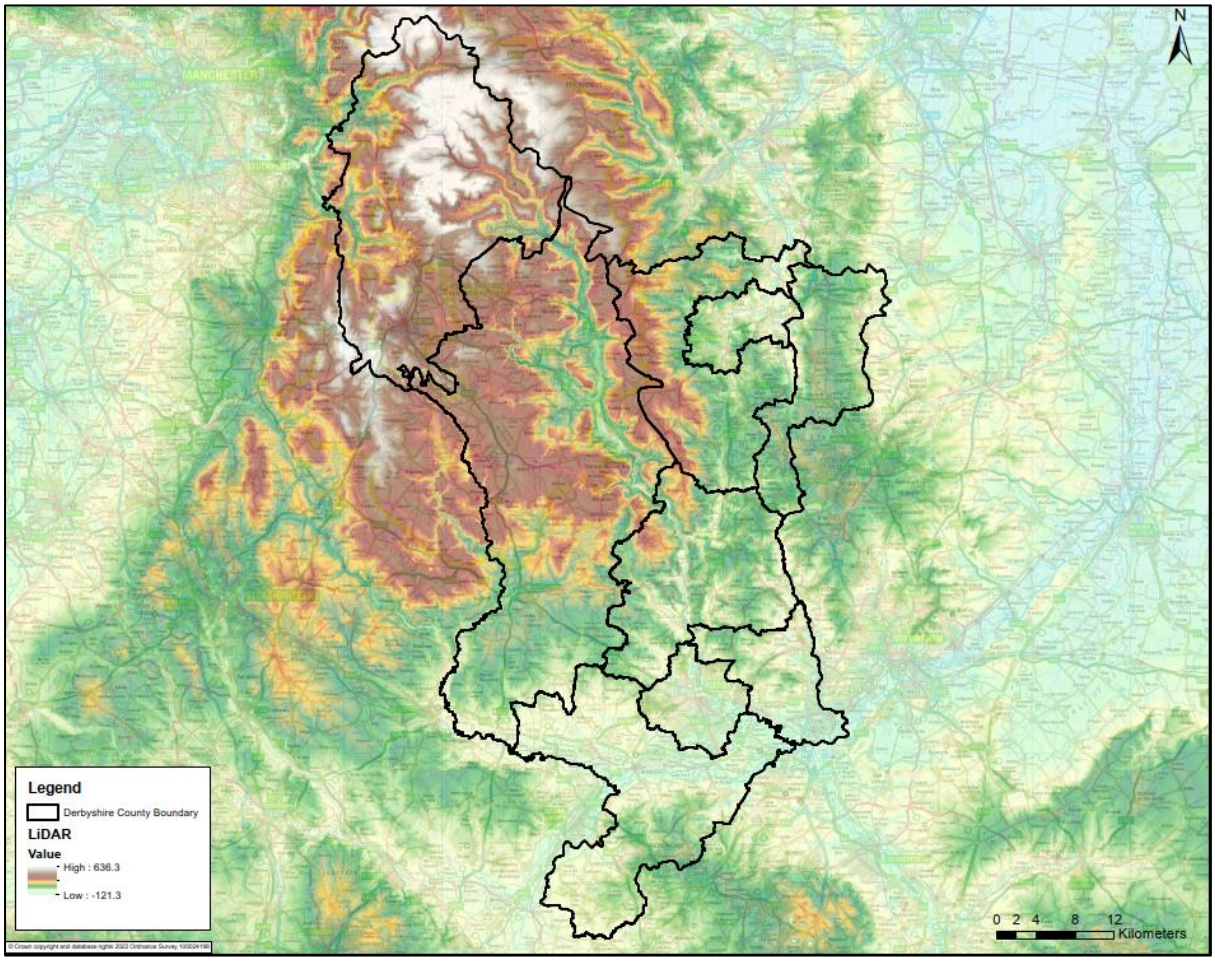

Figure 4 – Topography of Derbyshire and Derby City

2.3 Principal Watercourses

There are a number of designated Main Rivers within the study area. Main Rivers are watercourses shown on the statutory Main River Maps held by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA). The Environment Agency has permissive powers to carry out maintenance, improvement or construction work on Main Rivers to manage flood risk.

The River Derwent, River Rother, River Dove and River Trent are the four primary catchment areas of Derbyshire which form part of the River Humber Basin District before discharging to the North Sea. These are described below:

- The River Derwent catchment covers an approximate area of 1,194 km^2. Within this catchment the River Derwent Main River traverses through Derbyshire for approximately 80 km and flows in a southerly direction through the Peak District near Bamford towards Derby City in a relatively steep sided narrow valley. To the south of Derby City where the land is generally flat, the River Derwent approaches its confluence with the River Trent Main River, before flowing in a north-easterly direction towards the outfall at the Humber Estuary.
- The Don and Rother catchment covers an area of almost 1,700 km^2 and includes the local authorities of Chesterfield, North East Derbyshire and Bolsover. The southern extent of the catchment is located within Derbyshire's administrative boundary where the River Rother Main River arises near Clay Cross and flows in a northerly direction through Chesterfield before joining the confluence of the River Don and eventually discharging at the Humber Estuary.
- The Dove Catchment covers an approximate area of 1,020 km^2 and includes the local authorities of the High Peak and Derbyshire Dales. The River Dove achieves Main River status to the south of the Peak District National Park, approximately 1.8 km to the west of Ashbourne where the Main River flows in a southerly direction aligning with the south western boundary of the Derbyshire Dales. At Uttoxeter, the watercourse traverses to the east and joins its confluence of the River Trent near Burton upon Trent, before discharging at the Humber Estuary.
- The Lower Trent and Erewash catchment covers an approximate area of 2,045 km^2 and includes the local authorities of South Derbyshire and Erewash. The River Trent Main River originates in Staffordshire and flows in an easterly direction through South Derbyshire before joining the River Ouse and discharging at the Humber Estuary.

The locations of these principal Main Rivers in Derbyshire and Derby City are shown in **Figure 5** and **Appendix C**.

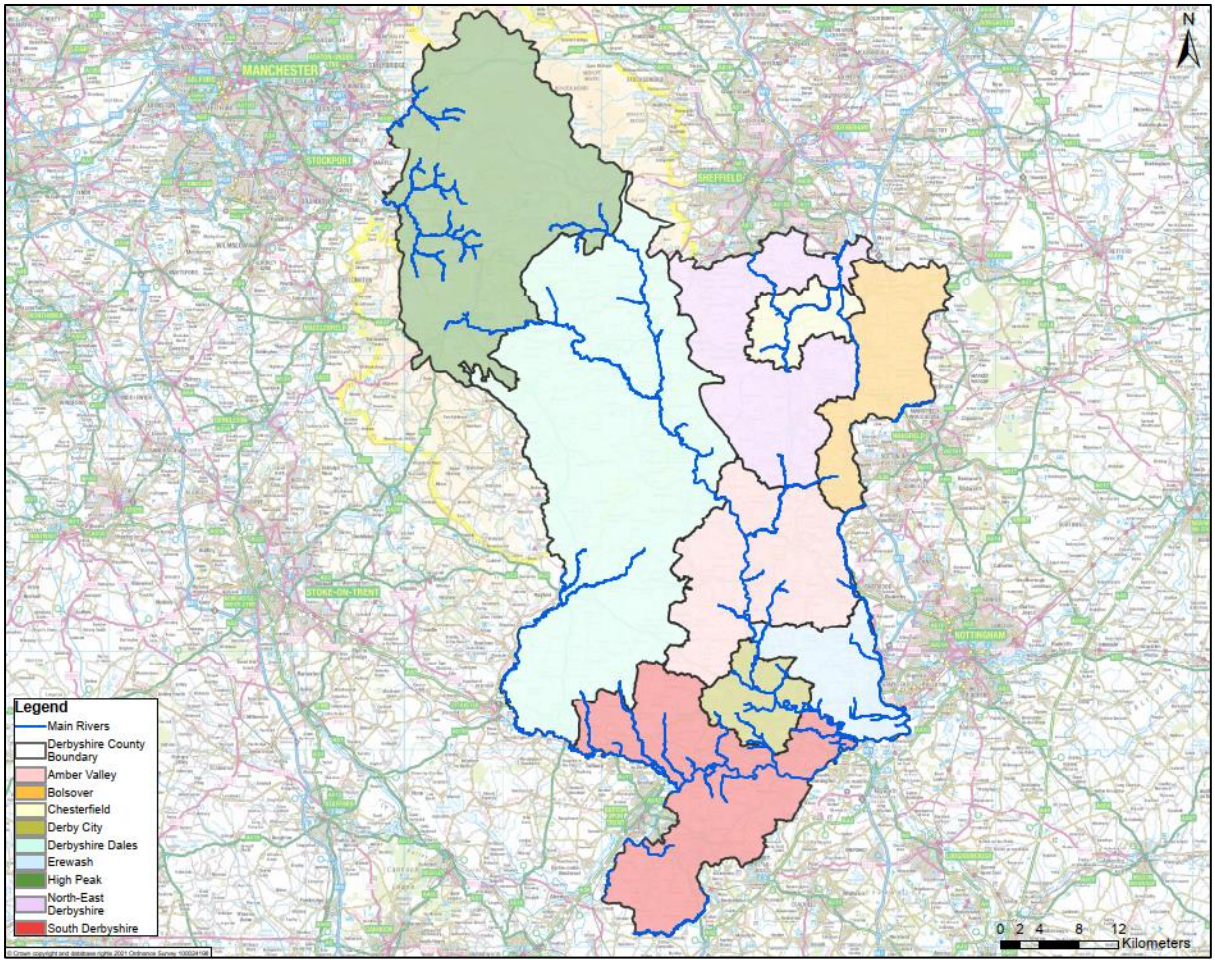

Figure 5 – Environment Agency Main River Network in Derbyshire and Derby City

2.4 Geology

Datasets have been obtained from the British Geological Survey (BGS) website[6] and the Environment Agency to provide a high-level identification of the superficial deposits and bedrock geology across Derbyshire and Derby City. This is shown in **Figure 6** and **Appendix D.**

Bedrock is the consolidated rock underlying the ground surface. Superficial deposits refer to the more geographically recent deposits that may be present above the bedrock such as floodplain deposits, beach, sands and glacial drift. Underlying geology can influence the presence and nature of groundwater in an area and therefore potential groundwater flood risk. The geology may also impact the potential for infiltration based drainage systems.

Derbyshire's geology can be split into two contrasting halves. In the northern, upland area of the county, Pennine Middle Coal Measures, Dolomitised Limestone and Dolomite and Kinderscout Grit Group are present which comprises siltstone, sandstone, coal, gritstones and limestone. To the south, including Derby City, Triassic Rocks and Branscombe Mudstone Formation comprising mudstone, siltstone and sandstone are present. Superficial deposits are also shown across Derbyshire with peat, clay, silt, sand and gravel shown in the northern region within the High Peaks administrative boundary. Superficial deposits are sparse across the centre of Derbyshire,

[6] British Geological Survey Geology Viewer. Retrieved: https://geologyviewer.bgs.ac.uk/?_ga=2.42924326.2070995612.1659459176-339367682.1659459176 Accessed: May 2022

however towards the south near Derby City, the Hemington Member and Allenton Terrace Deposits can be found comprising silt, gravel, terrace and river gravel deposits likely associated from the presence of fluvial channels.

Due to the varied geology, Derbyshire is rich in natural resources with large deposits of limestone, gritstone, lead and coal, some of which are today exploited commercially. The most significant mineral worked in Derbyshire is limestone, with Carboniferous Limestone located mostly in the north-west of the county and Permian Limestone located in the north-east of the county, near Bolsover.

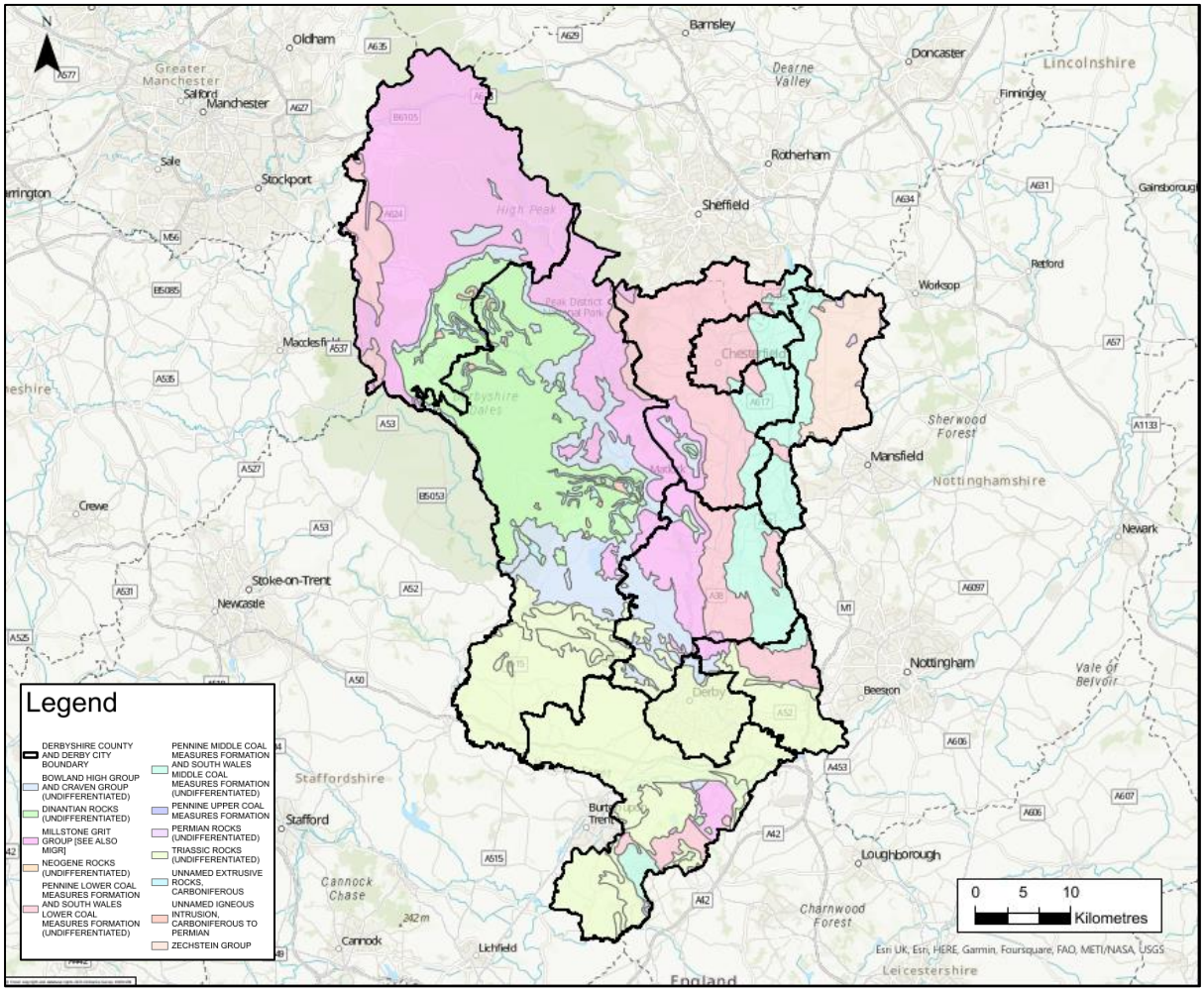

Figure 6 – BGS Bedrock Geology in Derbyshire and Derby City

2.5 Current Minerals Extraction Situation

Derbyshire County Council and Derby City Council Draft MLP provides an overview of the minerals infrastructure in the study area. Derbyshire is rich in mineral resources which serve both local and wider needs. The majority of mineral resources lies within the administrative boundary of Derbyshire where the most significant mineral worked is limestone, accounting for 91% of annual mineral production within the area, followed by sand and gravel accounting for 8%. There are limited unworked resources of sand and gravel in Derby City but these have not been worked for many years.

Derbyshire also makes an important contribution to the supply of minerals used for industrial processing and manufacturing purposes supplying 85% of the country with industrial limestone for glass and sealants etc.

Historically, Derbyshire was also an important supplier of deep mined and opencast coal for domestic fuel and electricity however at present there are no coal mining sites in operation.

2.5.1 Sand and Gravel

Sand and gravel are a nationally and locally important aggregate minerals which are often concentrated along the river valleys, such as the Trent Valley to the south of Derby and adjoining river valleys of the Lower Derwent and Dove.

Approximately 1 million tonnes each year of sand and gravel is produced within Derbyshire, of which approximately half is used within Derbyshire, Derby and the Peak District. Around 75% of the sand and gravel produced is used for concrete with the remainder being used to produce mortar, asphalt and fill material.

Derbyshire has substantial resources of sand and gravel occurring within the fluvial and terrace deposits, mostly to the south of the county. Whilst little mineral working to date has taken place in the Lower Dove Valley, most has taken place in the Trent and Lower Derwent Valleys. Only limited reserves of sand and gravel are in Derby City, as such, there are no current workings at this location.

As outlined by the NPPF, Mineral Planning Authorities (MPA) must prepare a Local Aggregate Assessment (LAA) to ensure a steady and adequate supply of minerals is available. In accordance with the MLP, Derbyshire and Derby should provide 18.81 million tonnes of sand and gravel from Jan 2020 to Dec 2038. Between 2010 and 2019, a total 11.43 million tonnes of sand and gravel were produced from the following sites;

- Swarkestone;
- Shardlow;
- Willington; and
- Mercaston.

A shortfall of 7.38 million tonnes has therefore been estimated and as such additional allocated sites are proposed to meet the expected demand for sand and gravel. This includes the following additional and / or extended sites;

- Swarkestone;
- Elvaston;
- Foston; and
- Sudbury.

It should be noted that sand and gravel workings are much shallower and easier to fill. As such, in the future the restoration of sand and gravel sites may contribute to increasing resilience to climate change or be used as flood storage areas.

2.5.2 Aggregate Crushed Rock

Aggregate crushed rock is produced in Derbyshire from the mechanical crushing of limestone and sandstone. It is a valued resource nationally as it is used throughout the UK for construction purposes, mainly as fill material, roadstone and concrete.

The main sources of carboniferous limestone within Derbyshire can be found around Buxton as well as near Matlock and Wirksworth/ Cromford whilst Permian limestone can be found in the north east of Derbyshire County near Bolsover and Whitwell. Relatively small amounts of sandstone are quarried in the north-west of the county near New Mills and Hayfield.

Derbyshire has a substantial resource of aggregate crushed rock with 13 quarries remaining operational. The LAA sets the annual provision rate at 9.44 million tonnes of aggregate crushed rock. In 2019 there was an

estimated reserve of approximately 652 million tonnes at these quarries, therefore there is landbank reserves of around 70 years after the annual provision has been removed. As such, there is an adequate supply of aggregate resources providing there is sufficient productive capacity and the existing reserves continue to be worked.

Therefore, there is no requirement to permit additional sites unless there is a clear benefit to the local environment or community in the future.

2.5.3 Building Stone

Building stone is in less demand compared to other mineral resources as it is mainly used to repair old historic buildings therefore supply needs are usually small and intermittent.

The main source of building stone is sandstone/ gritstone of the carboniferous era however the resources that are of the correct specification and quality are scarce. As such, there are only five quarries in the study area which provide building stone on a small and irregular scale. Two of which are situated within the High Peaks administrative boundary, one in North-East Derbyshire , one in Derbyshire Dales and one in Amber Valley.

The LPA should consider how to meet the demand for building stone needed to repair heritage buildings and roofing, however it is not possible to determine with any reasonable accuracy the level of supply which will be required in the future given the market fluctuates greatly. Supply is currently and will be maintained through the existing five permitted quarries.

2.5.4 Limestone

Limestone is the most significant quarried resource in the study area, with approximately 12 million tonnes of limestone produced in this area in 2019. Limestone is an important mineral for use in the construction, industrial and manufacturing processes and therefore holds local and national importance.

The Derbyshire study area makes an important national contribution to the production of limestone, as many areas in the UK where limestone is present are unsuitable due to the chemical or physical properties of the mineral. As of 2019, nine quarries within Derbyshire produce industrial limestone, with the main areas of production being around Buxton, Wirksworth and Whitwell. These limestone quarries are usually large scale and long term. In addition to the operational quarries, a further two non-operational quarries have reserves of industrial limestone, totalling an estimated 174 million tonnes of reserves in 2019.

The NPPF requires the MPA to plan for industrial minerals, like limestone, by communicating with other authorities to ensure adequate provisions are quarried to support its use in construction and manufacturing industries. It is also noted that safeguarding and stockpiling of limestone should be undertaken to ensure the future availability of the mineral. The PPG states that reserves should be calculated when a planning application is submitted or a new capital investment is proposed.

Demand for limestone is not expected to increase if it follows the annual national trend which has remained steady at around 3 million tonnes over the last 10 years. At the end of 2019, permitted reserves were equivalent to around 60 years of production at current annual rates, beyond the MLP period to 2038. However, some reserves may contain areas of low quality minerals and may not be suitable as industrial minerals. As such, at Aldwark/ Brassington Moor quarry, an extension is being promoted as the operator has indicated that the existing quarry has insufficient reserves of 'low cadmium, iron and lead' mineral to maintain supply. The permitted reserves of this limestone specification are predicted to run out between 2025 and 2031. The new extension area (Aldwark South) is expected to yield approximately 24 million tonnes of limestone reserve. However, planning proposals will need to provide sufficient evidence to satisfy all policies of the development plan.

2.5.5 Cement

Industrial limestone is a primary raw material in the manufacture of cement with clay and shale as secondary materials. The most important use of cement is in the production of mortar and concrete which are both vital construction materials nationally.

The NPPF and PPG outline the need to ensure sufficient stocks of permitted reserves of primary (chalk/limestone) and secondary (clay/shale) materials. The stock of reserves must be available for at least 15 years to maintain or improve existing plant or 25 years to provide a new kiln for cement manufacture.

The demand for cement has recently increased due to the Governments objective to boost the supply of new homes which is likely to continue. Within Derbyshire, one cement plant is located at Tunstead Quarry which is supplied by two adjoining quarries Tunstead and Old Moor. Permitted reserves of industrial limestone at these two quarries are substantial and are likely to last beyond 2038. Permission has been granted for a second cement kiln to increase the capacity although this will not be commissioned until the long term. Secondary materials including shale and marl are required for cement production. These are imported from Kingsley Quarry and Keele Quarry in Staffordshire.

2.5.6 Brick Clay

Brick clay is used in the manufacture of bricks, tiles and other clay products. There are currently no brickworks within the study area however there are two active sites in Derbyshire where brick clay is excavated and exported to works in adjacent MPA areas. The two active sites are:

- Mouselow Quarry, Glossop - supplies the company's brick works at Denton, East Manchester.
- Waingroves Quarry, Ripley - supplies the company's brickworks at Kirton, in Nottinghamshire, and at Desford, in Leicestershire.

The NPPF identifies brick clay as an important mineral and requires the MPA to communicate with other authorities to ensure adequate provisions are quarried to support its use in construction and manufacturing industries.

At the two active sites within Derbyshire, permitted reserves are predicted to sustain production beyond 2038. However, as there is no national assessment for brick clay demand, both anticipated and unforeseen need should be considered. Brick clay production is anticipated to increase over the plan period in response to the Government's initiatives to stimulate the housing market.

Brick clay will continue to be supplied through existing permitted reserves which are present at two active quarries in Derbyshire. In addition, a small amount of brick clay (250,000 tonnes) will also be stockpiled at a site named Foxlow Tip in North-East Derbyshire.

2.5.7 Vein Minerals

Vein minerals such as fluorspar and barytes are high-value specialist minerals used mainly in the steel manufacture are often found in narrow bands of limestone.

In Derbyshire, most of the mineral deposits are located within the areas bordering the Peak District National Park. There is only one operational site in the study area at Slinter Top where vein minerals are quarried alongside limestone aggregates. A planning application has been submitted in 2021 to extend working to 2031. A non-operational site at Balleye Quarry (Deepwood Mining), Bonsall is also present within the Plan area.

There is no national assessment for vein mineral demand, as such, both anticipated and unforeseen need should be considered. However, there has been recent increased demand for fluorspar for chemical applications and growth in new markets for fluoro-polymers which could lead to an increase in demand for vein materials in the study area. Supply will be maintained through existing permitted reserves at the two sites within the study area and unforeseen needs will be supplied through a criteria based policy that allows additional reserves to be worked.

2.5.8 Coal

Coal is a very important mineral resource nationally and has had a major role in the development of the UK. Primarily, the combustion of coal has been used to harness energy to fuel the industrial development such as

domestic heating. However, as the demand for coal has significantly declined in favour of green energy and the use of imported coal supplies, coal production in the study area has been restricted to surface mining only given all deep mined collieries in the County closed by the mid-1990s.

Derbyshire contains both shallow and underground coal resources. The shallow coal resources are found in both the North and South Derbyshire Coalfields with an extensive tract of varying thickness in the North and a smaller and shallower reserve in the South.

The NPPF has adopted a negative approach to coal extraction given the drive to reduce the use of fossil fuels and reduce carbon emissions. As such there are no national assessments or targets for the need of coal unless the development benefits outweigh the negative environmental impacts. Proposals for coal extraction should make provision for the extraction and stockpiling of fireclays instead.

3. Policy Context

Since the Derbyshire County Council and Derby City Council Level 1 Minerals SFRA was completed in 2012, there have been further updates to national and local planning policies. This section provides an updated summary of policies relating to flood risk.

3.1.1 National Planning Policy Framework 2021

The National Planning Policy Framework (NPPF) was initially published in March 2012 together with accompanying Technical Guidance. The NPPF revoked most of the previous Planning Policy Statements (PPS) and Planning Policy Guidance, including PPS25: Development and Flood Risk Practice Guide. The NPPF was updated in July 2021[7] and advises how the planning process can take account of the risks associated with flooding.

The overall approach is broadly summarised in NPPF Paragraph 167:

> *"When determining any planning applications, local planning authorities [LPA] should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*
>
> *a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
>
> *b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
>
> *c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*
>
> *d) any residual risk can be safely managed; and*
>
> *e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."*

The NPPF consists of a framework where LPA's can produce local and neighbourhood plans that reflect the needs and priorities of their communities. The NPPF and supporting guidance also require LPA's to undertake SFRA's and use their findings to inform strategic land use planning within the county. This may include the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas at greater risk.

Section 17 of the NPPF also seeks that LPA's should

> "*encourage the prior extraction of minerals, where practical and environmentally feasible […], and set out criteria or requirements to ensure that permitted and proposed operations do not have unacceptable adverse impacts on the natural and historic environment".*
>
> *"encourage safeguarding or stockpiling so that important minerals remain available for use'*

[7] National Planning Policy Framework (2021). Retrieved: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf Accessed: 12/01/22

"provide for the extraction of mineral resources of local and national importance, but not identify new sites or extensions to existing sites for peat extraction;"

"not normally permit other development proposals in Mineral Safeguarding Areas if it might constrain potential future use for mineral working"

"planning permission should not be granted for the extraction of coal unless: the proposal is environmentally acceptable, or can be made so by planning conditions or obligations; or if it is not environmentally acceptable, then it provides national, local or community benefits that clearly outweigh it's likely impacts"

3.1.2 National Planning Practice Guidance 2021

The Technical Guidance accompanying the NPPF was since replaced by a series of Planning Practice Documents referred to as the Planning Practice Guidance (PPG) in March 2014. This includes the PPG: Flood Risk and Coastal Change document which has since been updated in August 2022[8]. This document further advises how the risks of flooding and coastal change should be addressed in the planning process.

"Waste and mineral planning authorities need to take account of flood risk when allocating land for development. They should prepare their plan policies with regard to any available Strategic Flood Risk Assessments. The location of Mineral Safeguarding Areas and site allocations, in particular in relation to sand and gravel workings which are often located in functional floodplains, need to be identified. It is possible to explore benefits, such as restoring mineral working located in flood risk areas to increase flood water storage which can also enhance the natural environment. Partnership working on joint Strategic Flood Risk Assessments offer the best opportunity to identify and realise these opportunities."

As per Paragraph 009 of the PPG, LPA's should use the SFRA to:

- *"Determine the variations in risk from all sources of flooding across their areas, and also the risks to and from surrounding areas in the same flood catchment;*
- *Inform the sustainability appraisal of the Local Plan, so that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies, including policies for flood risk management to ensure that flood risk is not increased:*
- *Apply the Sequential Test and, where necessary, the Exception Test when determining land use allocations:*
- *Identify the requirements for site-specific flood risk assessments in particular locations, including those at risk from sources other than river and sea flooding;*
- *Determine the acceptability of flood risk in relation to emergency planning capability; and*
- *Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and of storage for flood water."*

[8] Planning Practice Guidance: Flood Risk and Coastal Change. Retrieved: https://www.gov.uk/guidance/flood-risk-and-coastal-change#full-publication-update-history Accessed: 12/01/22

3.2 Local Planning Policy

Derbyshire County Council is responsible for the minerals and waste planning within its administrative area, who devolves the responsibility of non-minerals and waste planning policies amongst the eight district and borough councils within the area. Derby City Council as a Unitary Authority are responsible for all planning matters within their administrative boundary and the Peak District National Park Authority are responsible for all planning matters within the National Park. A summary of the local plans amongst the county, city, district and borough councils within Derbyshire's administrative boundary are outlined in **Table 1**.

Table 1- Local Plans adopted by the County / City / Borough / District Councils and the Peak District National Park Authority covering the geographical area of Derbyshire.

County / City / Borough / District Councils	Planning Policy	Timeframe
Derbyshire County Council	Draft Minerals Local Plan [In Consultation] Minerals Local Plan Waste Local Plan	2021 – 2038 2002 – Present 2005 – Present
Amber Valley Borough Council	Local Plan	2021 - 2038
Bolsover District Council	Local Plan	2020 - 2033
Chesterfield Borough Council	Local Plan	2018 - 2035
Derbyshire Dales District Council	Local Plan	2017 - 2033
Erewash Borough Council	Core Strategy (supported by Saved Policies 2005)	2014 – 2028
High Peak Borough Council	Local Plan	2016 – 2035
North-East Derbyshire District Council	Local Plan	2014 – 2034
South Derbyshire District Council	Local Plan Part 1 Local Plan Part 2	2011 – 2028 2017 - 2028
Derby City Council	Draft Minerals Local Plan [In Consultation] Minerals Local Plan Waste Local Plan Local Plan Part 1 Strategy City of Derby Local Plan Review Saved Policies	2021 – 2038 2002 – Present 2005 - Present 2017 – 2028 2006 - Present
Peak District National Park Authority	Core Strategy (supported by Development Management Policies 2019 – 2026)	2011 - 2026

As of December 2021, Derby City Council's cabinet approved work on starting a new local plan which will cover the period to 2040. However, until the new plan is adopted, the following policies apply:

- The Adopted Mineral Local Plan (2002) and Waste Local Plan (2005);
- The Derby City Local Plan, Part 1 (2017); and
- The City of Derby Local Plan Review (2006).

3.2.1 Derby and Derbyshire Minerals Local Plan (2002)

The Minerals Local Plan was adopted in April 2000 and updated in November 2002[9] which provides guidance on planning applications for the extraction of minerals and associated works within the administrative boundary of Derby and Derbyshire, outside the Peak District National Park. The Local Plan highlights the supply of minerals required whilst ensuring the environment and communities are protected.

Please note, Derbyshire County Council and Derby City Council are working together to prepare an updated Minerals Local Plan which will cover the period to 2038. A new Draft Minerals Local Plan was published in December 2021 for consultation. However, until the New Minerals Local Plan is adopted, the following policies have been retrieved from the 2002 updated version. The current adopted development plan also comprises the saved polices of the 2000 adopted Minerals Local Plan (with alteration to coal polices adopted in 2002).

- **Policy MP1 – The Environmental Impact of Mineral Development**

  "Proposals for mineral development will be permitted provided that their impact on the environment is acceptable having regard to: the effect on the quality and quantity of water resources including the ecology of water courses and wetlands, and on water supply and flood protection interests."

- **Policy MP3 – Measures to Reduce Environmental Impact**

  "The Environment Agency is concerned with the possible impact of mineral working on water resources, flood defences […]. Mineral working may reduce groundwater levels, disturb natural drainage patterns, reduce the capacity of the floodplain and pollute local water resources. Mineral working proposals and associated schemes for reclamation and after-use which seriously damage these interests will not normally be acceptable."

- **Policy MP4 – Interest of Acknowledged Environmental Importance**

  "Proposals for mineral development will not be permitted where irreparable or unacceptable damage would result to interests of acknowledged environmental importance, and in particular where […] development would adversely affect the quality and quantity of water resource, water supply, land drainage or flood protection interests, or create water pollution problems."

- **Policy MP10 – Reclamation and After-Use**

  ***"**Proposals for mineral development will be permitted only where satisfactory provision has been made for the reclamation and after-use of the site as soon as practicable. In granting planning permission for mineral development conditions will be imposed, as appropriate, in respect of the following: measures are designed to enhance the natural environment […] improvement of watercourses."*

Supplementary planning guidance has been prepared for the after-use of sand and gravel sites and although not part of the development plan it is a material consideration in assessing planning applications.

3.2.2 Derby and Derbyshire Minerals Local Plan, Supplementary Planning Guidance on the After-Use of Sand and Gravel Sites

The Supplementary Planning Guidance (SPG)[10] has been prepared by Derby City Council and Derbyshire County Council and accompanies the Minerals Local Plan, in guiding on the after-use of sand and gravel sites in the Trent, Lower Derwent and Lower Dove Valleys.

[9] Derby and Derbyshire Minerals Local Plan. Retrieved: Derby and Derbyshire Minerals Local Plan - part one Accessed: 13/01/22

[10] Derby and Derbyshire Minerals Local Plan. *Supplementary Planning Guidance on The After-Use of Sand and Gravel Sites* (2004). Retrieved: After-use of sand and gravel sites (derbyshire.gov.uk) Accessed: 13/01/22

The SPG sets out a framework of principles aimed at securing preferred pattern of after uses for worked out sand and gravel sites. Due to the location of sand and gravel deposits within the river [...] raises a number of water related issues in conjunction to Policy MP10, and therefore, supplementary guidance has been provided. The Derby and Derbyshire Minerals Local Plan through Policy MP4 recognises the need to protect the quality and quantity of water resources and flood protection interests from the impact of mineral extraction and reclamation.

As outlined in Chapter 5 of Water Issues, in the Supplementary Planning Guidance on The After-Use of Sand and Gravel Sites, concludes that "*where appropriate, the opportunity should be taken to create wetlands to provide water storage and militate against flooding. All reclamation schemes will need to protect the quality and quantity of water resources, water supply and land drainage and flood protection interest from any adverse impacts*."

3.2.3 Derby City Local Plan – Part 1, Core Strategy (2017)

The Core Strategy is part of Derby City Local Plan which was adopted in January 2017[11] and sets the overall strategic direction for planning in the administrative area of Derby City over the period 2011 to 2028. Saved policies from the City of Derby Local Plan Review in 2006 are also included. It is important to note that there are a few mineral resources within Derby City and therefore it is unlikely that proposals for mineral working will come forward within the City boundary.

- **Policy CP2 – Responding to Climate Change [Flood Risk Management]:**

  "... when considering compliance with the sequential test, the council will take account of alternative sites and where appropriate, apply the exception test in line with national policy.'

  'Ensure development is flood resilient and resistant... and the development will not lead to an increased flood risk of flooding elsewhere.'

  'Ensure that where appropriate, development meets the objectives of the Water Framework Directive'

  'Ensure that development takes account of the need to provide access to watercourses"

3.2.4 City of Derby Local Plan Review (2006)

A former Derby City Local Plan adopted in 2006[12] has saved policies within which are still enacted as part of the Part 1, Core Strategy 2017. Flood related policies including Policy GD3 have been revoked and as such, no further policies have been extracted or reviewed from the Local Plan Review as part of this SFRA.

3.2.5 Derbyshire and Derby Minerals Local Plan – Proposed Draft Plan (January 2023)

Derbyshire County Council and Derby City Council are continuing to work together to produce a joint New Minerals Local Plan which will cover the period to 2038. The Draft Minerals Local Plan aims to continue to deliver sustainable minerals development whilst also ensuring the well-being and sustainable economic growth of communities, conservation of the environment and adaptation to the impacts of climate change.

[11] Derby City Local Plan – Part 1 – Core Strategy – Retrieved: https://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/environmentandplanning/planning/localplan/evidencebase/Core-Strategy_ADOPTED_DEC-2016_V3_WEB.pdf Accessed: 13/01/22

[12] City of Derby Local Plan Review (2006). Retrieved: https://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/environmentandplanning/planning/localplan/part1/CDLPR_2017.pdf Accessed: 13/01/22

Objective 8 – Minimising the impacts on Climate Change and Flood Risk

'To reduce the effect of mineral development on the causes of climate change and facilitate adaptation to the effects of climate change, including flood risk... maintain or enhance water quality; reduce the risk of flooding both on site and in the wider area.'

- **Policy SP2: Climate Change**

  '5) Avoiding locations in areas of vulnerability to climate change and flood risk. Where this is not possible, measures should be incorporated, to mitigate any flood risk associated with the development and to avoid increasing the risk of flooding elsewhere;'

- **Policy DM8: Water Management and Flood Risk**

  'Proposals for minerals development and minerals related development will be supported where it can be demonstrated that they would not result in unacceptable impacts on:

  - *surface water quality, quantity and flows;*
  - *groundwater quality, quantity, levels and flows;*
  - *flood flows and conveyance routes, flood storage capacity, the integrity of flood defences and local land drainage systems;...*

  Proposals will be expected to:

  incorporate flood risk protection, flood resilience measures appropriate to the character and biodiversity of the area and the specific requirements of the site, ensuring that the development would not increase flood risk to the site, or to others...'

3.2.6 Preliminary Flood Risk Assessment (2011)

As required by the Flood and Water Management Act (2010), the LLFA are required to prepare a Preliminary Flood Risk Assessment (PFRA) which seeks to provide a high-level overview of flood risk from local flood sources, namely surface water, groundwater and Ordinary Watercourses. An assessment of the probability and harmful consequences of past and future flooding are also undertaken.

As the LLFA, Derbyshire County Council prepared a PFRA[13] in 2011 which collated and evaluated historic and future flooding, identifying significant flood risk areas within DCC administrative area in order to inform and develop a Local Flood Risk Management Strategy to manage flooding in Derbyshire. The most significant flood events occurred in 2000, 2002 and 2007 which were a combination of fluvial and surface water sources. A map of historical flood events shows a cluster of events predominately within Amber Valley, North East Derbyshire, Chesterfield and Bolsover District and Borough Councils.

As the LLFA, Derby City Council also prepared a PFRA[14] which reported a high-level assessment of flood risk arising from surface water, groundwater, ordinary watercourses and canals within Derby City. Whilst Derby has a long history of flooding, sources were predominantly experienced from fluvial and pluvial sources.

3.2.7 Humber River Basin District Flood Risk Management Plan

The Environment Agency is required to prepare Flood Risk Management Plans (FRMPs) for all of England covering flooding from Main Rivers, the sea and reservoirs.

[13] Derbyshire Preliminary Flood Risk Assessment (2011) Retrieved: https://www.derbyshire.gov.uk/environment/flooding/prfa/preliminary-flood-risk-assessment.aspx Accessed: 13/01/22

[14] Derby City Council Preliminary Flood Risk Assessment (2011) Retrieved: Microsoft Word - Item 20 - Appendix 2.doc (geosmartinfo.co.uk) Accessed: 31/01/22

As such, the Humber River Basin District FRMP[15] was published in March 2016 and sets out the proposed measures to manage flood risk from all sources in the Humber River Basin District from 2015 to 2021. This document draws on existing reports and plans which have been prepared in the past and sets out how Risk Management Authority's will work with communities to manage flood and coastal risk.

The Humber FRMP sits alongside the Humber River Basin Management Plan which includes information on the following:

- Current state of the water environment;
- Pressures affecting the water environment;
- Environmental objectives for protecting and improving the waters;
- Programme of measures, actions needed to achieve the objectives; and,
- Progress since the 2009 plan.

3.2.8 Derbyshire County Council Local Flood Risk Management Strategy (LFRMS)

The Derbyshire County Council Local Flood Risk Management Strategy (LFRMS) was published in July 2015[16], which outlines how local flood risk is managed within Derbyshire and sets out the roles and responsibility of flood risk management partners. There are five key objectives outlined within the Local Strategy. These are as follows:

1. *To further develop an understanding of the flood risk to Derbyshire and the impacts of climate change working collaboratively with all other Risk Management Authorities and relevant groups / bodies to ensure a co-ordinated response to flood risk management for Derbyshire.*
2. *To continue to work with all relevant bodies to ensure appropriate and sustainable development in Derbyshire.*
3. *To aim to reduce the level of flood risk to the residents of Derbyshire.*
4. *To continue to prioritise limited resources effectively to support communities most at risk in Derbyshire.*
5. *To continue to help and support the local communities of Derbyshire to manage their own risk.*
6. *To continue to help protect and enhance the natural and historic environment of Derbyshire.*

3.2.9 Derbyshire County Council Flood Response Policy (2020)

A key action from the Derbyshire County Council LFRMS in 2015[17] was to 'Publish a Flood Response Policy'. As such this Policy aims to outline the operational framework within the Council to make best use of resources for flood conditions, create more resilient communities and improve the local's awareness of flood risk. The Policy document outlines key roles and responsibilities in three scenarios; when flooding is predicted, before flooding occurs and after flooding.

3.3 Water Legislation

3.3.1 Flood and Water Management Act 2010

The Government commissioned Sir Michael Pitt to undertake a review of flood risk management in response to the severe flooding across large parts of England and Wales in summer 2007 which led to the production of the

[15] Humber River Basin District FRMP (2016) Retrieved: https://www.gov.uk/government/publications/humber-river-basin-district-flood-risk-management-plan Accessed: 13/01/22

[16] Derbyshire County Council LFRMS (2015). Retrieved: https://www.derbyshire.gov.uk/environment/flooding/strategy/local-flood-risk-management-strategy.aspx Accessed; 13/01/22

[17] Derbyshire County Council Flood Response Policy. Retrieved: https://www.derbyshire.gov.uk/site-elements/documents/pdf/environment/flooding/flooding-response-policy.pdf Accessed: 13/01/22

Pitt Review – Learning Lessons from the 2007 flood. Subsequent progress reviews outlined the need for changes in the way the UK is adapting to the increased risk of flooding and the role different organisations have to deliver this function.

The Flood and Water Management Act 2010[18] designated Unitary Authorities and upper tier Local Authorities as Lead Local Flood Authorities (LLFAs). Both Derbyshire County Council and Derby City Council are designated as the LLFA for their respective administrative areas and have responsibility to lead and co-ordinate local flood risk management. This includes having lead responsibility for managing local flood risk such as surface water runoff, groundwater, land drainage ditches and Ordinary Watercourses, and maintaining a register of flood risk assets.

The Flood and Water Management Act also formalises the flood risk management roles and responsibilities for other organisations including the Environment Agency, Water Companies, Internal Drainage Boards and National Highways. The responsibility to lead and co-ordinate the management of tidal and Main River fluvial flood risk remains that of the Environment Agency. The role of Sustainable Drainage Systems Approval Body was initially given to LLFA's allowing them to be responsible for adopting and maintaining SuDS. As of January 2023, the government announced that Schedule 3 will be enacted in 2024. The new rules plan to mandate the use of SuDS in new developments in England, with an aim to reduce the risk of flooding and water pollution. Prior to Schedule 3 taking effect, the use of SuDS in new development is instead enforced by LPAs.

3.3.2 The Water Framework Directive Regulations

The Water Framework Directive Regulations[19] (WFD) establishes a framework for the protection and improvement of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater.

The WFD requires the UK to classify the current condition of key waterbodies (giving a 'Status' or 'Potential') and sets objectives to either maintain their condition or improve where a waterbody is failing minimum targets. The chemical quality status attainable by a watercourse is either 'Good' or 'Fail' and the ecological quality status attainable ranges from 'High' to 'Bad'. The target for all watercourses should be to achieve at least 'Good' chemical status. Any activities that could cause deterioration within a nearby waterbody or prevent the future ability of a waterbody to reach its target status, must be mitigated to reduce the potential for harm and allows the aims of the WFD to be realised.

To ensure the development does not result in deterioration in the status of a waterbody, development can contribute towards attainment of WFD objectives as well as other environmental benefits. Restoration of minerals sites may provide such opportunities within Derbyshire and Derby.

[18] Flood and Water Management Act 2010. Retrieved: https://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf Accessed: 12/02/22

[19] The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Retrieved: https://www.legislation.gov.uk/uksi/2017/407/contents/made Accessed February 2023

4. Climate Change

4.1 Context

The Environment Agency published updated climate change guidance in May 2022[20] to support the NPPF. The guidance indicates that climate change is likely to increase river flows, sea levels, rainfall intensity, wave height and wind speed. As such, these climate change allowances should be used to demonstrate how flood risk will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

4.2 Peak River Flow Allowances by River Basin District

The peak river flow allowances[21] show the anticipated changes to peak flow by management catchment. The range of climate change allowances are based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.

- Central allowance is based on the 50th percentile;
- Higher central is based on the 70th percentile; and
- Upper end is based on the 95th percentile.

In addition, three primary epochs are used:

- '2020s' (2015 to 2039);
- '2050s' (2040 to 2069); and
- '2080s' (2070 to 2115).

Table 2 shows how the appropriate climate change allowances for fluvial should be used with regards to the vulnerability of the development and category of flood risk.

Table 2– Assigning Appropriate Climate Change Allowance Categories (Fluvial)

	Water Compatible	Less Vulnerable	More Vulnerable	Highly Vulnerable	Essential Infrastructure
Flood Zone 2	Central Allowance	Central Allowance	Central Allowance	Central Allowance	Higher Central Allowance
Flood Zone 3a	Central Allowance	Central Allowance	Central Allowance	Development Not Permitted	Higher Central Allowance
Flood Zone 3b	Central Allowance	Development Not Permitted	Development Not Permitted	Development Not Permitted	Higher Central Allowance

Having determined a suitable allowance category, the corresponding percentages for increase in river flow should be assessed. This is dependent on the site location and management catchment but as an example the River Derwent Humber Catchment has been selected, refer to **Table 3**.

[20] Environment Agency (2021) Flood risk assessments: climate change allowances. Retrieved: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. Accessed 13/01/2022.
[21] Environment Agency (2021) Peak River Flow Allowances by management catchment Retrieved: https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3026 Accessed January 2023

Table 3 - Peak River Flow Allowances for the Derwent Derbyshire Management Catchment

Allowance Category	Central	Higher	Upper
2020s	13%	18%	29%
2050s	17%	23%	38%
2080s	29%	39%	63%

4.3 Peak Rainfall Climate Change Allowances by Management Catchment

The predicted increase in the frequency and intensity of storm events could increase the volumes of rainfall to enter the surface water and foul drainage network. **Table 4** and **Table 5** shows the anticipated changes in peak rainfall for the study area which is in the Derwent Derbyshire Management Catchment[22] for the 3.3% AEP event and 1% AEP event.

Table 4 - Peak Rainfall Intensity Allowances for the Derwent Derbyshire Management Catchment during the 3.3% AEP rainfall event

Allowance	Total Potential Change Anticipated for '2050s' (2022 to 2060)	Total Potential Change Anticipated for '2070s' (2061 to 2125)
Central	20%	25%
Upper End	35%	35%

Table 5 - Peak Rainfall Intensity Allowances for the Derwent Derbyshire Management Catchment during the 1% AEP rainfall event

Allowance	Total Potential Change Anticipated for '2050s' (2022 to 2060)	Total Potential Change Anticipated for '2070s' (2061 to 2125)
Central	20%	30%
Upper End	40%	40%

[22] Environment Agency (2021) Peak rainfall climate change allowances by management catchment. Retrieved: Climate change allowances for peak river flow in England (data.gov.uk) Accessed January 2023

5. Level 1 SFRA Methodology

5.1 Overview

Under Section 14 of the NPPF, the risk of flooding from all sources must be considered as part of a SFRA, including flooding from the sea, rivers, land, groundwater, sewers and artificial sources. The information in this Level 1 SFRA should be used by the LPA, to enable Derbyshire County Council and Derby City Council to apply the NPPF Sequential Test. This will assist in identifying where sites can be located in the lowest area of flood risk or where potential development sites which require the application of the Exception Test through a Level 2 SFRA.

5.2 Tasks

The sequence of tasks undertaken in the preparation of the Level 1 SFRA are outlined below:

- Arrange a meeting with Derbyshire County Council and Derby City Council to establish key objectives of the Level 1 SFRA; discuss available information and datasets; and to identify relevant stakeholders.
- Summarise national and local policies since the completion of the existing 2012 Level 1 Minerals SFRA.
- Outline the new climate change guidance, released in May 2022, and provide advice for the application of this guidance in the context of the SFRA.
- Liaise with stakeholders to request relevant datasets and information or to acquire data from online sources (as listed in **Section 5.4**).
- Interrogate received data and review against objectives of the SFRA to identify any gaps in the required information.
- Assess the risk of flooding from all sources, including flooding from rivers (fluvial), land (overland flow and surface water), groundwater, historical flood events, sewers and artificial sources.
- Produce updated strategic flood risk maps, GIS deliverables and a technical report to present available relevant information on flood sources and flood risk which covers the administrative boundary of Derbyshire County Council and Derby City Council.
- Review received data against the SFRA objectives and provide a high level assessment of flood risk on proposed site allocations and future minerals applications.

5.3 Stakeholder Consultation

In the preparation of this Level 1 SFRA update, the following stakeholders were contacted to provide data and information:

- Derbyshire County Council;
- Derby City Council;
- Environment Agency;
- Severn Trent Water;
- Yorkshire Water; and
- National Highways.

Please note, there are no Internal Drainage Boards (IDB) within the administrative boundaries of Derbyshire and Derby City.

5.3.1 Local Authorities

As LLFA, Derbyshire County Council has an overarching strategic coordinating role in managing flood risk from local sources; groundwater, surface water and ordinary watercourses through the creation and implementation of a local flood risk management strategy as required in the Flood and Water Management Act (2010)[23]. A key part of the preparation of the Level 1 SFRA is to collect, collate and review information relating to flood risk in the study area. As outlined in **Section 5.4,** Derbyshire County Council and Derby City Council have provided flood risk data that will be presented in this SFRA.

5.3.2 Environment Agency

The Environment Agency has the strategic oversight for all flood and coastal erosion risk management in England and is also responsible for managing coastal and fluvial flooding from Main Rivers in addition to the risk of flooding from reservoirs. The study area falls within the jurisdiction of the Environment Agency East Midlands Office and have been contacted to retrieve the outputs of fluvial hydraulic models to ascertain the flood extents including delineating Flood Zone 3b.

5.3.3 Water Companies

Severn Trent Water (STW) is the statutory water supply and sewerage provider for the majority of Derbyshire. Yorkshire Water (YW) is responsible for the potable water and wastewater services in North East Derbyshire. Both STW and YW have been asked to supply details of sewer flooding in Derbyshire in the form of their DG5 registers. Please note, at the time of writing, due to the sensitive nature of data, DG5 records have been excluded from the SFRA. As such, an assessment of historical records from sewer flooding has not been undertaken.

5.3.4 National Highways

National Highways have lead responsibility for providing and managing highway drainage under the Highways Act 1980. National Highways have been contacted for evidence of historic flooding as a statutory consultee in the planning system for Motorways and major A roads.

5.4 Data/ Information Requested

Datasets were requested from **Derbyshire County Council and Derby City Council** for the following data:

- Areas Susceptible to Groundwater Flooding;
- Existing (Active and Worked Out) and Potential Mineral Sites;
- Other Potential Sources of Flooding and Historical Flood Events;
- Flood Risk Information for Potential Mineral Sites; and
- Derbyshire County Council and Derby City Administrative Boundary.

A number of **Environment Agency Open Data**[24] datasets are available online as part of an Open Government Licence (OGL) initiative, allowing multiple datasets to be viewed and freely downloaded by AECOM. The data downloaded and used within this SFRA included:

- Environment Agency Flood Map for Planning (Rivers and Sea) Flood Zone 2 (0.1% annual exceedance probability (AEP) event and Flood Zone 3 (1% AEP event);
- Statutory Environment Agency Main Rivers;

[23] Flood and Water Management Act (2010) Retrieved: https://www.legislation.gov.uk/ukpga/2010/29/contents Accessed January 2023

[24] Environment Agency (2023) Defra Data Services Platform. Retrieved: Defra Data Services Platform Accessed January 2023

- Risk of Flooding from Surface Water;
- Groundwater Source Protection Zones;
- Flood Warning Areas;
- Areas Benefitting from Flood Defences and Spatial Flood Defences; and
- Flood Storage Areas.

Additional datasets were requested from the **Environment Agency** as these were not available to download online. These included:

- Bedrock and Superficial Deposits Aquifer Designation; and
- Detailed Modelled Flood Outlines (Defended) to determine Climate Change allowances and Flood Zone 3b (5% AEP event).

Datasets were requested from **Severn Trent Water** and **Yorkshire Water** for the following data:

- Historical Sewer Flood Records in the form of DG5 Registers

Datasets were requested from **National Highways** for the following data:

- Historical Flooding Hotspots.

5.5 Data Presentation

Using the GIS layers collected, 16 Derbyshire County wide maps and 19 detailed 1:50,000 scape maps covering the study area were produced as shown in **Table 6** to visually assist Derbyshire County Council and Derby City Council in their site allocation decision making process.

Table 6 - SFRA Mapping Content

	Contents	Appendix
County Overview Maps	Study Area, Main Watercourses & Inset Index	A, C & P
	Environment Agency Flood Zones (Undefended)	E
	Groundwater Source Protection Zones	K
	Environment Agency Bedrock and Superficial Deposits Aquifer Designation	L
	Areas Susceptible to Groundwater Flooding	J
	Flood Warning Areas	H
	Existing (Active and Worked Out) and Potential Mineral Sites	O
1:50,000 Scale County Maps	Fluvial (River Flooding)	E
	Pluvial (Surface Water Flooding)	I
	Other Potential Sources of Flooding and Historical Flooding	M
	Detailed Modelled Flood Outlines (Defended)	G

5.5.1 Fluvial and Tidal Flood Data

The guidance on SFRAs requires LPAs to define all Flood Zones within their administrative boundary area including the functional floodplain[25]. The Environment Agency's Flood Map for Planning (FMfP) (Rivers and Sea) outlines three main zones of fluvial flood risk. These are defined in **Table 7**.

Table 7 – Flood Zones

Flood Zone	Definition
Zone 1 Low Probability	This zone comprises land assessed as having a less than 1 in 1,000 chance of river or sea flooding in any year (<0.1% AEP)
Zone 2 Medium Probability	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 chance of river flooding (1% - 0.1% AEP) in any year; or between a 1 in 200 and 1 in 1,000 chance of sea flooding in any year (0.5% AEP – 0.1% AEP).
Zone 3a High Probability	This zone comprises land assessed as having a 1 in 100 or greater chance of river flooding in any year (>1% AEP); or a 1 in 200 year or greater chance of flooding from the sea in any year (0.5% AEP).
Zone 3b The Functional Floodplain	A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of a flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). LPA's should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the EA.

The Environment Agency's Flood Zone Maps comprises a combination of flood outlines derived through detailed numerical hydraulic modelling, national broad-scale (coarse) modelled flood outlines (JFLOW), topographic surveys and incorporating information from recorded flood events.

The Environment Agency FMfP dataset is the main reference for planning purposes and defines the extent of flooding ignoring the presence of flood defences. The reason for this approach is to make an allowance for residual flood risk in the event of a failure or breach/overtopping of the flood defences. This conservative approach over time will reduce reliance on flood defences and raises the awareness of flood risk in defended areas to help ensure that it is managed appropriately as part of development proposals.

[25] Environment Agency (2021) How to prepare a strategic flood risk assessment. Retrieved: https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment Accessed January 2023

A separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'[26]. This map takes into account the presence of flood defences and so describes the actual chance of flooding, rather than the chance if there were no defences present. Although flood defences reduce the level of flood risk, they do not completely remove the chance of flooding due to breaches or overtopping which could happen during extreme weather conditions. As such, for planning purposes and informing the public the Environment Agency FMfP and associated Flood Zones remains the primary source of information. **Appendix E** presents a county wide map of the Environment Agency FMfP across the Derbyshire County. **Appendix E1 – E19** shows 19 inset maps of the Environment Agency FMfP across the Derbyshire County at a 1:50,000 scale.

5.5.2 Detailed Hydraulic Modelling

The outputs of 16 No. detailed hydraulic modelling studies within the study area has been supplied by the Environment Agency. This includes the 1 in 100 year, 1 in 100 year plus CC and 1 in 1000 year flood event.

5.5.2.1 Flood Zone 3b Functional Floodplain

Flood Zone 3b is defined in the NPPF as land where water has to flow or be stored in times of a flood and has a 3.3% AEP (1 in 30 year return period). As such, functional floodplains have the highest probability of all the Flood Zones defined in **Table 7**. As Flood Zone 3b is not separately distinguished from Zone 3a on the FMfP, this information is derived from detailed hydraulic modelling studies where available.

The Environment Agency have supplied modelled flood outlines for the functional floodplain for the watercourses shown in

. Given the definition of Flood Zone 3b was updated in August 2022, most models retrieved from the Environment Agency have since not been updated to reflect the recent legislation changes. As such, email correspondence with the Environment Agency on the 6th October 2022 confirmed the approach to use the 1 in 20 year flood event or the 1 in 25 year flood event was considered acceptable to define the Flood Zone 3b Functional Floodplain.

Appendix F outlines the Flood Zone 3b flood extents across Derbyshire. **Appendix F1 – F12** shows 12 inset maps of Flood Zone 3b across the Derbyshire County.

5.5.2.2 Climate Change

Climate change may increase peak rainfall intensity and river flow, which could result in more frequent and severe flood events. To ensure sustainable development now and in the future, the NPPF requires that the effects of climate change should be taken into account in an SFRA and the flood outlines delineating climate change should be presented.

At the time of writing, the climate change allowances used within the hydraulic models in the study area uses 20% and 30% allowances for future increase in fluvial flood risk which are based on UKCP09 climate change projections for the Humber River Basin. These allowances are applied to the 1 in 100 year annual probability (1% AEP) flow and the resulting flood maps are provided in **Appendix G** and inset maps in **Appendix G1- G12**. **Appendix G** also shows the 1 in 100 year flood extents, 1 in 100 year + 20% or 30% climate change flood extents and the 1 in 1000 year flood extents.

[26] Environment Agency (2021) Long Term Flood Risk for an area in England. Retrieved: https://www.gov.uk/check-long-term-flood-risk#x=237038&y=161974&scale=1 Accessed January 2023

The Environment Agency's guidance on climate change allowances were updated in May 2022[27] and as such, not all of the detailed hydraulic modelling studies provided by the Environment Agency reflect these recent climate change allowances. **Table 9** shows the climate change allowance used for each study.

The appropriate climate change allowance is dictated by the vulnerability classification outlined in the NPPF. This is shown in **Table 8.** As per the NPPF guidance, the central allowance should be used for both vulnerability classifications. Assuming an epoch of 2080's, the guidance suggests an updated climate change allowance of 29% should be used. Given the climate change allowances in the existing hydraulic models are not too distant from the updated guidance, it has been judged that these are acceptable to be used within the SFRA.

Table 8 - Flood Risk Vulnerability Classifications

Development Type	Vulnerability Classification
Minerals working and processing (except for sand and gravel working)	Less Vulnerable
Sand and Gravel Working	Water Compatible

Please note, if the 1 in 100 year plus climate change event outline is not available for the proposed site allocations then detailed modelling will need to be undertaken to determine the flood outline in a site-specific Flood Risk Assessment. **Section 4** can be used to identify the appropriate climate change allowance to use for a particular site.

Table 9 - Model Studies and associated Climate Change Allowance and Modelled Return Period for Flood Zone 3b

ID	Watercourse	Study	Date of Model	Climate Change Allowance	Modelled Return Period for Flood Zone 3b
1	River Amber	River Amber SFRM2, JBA	2012	1 in 100 year + 30%	1 in 20 year
2	Derbyshire Trent	Derbyshire Trent Model Report, Jacobs	2018	1 in 100 year + 30%	1 in 30 year
3	Bottle Brook	Bottle Brook Modelling Study, EA	2012	1 in 100 year + 30%	1 in 20 year
4	Bradwell Brook	Bradwell Brook – Midlands Region Rapid Response Catchment, EA	2011	1 in 100 year + 30%	1 in 20 year
5	Chaddesden Brook	Derby City Tributaries SFRM, JBA	2013	1 in 100 year + 20%	1 in 25 year
6	Coppice Brook	N/A	2011	1 in 100 year + 20%	1 in 20 year

[27] Environment Agency (2021) Flood Risk Assessments: Climate Change Allowances. Retrieved: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances Accessed January 2023

ID	Watercourse	Study	Date of Model	Climate Change Allowance	Modelled Return Period for Flood Zone 3b
7	Cuttle Brook	Cuttle Brook Model, JBA	2006	1 in 100 year + 20%	1 in 25 year
8	Ecclesbourne Derwent	N/A	2014	1 in 100 year + 20%	1 in 20 year
9	Markeaton Brook	Derby City Tributaries SFRM, JBA	2013	1 in 100 year + 20%	1 in 25 year
10	Matlock Belper	Matlock and Belper Final Report, RevB	2011	1 in 100 year + 20%	1 in 20 year
11	Ock Brook	Derby City Tributaries SFRM, JBA	2013	1 in 100 year + 20%	1 in 25 year
12	Peakshole Water and Noe	Peakshole Water and River Noe Hydraulic Modelling Report, Hyder	2011	1 in 100 year + 20%	1 in 20 year
13	Tideswell Brook	Tideswell Brook – EA Midlands Region Rapid Response Catchment, Hyder	2011	1 in 100 year + 30%	1 in 20 year
14	Alfreton	Alfreton Brook SFRM, Capita Symonds	2006	1 in 100 year + 20%	1 in 25 year
15	Derwent Confluence - Trent and Derwent	Derwent-Trent Confluence Modelling Report, JBA Consulting	2010	1 in 100 year + 30%	1 in 20 year
16	Wye	River Wye SFRM, Halcrow	2010	1 in 100 year + 30%	1 in 20 year

5.5.3 Flood Defences

Flood defences are typically engineered structured designed to limit the impact of flooding. Flood defences take several forms including bunds / embankments, canalised channels, culverts and flood storage areas which can be devised between man-made and natural defences. Normally a number of assets will be used together to manage the risk in a particular area, working in combination within a risk management system. They generally fall into one of two categories; 'formal' or 'informal'.

A 'formal' flood defence is a structure which has been specifically built to control floodwater. It is maintained by its owner or statutory undertaker so that it remains in the necessary condition to function. In accordance with

the Flood and Water Management Act (FWMA), the Environment Agency has powers to construct and maintain defences to help protect against flooding.

Information on 'formal' raised flood defences was provided by the open online dataset 'Spatial Flood Defences (inc. standardised attributes)'[28]. This dataset shows the flood defences which are currently owned, managed or inspected by the Environment Agency. Flood defences can be structures, buildings or parts of buildings. Typically, these are earth banks, stone and concrete walls, or sheet-piling that is used to prevent or control the extent of flooding. The importance of regular maintenance and inspection by the Environment Agency is highlighted as flood defences may present a residual risk of flooding in the unlikely event of a breach or failure. **Appendix E** shows the locations of 'formal' flood defences using the Spatial Flood Defences (inc. standardised attributes) EA dataset.

An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes rail and road embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining areas or change the flow path of water in addition to their primary function. This is usually seen on a smaller scale at local sites.

The Environment Agency 'Areas Benefitting from Defences' dataset had been retired at the time of writing and is superseded by a new dataset called 'Reduction in Risk of Flooding from Rivers and Sea due to Defences'. This dataset was not yet available at the time of writing and has therefore not been included within this assessment.

5.6 Flood Warnings

The Environment Agency is the national authority for managing flood risk and therefore have a duty to warn, inform and advise the public in relation to particular flooding emergencies. As such, the Environment Agency has a network of flood warning telemetry systems in place around the country and a team of specialists who frequently monitor the systems. A series of river level gauges coupled with information from the Met Office enables a Warning to be delivered to recipients in community focussed "Flood Warning Areas".

Derbyshire County Council also have responsibility to warn and inform the public, under the Civil Contingencies Act 2004, when appropriate through the County Council's Emergency Planning Division. The Derbyshire Prepared website[29] is one line of communication that is used.

Appendix H shows the Flood Warning Areas from the Environment Agency Open Data within the Study Area.

5.7 Flooding from Surface Water

Surface water flooding occurs when the volume of rainfall or flowing water overwhelms drainage systems and is unable to percolate into the ground. Surface water flooding effects almost everybody not just those located near rivers or the sea.

Surface water flooding is the responsibility of the LLFA, who work in partnership with the Environment Agency, district councils and utility companies. They are responsible for effectively assessing, mapping and planning for local flood risk.

The Risk of Flooding from Surface Water (RoFfSW) Map, has been produced by the Environment Agency using information and input from LLFA to help assess and manage surface water flooding. It includes the extent of flooding that could result from three different design rainfall events:

- High Probability – 3.3% AEP (1 in 30 chance of flooding in any one year)

[28] Environment Agency (2021) Spatial Flood Defences (including standardised attributes) dataset. Retrieved: https://environment.data.gov.uk/dataset/8e5be50f-d465-11e4-ba9a-f0def148f590 Accessed January 2023

[29] Derbyshire Local Resilience Forum (2023) Derbyshire Prepared. Retrieved: https://www.derbyshireprepared.org.uk/ Accessed January 2023

- Medium Probability – 1% AEP (1 in 100 chance of flooding in any one year); and,
- Low Probability – 0.1% AEP (1 in 1000 change of flooding in any one year).

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three events, 3.33% AEP, 1% AEP and 0.1% AEP. GIS layers of the RoFfSW flood extents were obtained through the Open Government License, as shown in **Appendix I** and inset maps in **Appendix I1 – I19.**

The RoFfSW map does not show the impact of climate change on future surface water flood risk. As such, the updated climate change allowances, shown in **Section 5.5.2.2**, should be used when assessing the potential effects of climate change of surface water flooding.

5.8 Flooding from Groundwater

Groundwater flooding occurs when water levels rise above the ground surface. Groundwater flooding is most common in areas underlain by permeable rock or aquifers such as chalk or locations with sand and gravel such as in river valleys. Groundwater flooding is slower to occur than river or surface water flooding however flooding can last weeks or months.

The groundwater flooding susceptibility data shows the degree to which areas of England, Scotland and Wales are susceptible to groundwater flooding on the basis of geological and hydrogeological conditions. It does not show the likelihood of groundwater flooding occurring and should be used in conjunction with other data to investigate the groundwater in the area before planning decisions are made. **Appendix J** shows the areas susceptible to groundwater flooding within the county boundary of Derbyshire.

The susceptible areas are represented by one of four area categories (listed below) showing the percentage of each 1km^2 that is susceptible to groundwater emergence.

- < 25%
- >=25% <50%
- =50% <75%
- >= 75%

5.9 Groundwater Source Protection Zones

Groundwater sources that supply drinking water are protected by the Environment Agency from pollution and contamination as groundwater supplies a third of the UK's drinking water. There are over 2,600 Ground Water Source Protection Zones in England surrounding wells, boreholes and springs used for public drinking water supply[30]. In some areas it is the only available drinking water supply where homes are not connected to water mains. These are zones which show the level of risk to the source from contamination from any polluting activity in the area. It is assumed the closer the activity, the greater the risk of pollution and as such the time taken for a pollutant to travel to the source is used to help define the SPZ classification of an area. The maps show three main zones (inner, outer and total catchment).

- SPZ1 – Inner Protection Zone - Defined as a 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres;

[30] Environment Agency (2021) Protect groundwater and prevent groundwater pollution. Retrieved: https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution/protect-groundwater-and-prevent-groundwater-pollution Accessed January 2023

- SPZ2 – Outer protection zone - Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250m or 500m around the source, depending on the size of the abstraction;
- SPZ3 – Total Catchment Zone - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.
- SPZ4 – Zone of Special Interest – Defined as an area where local conditions require additional protection.

The zones are used in conjunction with the Environment Agency's Groundwater Protection Position Statements which aim to prevent the pollution of groundwater and protect it as a resource for future generations. The zones and statements inform high risk areas in which pollution prevention measures are needed and to monitor potential polluters nearby. **Appendix K** presents the groundwater protection zones dataset.

5.10 Aquifer Designation

The Environment Agency provides free access to information on Aquifer Designation online through 'Magic Map'[31], however the data is not available to download freely. As such the Bedrock and Superficial Deposits Aquifer Designations dataset has been used.

Groundwater protection policy in England and Wales uses aquifer designations that are consistent with the Water Framework Directive[32]. These designations reflect the importance of aquifers not only in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

Contamination of groundwater aquifers can lead to the spreading of a pollutant over a wider area through the movement of water. The dispersion of water can result in interaction with the groundwater table which in turn can discharge through seeps and springs into surface water, therefore eventually contaminating both ground and surface water over a large area. However, processes that take days or weeks in surface water systems may take decades to centuries in groundwater. As such, pollutants may take a long time to move from the source to a receptor or to a point where they can be detected yet large amounts of contamination will already have taken place. Protecting groundwater is therefore essential, as returning polluted areas back to their original condition is very difficult.

The Environment Agency provides the following definitions for the Aquifer Designations:

- Principal aquifers provide drinking water or support rivers, lakes and wetlands.
- Secondary Aquifers are split into three groups:
  - Secondary 'A' aquifers comprise permeable layers that can support local water supplies and may form an important source of river base flow.
  - Secondary 'B' aquifers are mainly lower permeability layers that may store and yield amounts of groundwater through characteristics like thin cracks (called fissures) and opening or eroded layers.
  - Secondary 'undifferentiated' aquifers are aquifers where it is not possible to apply either a Secondary 'A' or 'B' definition because of the variable characteristics of the rock type. These have only minor value.

[31]Natural England (2023) Magic Map Application. Retrieved: https://magic.defra.gov.uk/MagicMap.aspx?chosenLayers=aqbedrock,aqdrift,backdropDIndex,backdropIndex,europeIndex,vmlBWIndex,25kBWIndex,50kBWIndex,250kBWIndex,miniscaleBWIndex,baseIndex&box=-596566:-83527:1410471:1316473&useDefaultbackgroundMapping=false Accessed: January 2023

[32] British Geological Survey (2023) Aquifer designation data. Retrieved: https://www.bgs.ac.uk/datasets/aquifer-designation-data/ Accessed: January 2023

– Unproductive Strata

The Environment Agency maps are split into two different types of aquifer designations:

– superficial: permeable, unconsolidated (loose) deposits, e.g. sands and gravels

– bedrock: solid, permeable formations, e.g. sandstone, chalk and limestone

Many factors that will influence the risk of contamination of an aquifer, these include whether the aquifer is classed as confined or unconfined; the depth of the aquifer; whether a pathway exists to the aquifer i.e. if impermeable layers lie above an aquifer; and the soil vulnerability.

Appendix L presents the Environment Agency aquifer designation across the Derbyshire County. It is important to note that Aquifer Designation mapping is intended to be used at a high level assessment and further site-level investigation may be required.

5.11 Sewer Flooding

During heavy rainfall, flooding from the sewer system may occur if:

1. The rainfall event exceeds the capacity of the sewer system/drainage system:

Sewer systems are typically designed and constructed to accommodate rainfall events with an annual probability of 1 in 30 (3.3% AEP) or greater. Therefore, rainfall events with an annual probability less than 1 in 30 (3.3% AEP) would be expected to result in surcharging of some of the sewer system. It is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

2. The system becomes blocked by debris or sediment:

Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter).

3. The system surcharges due to high water levels in receiving watercourses:

Within the study area there is potential for surface water outlets to become submerged due to high river levels. When this happens, water is unable to discharge. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses. Where the local area is served by 'combined' sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

Derbyshire County consists of three Water Authorities; Severn Trent Water, Yorkshire Water and United Utilities. Derby City consists of only Severn Trent Water. Water companies are regulated by the Water Services Regulation Authority (OFWAT) and are required to maintain records of areas of frequent sewer flooding and to address this through their capital investment plans.

Areas at risk from sewer flooding are determined though a review of records from DG5 registers. The DG5 register is principally a register of known flooding locations caused by overloading of the system and records only appear in instances where sewer flooding has been reported to the local Water Authorities e.g. Severn Trent Water. The DG5 is held by water companies and shows a list of properties impacted by sewer flooding and is used to target interventions to avoid sewer flooding. As such, areas on the DG5 register may no longer be at risk if interventions have been put in place.

At the time of writing, the DG5 register from Severn Trent Water held sensitive data and has not been included within the SFRA. As such, an assessment of sewer flooding has been excluded. Severn Trent Water should be contacted for further information to support site-specific FRAs within Derbyshire.

5.12 Proposed Mineral Sites

Derbyshire County Council provided the locations of 29 potential future mineral sites. A number of these sites are from the Derby and Derbyshire Minerals Plan. A summary of the sites is detailed below in **Table 10**.

Table 10 – Proposed Mineral Sites

ID	Site Name	District	Mineral Type	Grid Ref Easting	Grid Ref Northing
1	Aldwark South	Derbyshire Dales	Industrial Limestone	423688	357060
2	Swarkestone North	South Derbyshire	Sand and Gravel	442129	332429
3	Swarkestone South	South Derbyshire	Sand and Gravel	433932	328022
4	Foston	South Derbyshire	Sand and Gravel	432872	327573
5	Sudbury	Derbyshire Dales	Sand and Gravel	418102	330537
6	Elvaston	South Derbyshire	Sand and Gravel	417112	331063

Table 11 – Existing Mineral Sites

ID	Site Name	District	Mineral Type	Grid Ref Easting	Grid Ref Northing
1	Mouselow Quarry, Glossop	High Peak	Millstone Grit Shale /Sandstone	402422	395157
2	Hayfield Quarry	High Peak	Millstone Grit	402994	387013
3	Dove Holes Quarry, Buxton	High Peak	Carboniferous Limestone	408186	377816
4	Tunstead Quarry (Tunstead - Old Moor), Buxton	High Peak	Carboniferous Limestone	409378	374375
5	Ashwood Dale, Buxton	High Peak	Carboniferous Limestone	408199	372593
6	Hillhead Quarry, Buxton	High Peak	Carboniferous Limestone	407051	370070
7	Brierlow Quarry, Buxton	High Peak	Carboniferous Limestone	408711	369052
8	Hindlow Quarry Buxton	High Peak	Carboniferous Limestone	409699	368201
9	Dowlow Quarry, Buxton	High Peak	Carboniferous Limestone	410326	367880
10	Bone Mill Quarry (Ryder Point), Hopton	Derbyshire Dales	Carboniferous Limestone	426010	354740
11	Brassington Moor Quarry (Longcliffe)	Derbyshire Dales	Carboniferous Limestone	423708	356975
12	Grange Mill Quarry, Wirksworth	Derbyshire Dales	Carboniferous Limestone	424256	357268

ID	Site Name	District	Mineral Type	Grid Ref Easting	Grid Ref Northing
13	Halldale Quarry, Darley Dale Non Operational	Derbyshire Dales	Sandstone	427962	363419
14	Ball Eye Quarry, Cromford Non Operational	Derbyshire Dales	Carboniferous Limestone	428760	357311
15	Slinter Top Quarry, Cromford	Derbyshire Dales	Carboniferous Limestone	430400	357000
16	Dene Quarry, Cromford	Derbyshire Dales	Carboniferous Limestone	428961	356285
17	Mercaston Quarry	Derbyshire Dales	Sherwood Sandstone	426738	344349
18	Sudbury	Derbyshire Dales	Sand and Gravel	416843	331417
19	Whitwell Quarry	Bolsover	Permian Limestone	453106	375229
20	Bolsover Moor - Non Operational	Bolsover	Permian Limestone	449886	372041
21	Shirebrook Colliery CMM	Bolsover	Coal Measures	452857	367226
22	Moorhay Farm	North East Derbyshire	Sandstone	431000	372430
23	Dukes Quarry, Whatstandwell	Amber Valley	Sandstone	433434	354689
24	Waingroves Quarry, Ripley	Amber Valley	Coal Measures	440915	348503
25	Elvaston - Non Operational	South Derbyshire	Sand and Gravel	442761	331486
26	Shardlow	South Derbyshire	Sand and Gravel	443200	329400
27	Swarkestone	South Derbyshire	Sand and Gravel	434366	328400
28	Willington	South Derbyshire	Sand and Gravel	428309	328384
29	Foston	South Derbyshire	Sand and Gravel	418059	330695

Appendix O presents a map of the proposed and existing mineral sites across Derbyshire and **Table 12** shows flood risk information in a tabular format for all of Derbyshire's County Councils potential future mineral sites at the time of writing.

Table 12 – Proposed Mineral Sites Table

Name	District	Mineral Type	Area (km²)	Easting	Northing	EA FZ 1	EA FZ 2	EA FZ 3	EA FZ 3b	Flood Warning Area	RoFfSW (1 in 30 year)	RoFfSW (1 in 100 year)	RoFfSW (1 in 1000 year)	AStGWF (<25%)	AStGWF (25 - 50 %)	AStGWF (50 - 75 %)	AStGWF (>75 %)	Main River in Site
Aldwark South	Derbyshire Dales	Industrial Limestone	0.26 km²	423688	357060	✓	-	-	-	-	✓	✓	✓	✓	-	-	-	-
Swarkestone North	South Derbyshire	Sand and Gravel	0.5 km²	433932	328022	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓
Swarkestone South	South Derbyshire	Sand and Gravel	0.5 km²	432872	327573	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓
Foston	South Derbyshire	Sand and Gravel	0.7 km²	418102	330537	✓	✓	✓	-	-	✓	✓	✓	-	-	-	✓	✓
Sudbury	Derbyshire Dales	Sand and Gravel	0.8 km²	417112	331063	✓	✓	✓	-	✓	✓	✓	✓	-	-	-	✓	✓
Elvaston	South Derbyshire	Sand and Gravel	0.5 km²	442129	332429	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓

6. Flood Risk in Derbyshire

6.1 Introduction

Section 1 provides an overview of the risk of flooding from all sources in Derbyshire with the support of mapped deliverables.

6.2 Requirements of the National Planning Policy Framework

The NPPF and PPG requires SFRAs to present information on all sources of flooding to allow the LPAs and MPA to apply the sequential test and identify areas at risk of flooding. A series of figures/ maps have been produced to support the report.

6.3 Historical Flooding

There have been a number of recorded historical flood events in Derbyshire derived from the Environment Agency and National Highways.

Appendix M and inset maps in **Appendix M1 – M19** illustrates the Environment Agency Historic Flood Map (HFM) which shows areas of land which have been previously subject to flooding in England from predominantly fluvial sources such as the River Derwent and the River Trent which traverse around Derby City in the south of the Study Area.

Historical flooding data from National Highways has also been provided, showing over 2500 incidents of flooding within the Derbyshire County area. Types of flooding include internal property flooding, flooding from brooks and streams, ponding or surface water and flooding on highways. These flooding hotspots are also illustrated in **Appendix M.**

6.4 Fluvial Flooding

The predominant risk of flooding within Derbyshire is fluvial flooding from the overtopping of watercourses, rivers, streams and drainage channels. The main watercourses within the SFRA study area are shown in **Appendix C** and the Environment Agency Flood Zones associated from these main watercourses are shown in **Appendix E**.

The River Derwent and the River Trent are the dominant catchments draining Derbyshire. The Main River flows 50 miles south east where it ends at Derwent Mouth and joins the River Trent, at the southern border of the Derbyshire study area. Major tributaries join the River Trent including the River Noe, Bentley Brook, River Amber and the River Ecclesbourne as well as other minor tributaries.

As such, there are fluvial flood zones associated with all of the Main Rivers across the county. The most prominent flood zones are associated with the River Derwent and River Trent, particularly around the area of confluence in the south east of the Derbyshire county. Fluvial flood extents are largest in the South Derbyshire district, Erewash district and Derby City district.

The Proposed Mineral Sites table in **Table 12** and the maps included in **Appendix E** identify five out of the six sites which are located almost entirely within Flood Zone 2 and 3;

- Elvaston
- Foston
- Sudbury
- Swarkestone North
- Swarkestone South

Two sites are also located within land that has been defined as Flood Zone 3b;

- Swarkestone North
- Swarkestone South
- Elvaston

Mineral extraction in floodplains can have two opposing impacts. Extraction can increase the level of flood risk through the reduction in flood storage capacity due to stockpiles or associated infrastructure to undertake the works. On the other hand, mineral extraction can reduce the level of flood risk by providing additional capacity for floodwater storage during the operational phase.

However, as minerals can only be worked where they naturally occur, it causes difficulties when carrying out the Sequential Test. The requirement is to steer the development to the areas of lowest flood risk however a reasonable alternative site may not always be available. This is particularly the case for sand and gravel mineral sites. Sand and gravel deposits are located within the floodplains of natural rivers which are usually inundated during flood events. As such, these locations would not be considered as preferred in line with the Sequential Test.

However, sand and gravel working (together with essential ancillary sleeping or residential accommodation for staff required by these uses (subject to a specific flood warning and evacuation plan)) are classified as Water Compatible development. The NPPF acknowledges the minor scope for relocation and as such they will be located in areas of flood risk. Despite this, mineral workings should not increase flood risk elsewhere and the site should be designed to ensure this. As mineral working are usually large sites, there are opportunities to implement the Sequential Test at a site level. **Section 6.11** further discusses the potential future mineral sites and flood risk.

The majority of the proposed mineral sites are located within Flood Zone 1 and are at low risk of fluvial flooding. Six sites are located entirely within Flood Zone 2 or 3 and the Sequential Test should be applied. For those sites located within a range of Flood Zone classifications, the sequential approach should be applied within the site to ensure that stockpiles and ancillary buildings are located in areas of least flood risk to avoid being adversely affected by flooding or increasing flood risk elsewhere. Further details regarding the Sequential Test are provided in **Section 8**.

6.5 Surface Water Flooding

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to infiltrate into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well as other available information.

Reference has been made to the EA RoFfSW map which is presented in (**Appendix I**). These highlight areas within the Derbyshire County where surface water flooding may be an issue and should be considered in more detail as part of a site-specific FRA. **Table 12** indicates the proposed mineral sites that are at risk of flooding from surface water during the 1 in 30 year flood event, 1 in 100 year flood event, 1 in 1000 year flood event.

One of the main issues with pluvial flooding is that relatively small changes to hard surface and surface gradients can cause flooding. In developed areas, this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Furthermore, development for minerals sites including the stockpiles and ancillary buildings could lead to more frequent surface water flooding which can cause disruption to the site and surrounding land.

Due to the scale and permeability of the proposed mineral sites, it is considered that any problems encountered from pluvial flooding are more likely to inconvenience the operator. Surface water flooding is unlikely to be a significant factor when assessing the suitability of sites, providing a sufficient drainage strategy is incorporated within the site to ensure there is no increased risk of flooding elsewhere as a direct result of site activities.

6.6 Groundwater Flooding

Groundwater flooding occurs when the natural level of water stored within the ground rises above local ground level. This can result in deep and long-lasting flooding of low lying or below ground areas. It tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is most likely to occur in areas underlain by major aquifers, although it is also associated with more localised floodplain sands and gravels.

Derbyshire county is comprised of a range of bedrock geologies (**Appendix D**). In the north of the county, within the High Peak district, the area is mainly comprised of sandstone formations. Areas of limestone are present within the Derbyshire Dales district. Further south, mudstone is the prominent bedrock geology underlying Derby City district and South Derbyshire district.

Mineral workings in most cases excavate below the natural water table, which during periods of heavy rainfall, may rise. Mineral workings often operate a pumped drainage system and can therefore interfere with groundwater flow. These issues would be most appropriately addressed in a site-specific FRA at the planning application stage.

Furthermore, in Derbyshire there are historic networks of soughs which was an effective way of lowering the water table and dewatering activities are still used at mining extraction sites. As a result, there is a risk of flooding in Derbyshire caused by the rebound or exchange of groundwater due to the closure of mine water pumping. As such, consideration must be given to any development near extraction sites as original groundwater assessments may not have considered the impact after closure of sites. Some of this flooding may also be contaminated.

There is limited data available regarding groundwater flooding incidents in the study area. The presence of bedrock and superficial aquifers within the study area is shown in **Appendix L**. The superficial aquifers are predominantly within the High Peak district as well as the south of the county, following the line of the Main Rivers of the River Trent and River Derwent. The Environment Agency dataset Areas Susceptible to Groundwater Flooding (AStGWF) has also been used to show the wider areas within the Derbyshire County which might be at risk from groundwater flooding in the study area (**Appendix J**). The susceptible areas are represented by four categories showing the proportion of each 1km^2 that may be susceptible to groundwater emergence. It does not show the likelihood of groundwater flooding occurring. **Table 11** indicates how susceptible each proposed mineral site is to groundwater emergence.

6.7 Sewer Flooding

Sewer flooding is usually caused by localised short term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding can also occur as a result of blockage by debris or sediment poor maintenance, structural failure or surcharging of the system due to high water levels in the receiving fluvial system.

As mentioned in **Section 5.11**, the DG5 register from Severn Trent Water has not been included within the SFRA.

Minerals sites are generally located in rural areas remote from settlements and scattered housing, therefore, sewer flooding is not thought to be a large issue with regard to flood risk at proposed minerals sites. However, sewer and surface water flooding are likely to become more frequent and widespread as a result of urbanisation and climate change, further reinforcing the importance of integrated SuDS, as explained in **Section 10**.

6.8 Artificial Sources

Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.

6.8.1 Canals

The Trent and Mersey Canal, Erewash Canal, Peak Forest Canal and Cromford Canal are all located within the Derbyshire County boundary. The Trent and Mersey Canal is approximately 93 miles in length and links the River Trent at Derwent Mouth in Derbyshire to the River Mersey and traverses across the South Derbyshire district. The Erewash Canal is 12 miles in length and flows along the boundary of the Erewash District. The Peak Forest Canal is partially located within the High Peak District of Derbyshire, where it was built to ship Derbyshire limestone to Manchester. The Canal and River Network is shown in **Appendix N**.

Flood risk posed by the canals is un-quantified at present. However, it is widely acknowledged that canals may present potential flood risks. Canals are considered to be controlled water bodies so flood risk is deemed to be minimal unless overtopped in storm conditions. Structural failure could lead to a breach which can potentially be hazardous as they may involve the rapid release of large volumes of water at high velocity, however this risk is considered residual.

In general, the canal system is hydraulically closed down at relatively low river levels prior to the issuing of a flood alert from the Environment Agency. This is to protect the canal corridors from higher than average river levels which would overtop the banks, and to protect craft from venturing onto rivers at dangerous flows. The main causes of flooding are likely to be vandalism and a failure of a canal embankment. This has been known to happen occasionally, but the impact is not considered to be as extensive as a failure of a reservoir dam as studies have shown that maximum discharges are limited to the volume held within the canal cross section between two locks. This risk is managed by the Canal and River Trust.

Shardlow mineral site is located adjacent to the Trent and Mersey Canal in the South Derbyshire district. For potential mineral sites located adjacent to a canal, a detailed site-specific FRA should be undertaken to determine the risk of overtopping.

6.8.2 Flooding from Reservoirs

The Environment Agency's Risk of Flooding from Reservoirs Mapping identifies the areas that may be at risk of flooding in the unlikely event of dam or reservoir failure. The Environment Agency website should be consulted for further information on risk from reservoirs[33].

Table 13 – Reservoirs within Derbyshire

Reservoir	District
Carsington Water	Derbyshire Dales
Ladybower Reservoir	High Peak
Foremark Reservoir	South Derbyshire
Derwent Reservoir	High Peak
Howden Reservoir	High Peak

[33]EA Risk of Flooding from Reservoirs Mapping Retrieved: Reservoir flood maps: when and how to use them - GOV.UK (www.gov.uk) Accessed February 2023

Reservoir	District
Torside Reservoir	High Peak
Staunton Harold Reservoir	South Derbyshire
Ogston Reservoir	North East Derbyshire
Woodhead Reservoir	High Peak
Fernliee Reservoir	High Peak
Errwood Reservoir	High Peak
Bottoms Reservoir	High Peak
Valehouse Reservoir	High Peak
Kinder Reservoir	High Peak
Rhodeswood Reservoir	High Peak
Combs Reservoir	High Peak
Toddbrook Reservoir	High Peak
Arnfield Reservoir	High Peak
Linacre Upper Reservoir	North East Derbyshire
Linacre Middle Reservoir	North East Derbyshire
Linacre Lower Reservoir	North East Derbyshire
Butterley Reservoir	Amber Valley
Codnor Park Reservoir	Amber Valley
Hurst Reservoir	High Peak
Swineshaw Reservoir	High Peak

Reservoir failure can be particularly dangerous as it causes the release of large volumes of water at a high velocity, which can result in deep and widespread flooding. As shown in **Table 13**, the majority of the reservoirs are found within the High Peak district. Predicted reservoir flood extents follow the routes of the Main Rivers with Derbyshire, particularly the River Derwent due to potential breaches from Howden Reservoir, Derwent Reservoir and Ladybower Reservoir. The River Amber is also predicted to carry flood extents from Ogston Reservoir in the event of a breach scenario. The Environment Agency is the regulatory authority for the Reservoirs Act 1975 in England and Wales. As such the Environment Agency ensures, all large reservoirs are inspected and supervised by reservoir panel engineers on an annual basis and as such reservoirs in the UK have an extremely good safety record, with few historical incidences of reservoir failure. Therefore, reservoirs present a managed risk.

6.8.3 Infrastructure Failure

Flooding may result from the failure of engineering installations such as flood defences, land drainage pumping stations, sluice gates, floodgates and weirs. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. Such deterioration is often difficult to detect, meaning that should a failure occur, it is often sudden and unexpected. Failure is more likely when a structure is under maximum stress, such as extreme fluvial flooding events. However, information on the probability of flood defence failure is unsuitable for planning purposes given the uncertainties involved in such long-term predictions.

As mentioned in **Section 5.5.3** the Environment Agency's Areas Benefitting from Flood Defences dataset had been retired at the time of writing. Areas benefitting from the protection of flood defences are at residual risk from flooding in the event of a breach of the defences.

6.9 Potential Future Minerals Sites and Flood Risk

Appendix O presents a map of the proposed mineral sites across Derbyshire and **Table 11** shows flood risk information in a tabular format for all of DCC's potential future mineral sites.

Stockpiles and ancillary buildings located on mineral sites can reduce flood storage capacity of the floodplain as well as potentially altering and increasing flow routes. There are larger potential impacts within winter months as stockpiles are often larger and flooding is more likely during these months.

In order to mitigate this, the sequential approach should be applied on a site level therefore ensuring vulnerable assets are located within areas at lowest flood risk. Flood risk information contained within this Level 1 SFRA Update will form the evidence base to carry out the Sequential Test for the potential mineral sites within Derbyshire.

Whilst the Sequential Test has not yet been completed by Derbyshire County Council, based on existing and potential locations available at the time of writing, the following comments can be made regarding the need for an Exception Test or potential Level 2 SFRA.

There are three potential Carboniferous Limestone extraction sites and one coal measures extraction site located within Flood Zone 2 and 3. These developments are considered to be 'Less Vulnerable' and as such the Exception Test is not required.

Six potential Sand and Gravel extraction sites are also located wholly or partially within Flood Zone 2,3 or 3b. These developments are considered to be 'Water Compatible' and it is not expected that an Exception Test will need to be undertaken for such sites. Sand and gravel sites are often located on low lying ground characteristic of lowland meandering floodplain deposits where there may be limited surface water drainage due to the water table being close to the ground surface. Therefore, these may be at increased risk of surface water and groundwater flooding resulting in standing water and overland flow from adjacent higher ground. Overland flow paths should therefore be taken into account in spatial planning for mineral developments.

A Level 2 SFRA may be required for all sites within Flood Zone 2 and 3 to determine the areas within these flood zones that pose the least hazard (resulting from a combination of flood depth and velocity), within which to suitably locate the buildings and stockpiles. The Sequential Test approach is explained in further detail in **Section 8.**

7. Flood Risk Management Measures

7.1 Overview

All new mineral developments should aim to implement flood risk management into the planning stages through the use of sustainable flood risk management strategies where possible. This section of the Minerals SFRA will describe how flood risk management can be used within Derbyshire.

LLFA's are responsible for developing, maintaining and applying flood risk management strategies within their areas. Both LLFA's and developers should aim to identify flood risk management opportunities to reduce the causes and impacts of flooding both now and in the future. Furthermore, flood risk both to and from developments must be considered. By assessing flood risk at the start of the planning process, the most appropriate flood risk management techniques can be incorporated early on and therefore the risk of additional costs being incurred in the future are reduced.

The Flood and Water Management Act (FWMA, 2010) specifies that all RMAs must aim to make a contribution towards the achievement of sustainable development in their risk management function. Sustainable flood risk management promotes a catchment-wide approach which is more effective than managing flooding at the source on a local level.

Once mineral sites are no longer in-use, opportunities for flood risk management are available through floodplain creation and restoration. Furthermore, disused mineral sites provide other social and environmental benefits such as improvements in biodiversity, water quality and appearance of the area.

7.2 Existing Flood Risk Management in Derbyshire

A key consideration for any new development is whether adequate flood warning systems and procedures are in place to ensure that occupants of the site are able to act upon the warnings and are equipped to take steps to remain safe in the event of a flood.

For sand and gravel workings, the NPPF Technical Guidance states that any essential ancillary sleeping or residential accommodation for staff required by the workings will only be permitted in areas of flood risk subject to a specific warning and evacuation plan.

7.2.1 Flood Warning Areas

It is vital that people in areas of flood risk are aware of the potential danger and are prepared to take action to when necessary. Over time, forecasting techniques have improved, allowing more time to prepare for flood events and protect against property damage and loss of life. The Environment Agency operates a flood warning service for areas that are at risk of fluvial and tidal flooding, by issuing flood warnings to properties that are expected to flood. There are four potential EA flood warning codes as outline in **Table 13.**

Table 14 – Flood Warnings

Flood Warning Code	What it means?	When is it used?	What to do?
	Flooding is possible. Be prepared.	Two hours to two days in advance of flooding.	• Be prepared to act on your flood plan. • Prepare a flood kit. • Monitor water levels on EA website.
	Flooding is expected. Immediate action required.	Half an hour to one day in advance of flooding.	• Move family, pets and valuables to a safe place. • Turn off gas, electricity and water supplies.

Flood Warning Code	What it means?	When is it used?	What to do?
			• Put flood protection equipment in place.
	Severe flooding. Danger to life.	When flooding poses a significant risk to life or significant disruption to communities.	• Stay in a safe place with a means of escape. • Be ready to evacuate your home if necessary. • Call 999 if you are in immediate danger.
Warning no longer in force	No further flooding is currently expected for your area.	When a flood warning or severe flood warning is no longer in force	• Be careful. Flood water may still be around for several days and could be contaminated. • Ring your insurance company as soon as possible if you have been flooded.

In Derbyshire, the Environment Agency Flood Warning Areas are predominantly located along Main Rivers which flow through the study area, namely the River Derwent, River Wye, River Erewash and River Trent. The largest Flood Warning Area is located along the River Derwent starting at High Peak Borough in the north and flows through the Derbyshire Dales, Amber Valley, through the densely populated Derby City and into South Derbyshire where the watercourse comes into confluence with the River Trent creating a large Flood Warning Area around Long Eaton and Elvaston. Another Flood Warning Area is located along the River Trent through South Derbyshire and a smaller Flood Warning Area is located along the River Erewash on the eastern border of the study area.

The Environment Agency's Flood Warning Areas within the Derbyshire Study Area are presented in **Appendix H**.

7.3 Emergency Planning

Under the Civil Contingencies Act 2004, both the county and district and borough councils are designated as 'Category 1 Responders'. As such it is Derbyshire County Council and Derby City Councils responsibility, along side emergency services, to carry out risk assessments of a range of hazards that may affect the county. Flooding is considered to be one of the highest risks the study area faces.

Derbyshire County Council has a flood contingency plan in place and advice on how to stay prepared in Derbyshire. The Derbyshire Local Resilience Forum has also published a Multi-Agency Flood Plan[34] to help to respond to the flood risks identified in each district/borough council area of the County of Derbyshire and in Derby City. The Multi-agency Flood Plan objectives are:

- outline the causes and context of flooding in Derbyshire and Derby City and describe the flood risks and vulnerabilities in each council area.
- identify the roles and responsibilities of the multi-agency response organisations before, during and after a flood incident.
- outline the activation and triggers used to implement the plan.
- describe the control and co-ordination arrangements for the flood incident response including local incident control points appropriate to flood risk areas.

Derbyshire County Council as LPA should use this SFRA to determine the risk of flooding at both existing and proposed mineral sites in relation to emergency planning measures. It is vital that emergency planning is

[34] Derbyshire County Council (2020) Multi-Agency Flood Plan. Retrieved: https://www.derbyshireprepared.org.uk/risks-derbyshire/flooding/ Accessed January 2023

considered for any new development, including mineral sites, ensuring efficient flood warning systems and procedures are in place. Effective emergency planning ensures occupants of the site are able to act quickly upon the warnings and have the knowledge and equipment to remain safe in a flood event.

The PPG states that for sand and gravel workings, any essential overnight or residential accommodation for staff will only be permitted in areas of flood risk where a specific warming and evacuation plan have been put in place.

7.4 Sustainable Flood Risk Management

Traditional flood risk management measures have historically consisted of hard engineering techniques at a local scale such as installing flood walls, embankments and culverts. Similarly, watercourses have been straightened and floodplains drained for farming and development resulting in a change in fluvial flows from their natural state. As a result, flood risk has increased in other areas and historical flood management techniques have become ineffective due to climate change exacerbating flood risk and the static nature of flood solutions to account for this change. Sustainable flood risk management aims to take a holistic approach to flooding, taking into account social, environmental and economic factors whilst also considering long-term drivers such as climate change. Future sustainable solutions aim to increase resistance and resilience to flooding whilst also including communities within the decision making process rather than taking a historical top-down approach.

The Derbyshire FRMS[35] provides objectives for managing flood risk within Derbyshire with a focus on sustainable development including social, economic and environmental focus:

- **Objective 1**: To further develop an understanding of the flood risk to Derbyshire and the impacts of climate change working collaboratively with all other Risk Management Authorities and relevant groups/bodies to ensure a coordinated response to flood risk management for Derbyshire.
- **Objective 2**: To continue to work with all relevant bodies to ensure appropriate and sustainable development in Derbyshire.
- **Objective 3**: To aim to reduce the level of flood risk to the residents of Derbyshire.
- **Objective 4**: To continue to prioritise limited resources effectively to support communities most at risk in Derbyshire.
- **Objective 5**: To continue to help and support the local communities of Derbyshire to manage their own risk.
- **Objective 6**: To continue to help protect and enhance the natural environment of Derbyshire.

The new Minerals Local Plan will have a focus on sustainable minerals development and aim to continue to reflect the importance of the historical mineral developments, make a positive contribution to delivering sustainable economic growth, conserve and enhance the environment and adapt to the impacts of climate change.

7.5 Restoration and Aftercare of Mineral Sites

The PPG[36] states that the responsibility for the restoration and aftercare of mineral sites lies with the mineral operator and, in the case of default, with the landowner. The most appropriate method of site restoration for each mineral site should be addressed in Derbyshire's new Minerals Local Plan with policies in the Draft Minerals Local Plan ensuring that dis-used land will be reclaimed at the earliest opportunity for aftercare and restoration. Restoration and aftercare of mineral sites should be of high quality and site-specific, and aim to provide economic, environmental and social opportunities for the local community and wildlife. Effective restoration schemes will increase resilience and adaptation to climate change through carbon reduction schemes including the creation of green infrastructure including tree planting, biodiversity and habitat creation, carbon sinks and flood storage and attenuation. In order to explore all potential restoration options, collaborative working between

[35]Derbyshire County Council Flood Risk Management Strategy. Retrieved: Local flood risk management strategy - Derbyshire County Council (Accessed: 09/08/2022)

[36] Minerals Guidance Retrieved: https://www.gov.uk/guidance/minerals Accessed January 2023

the site operator, Derbyshire County Council (as the Minerals Planning Authority) and relevant flood risk, wildlife and environmental organisations is strongly encouraged.

There are five stages to follow when restoring mineral sites which MPA's should use as appropriate:

1) stripping of soils and soil-making materials and either their storage or their direct replacement (ie 'restoration') on another part of the site;

2) storage and replacement of overburden;

3) achieving the landscape and landform objectives for the site, including filling operations if required, following mineral extraction;

4) restoration, including soil placement, relief of compaction and provision of surface features; and

5) aftercare.

Derbyshire's draft local minerals plan notes how restoration schemes for sand and gravel quarries (often located in the flood plains of the river valleys) can contribute towards reducing the risk and scale of flooding. Natural flood management techniques can be used such as using the extraction area next to the river for river braiding or widening or to provide increased capacity for winter flood water storage. Furthermore, restoration efforts can link the wider green infrastructure networks between fragmented habitat blocks to help increase biodiversity and establish habitats for species affected by climate change. By filling mineral extraction sites with water, it creates valuable stopping points for migrating wildfowl and a new habitat for other animals. Introducing vegetation can provide nesting sites, habitats for invertebrates and improve the appearance of the site.

There are many possible land-uses once restoration and aftercare of land is complete including:

- Creation of new habitats and biodiversity;
- Use for agriculture;
- Forestry;
- Recreational activities;
- Waste management; and,
- The built environment, such as residential, industrial and retail where appropriate.

Once potential restoration options have been considered, a site-specific FRA will be required to provide an adequate assessment of flood risk.

8. NPPF Sequential Test Guidance

8.1 Overview

A sequential approach to site selection ensures that as far as reasonably practicable, sites are located where the risk of flooding from all sources is lowest. This approach considers climate change alongside the vulnerability of future uses of sites. In plan making, this involves applying the Sequential Test to local plans.

The PPG states that LPAs should undertake a SFRA to fully understand the flood risk in an area to inform the preparation of Local Plans. The NPPF ensures strict testing to protect people and properties from flooding and that development is steered towards areas that are at the lowest risk of flooding by applying the Sequential Test and where necessary the Exception Test. Developments should be directed to Flood Zone 1 if possible, and then sequentially to Flood Zones 2 and 3, ensuring the lowest flood risk possible.

The PPG states that: *'Waste and mineral planning authorities should apply the sequential approach to the allocation of sites for waste management and, where possible, mineral extraction and processing.'*

Derbyshire County Council must show that they have considered a range of potential sites in conjunction with the assessment of flood risk from all sources, as outlined in the SFRA and therefore has applied the Sequential Test in the mineral site allocation process.

The PPG also notes how the Sequential Test can also be implemented at a site level as mineral sites often expand over a large area. As such, ancillary facilities could be located in the areas of lowest flood risk, in order to reduce the risk of being adversely affected by flooding or increasing flood risk elsewhere.

Application of the Sequential Test requires:

- An understanding of medium and high flood risk areas from all sources in the study area; and,
- An understanding of the vulnerability classifications of the proposed developments.

A summary of the vulnerability classifications for mineral developments is provided in **Table 14** (based on Annex 3 of the PPG).

Table 15- Summary of Vulnerability Classifications for Mineral Sites

Type of Development	Vulnerability Classification
Minerals working and processing (except for sand and gravel working)	Less Vulnerable
Sand and gravel working	Water Compatible
Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan	

Table 14 shows that mineral developments are classified as either Water Compatible or Less Vulnerable development. As such, they are permitted within Flood Zone 1, Flood Zone 2 and Flood Zone 3a, subject to the satisfaction of the Sequential Test. The Exception Test is not required. However, any essential ancillary sleeping or residential accommodation for staff required by Water Compatible development, such as sand and gravel workings, are subject to a specific flood warning and evacuation plan. A site-specific flood risk assessment should also be undertaken to assess flood risk from all sources to pass the Sequential Test.

A flow diagram for the application of the Sequential Test from the PPG is provided in **Figure 7.**

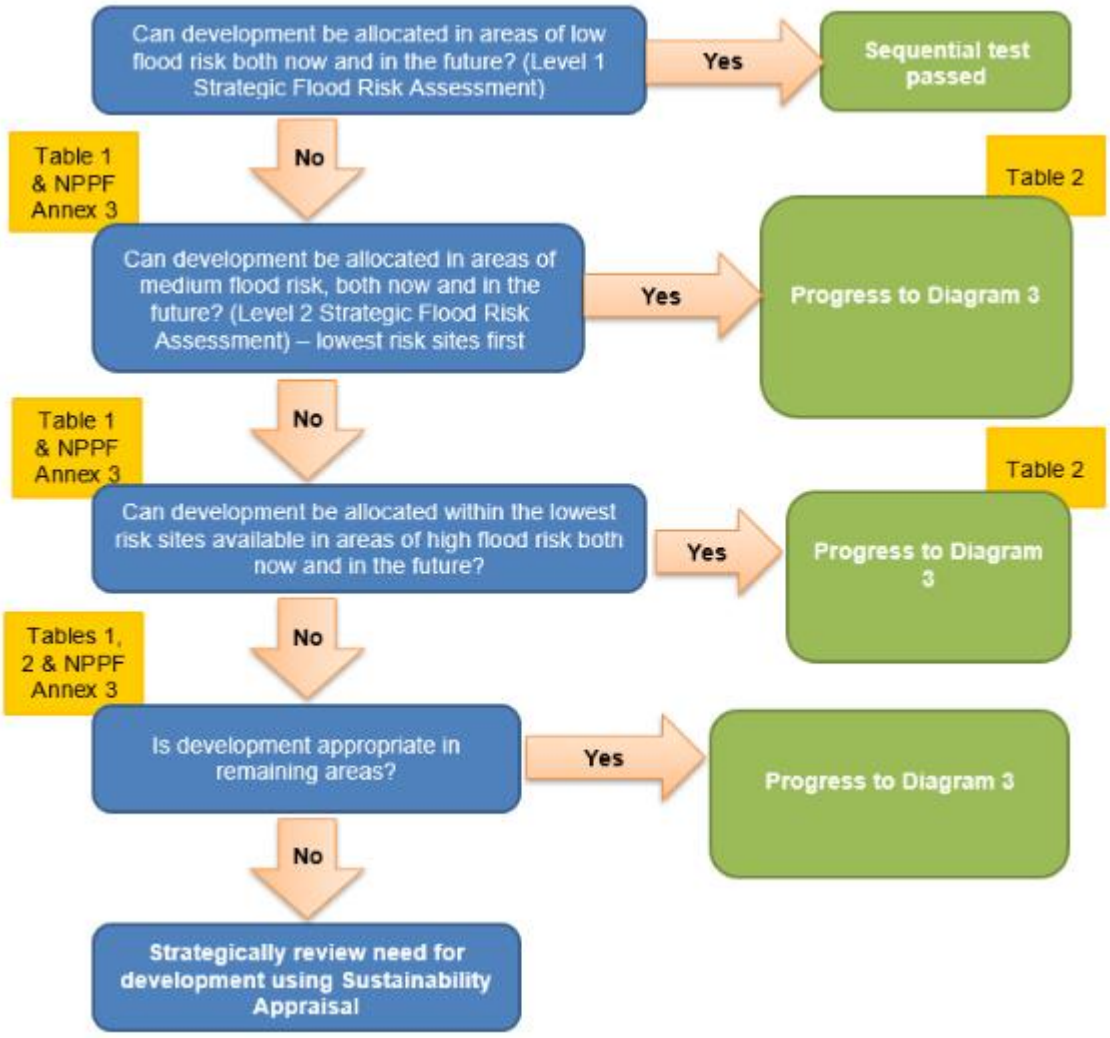

Figure 7– Application of the Sequential Test for Plan Preparation

8.2 The Exception Test

The Exception Test allows necessary development to go ahead in situations where suitable sites at a lower risk of flooding are not available. For the Exception Test to be passed, the following points must be satisfied:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk.
- It must be demonstrated that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.
- It must be demonstrated whether the development can reduce flood risk overall, through the provisions or new or improved flood defences or improved drainage.

It is noted that the Exception Test is not usually applied to mineral developments due to their vulnerability classification.

The Flood Zone and Flood Risk Vulnerability Classification to help determine which types of mineral development site are appropriate within each flood zone and whether the Exception Test is required is shown in **16**.

Table 16- Flood Zone and Flood Risk Vulnerability Classification

	Flood Risk Vulnerability Classification				
Flood Zones	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
FZ 1	✓	✓	✓	✓	✓
FZ 2	✓	Exception Test Required	✓	✓	✓
FZ 3a	Exception Test Required	✗	Exception Test Required	✓	✓
FZ 3b	Exception Test Required	✗	✗	✗	✓

A flow diagram for the application of the Exception Test from the PPG is provided in **Figure 8.**

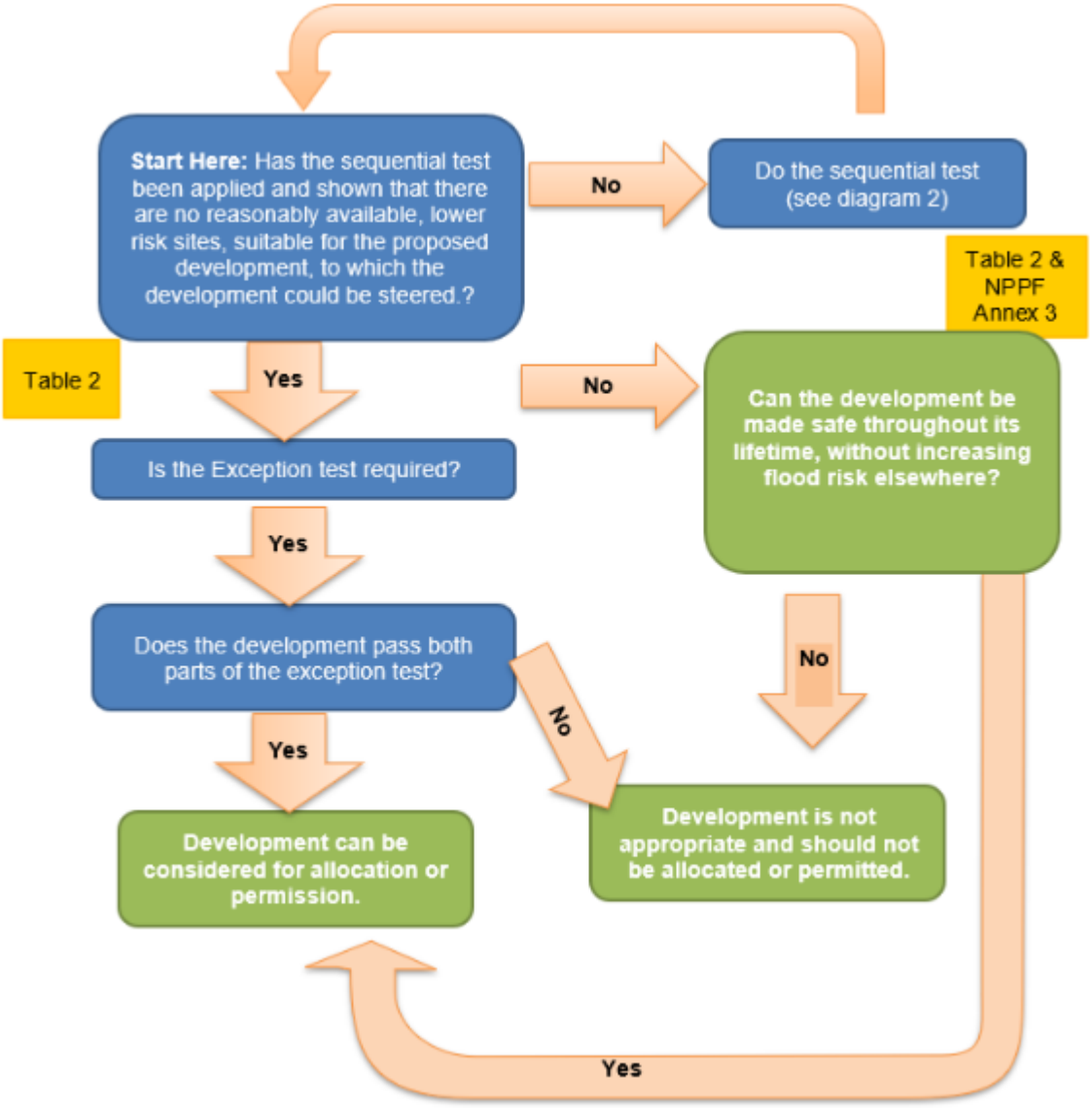

Figure 8 - Application of the Exception Test to plan preparation[37]

8.3 What is a Level 2 SFRA?

Where a Level 1 SFRA shows that land outside of flood risk areas cannot appropriately and adequately accommodate all necessary development, a Level 2 assessment may be required. A Level 2 SFRA should give more detail on the nature of the flood risks identified in the Level 1 SFRA. This may include flood probability, flood depth, flood velocity and duration of flood.

[37] PPG (2022) Flood Risk and Coastal Change Guidance Retrieved: https://www.gov.uk/guidance/flood-risk-and-coastal-change#the-exception-test Accessed January 2023

9. Site Specific Flood Risk Assessment Guidance

9.1 Introduction

This Level 1 Minerals SFRA for Derbyshire County Council and Derby City Council provides a high-level assessment of flood risk posed to the site area. However, it is essential that site-specific flood risk assessments are produced for individual mineral developments and suitable mitigation measures are recommended, where appropriate.

This section sets out recommendations and guidance for site specific flood risk assessments that are required for submission alongside planning applications for mineral sites in Derbyshire to the LPA. Site-specific flood risk assessments are usually carried out by flood risk specialists to assess flood risk both to and from the proposed development. The assessment must determine the vulnerability classification of the development, then decide how the flood risk will be managed both now and in the future with consideration given to climate change requirements.

9.2 When is a Flood Risk Assessment required?

A site-specific flood risk assessment is required for a development when the following circumstances apply:

- In Flood Zone 2 or 3 including minor development and change of use;
- For developments more than 1 hectare (ha) in Flood Zone 1;
- For developments less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs); and,
- For developments in an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency

All of the proposed mineral sites for Derbyshire considered within this SFRA are greater than 1 ha and therefore require a site-specific FRA alongside the planning application.

Guidance provides information on:

- When you do and do not need to complete a flood risk assessment;
- How to complete a flood risk assessment; and,
- How a flood risk assessment is processed.

9.3 Scope of a Site-Specific Flood Risk Assessment

The PPG states the objectives of a state-specific FRA are to establish[38]:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable.

[38] Department for Environment, Food & Rural Affairs and Environment Agency (2017) Retrieved: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications Accessed: January 2023

The PPG provides a checklist and information on the level of detail needed when writing a site-specific flood risk assessment to assist applicants and developers.

It is the responsibility of applicants to consider whether a site needs a site-specific flood risk assessment. A site-specific flood risk assessment should demonstrate how flood risk will be managed now and into the future and should demonstrate that the development does not increase the risk of flooding elsewhere from all sources. It is important that the assessment is compliant with local planning policy as this could be rejected by the LPA.

9.4 Sequential Approach within Development Sites

All site-specific flood risk assessments should use the Sequential Test, as detailed in **Section 8**. The sequential approach is designed to ensure that the most vulnerable elements of a new development are located in areas at the lowest risk of flooding possible. If development pressure results in the need to develop on more vulnerable land in higher flood risk areas, appropriate mitigation measures should be implemented which create a flood resilient development and do not increase the risk of flooding to surrounding areas.

9.5 Surface Water Management

A site-specific FRA will need to include how surface water run off generated by the development will be managed. As surface water flooding is the most widespread form of flooding in England, managing this risk is vital. The NPPF and PPG require LPAs and developers to reduce the cause and impacts of flooding through the design and layout of developments. The NPPF states that flood risk should not be increased elsewhere as a result of new development and as such surface water runoff flowing offsite should not increase from existing rates. The PPG states that this should be applicable over the lifetime of a development and should take into account climate change allowances.

The government published its surface water management action plan in July 2018[39], with 22 actions to help mitigate the risk from surface water flooding. The actions include:

- improving risk assessment and communication;
- making sure infrastructure is resilient;
- clarifying responsibilities for surface water management;
- joining up planning for surface water management; and
- building local authority capacity,

Sustainable drainage systems are a preferred method of surface water management technique. SuDS are designed to control surface water run off close to where water falls within the catchment and to mimic natural drainage. SuDS provide wider benefits including opportunities to:

- Reduce the causes and impacts of flooding;
- Remove pollutants from urban run-off at source; and,
- Combine water management with green space with benefits for amenity, recreation and wildlife.

Additional information on SuDS is provided in **Section 10** of this SFRA.

However, sustainable drainage systems may not always be the most suitable technique for some forms of development, including mineral extraction.

[39] Department for Environment, Food & Rural Affairs and Environment Agency (2021) Retrieved: https://www.gov.uk/government/publications/surface-water-management-action-plan Accessed January 2023

9.6 Residual Risk

Residual risks are those that remain once the sequential test has been undertaken and mitigation techniques have been implemented, however a potential flood risk still remains. The PPG states the two main forms of residual risk are[37]:

- Residual risk from flood risk management infrastructure; and
- Residual risk to a development once any site-specific flood mitigation measures are taken into account.

Examples of residual risk include:

- a breach of a raised flood defence, blockage of a surface water conveyance system or failure of a pumped drainage system;
- failure of a reservoir; and
- a flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot accommodate.

The NPPF states that residual risk(s) of flooding should be included with a site-specific FRA, and should indicate the nature, variation and severity of residual risk within the area. Furthermore, an FRA should provide guidance on how to manage residual risk.

9.7 Summary

To achieve the aims of the NPPF with regard to site-specific FRAs, Derbyshire County Council and Derby City should:

- Ensure that the Sequential Test is implemented for all developments within both administrative areas;
- Look at the vulnerability classifications associated with developments and any local emergency planning issues when deciding on a suitable location for mineral sites;
- Understand the cumulative impact of development on flood risk from all sources of flooding. It should be noted that minerals sites typically cover a large area and therefore the cumulative impact may be considerable;
- Ensure the management of residual risks after the sequential approach has been utilised;
- Consider flood risk as one of a number of policies that in parallel can provide mechanisms to deliver sustainable developments with multiple benefits;
- Encourage a reduction in the causes and impacts of flooding through the layout and form of development including the use of SuDS; and,
- Engage with developers and local regulators throughout the development process to develop and instigate initiatives for the reduction of flood risk.

10. Sustainable Drainage Systems

10.1 What are SuDS?

Sustainable Drainage Systems (SuDS) are surface water drainage solutions designed to manage surface water runoff and mitigate the adverse effects of urban storm water runoff by reducing flood risk and controlling pollution[40] . SuDS techniques are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. As such, SuDS allow surface water runoff from development to be controlled in ways that imitate natural drainage by controlling the rate of discharge to a receiving watercourse. SuDS may also provide valuable habitat and amenity value when carefully planned for in development. Where possible, SuDS solutions for a site should seek to:

1. Reduce flood risk (to the site and to neighbouring areas;
2. Reduce pollution, and,
3. Provide landscape and wildlife benefits.

To achieve the aim of SuDS outlined above, a management plan incorporating a chain of techniques should be utilised[41], where each component adds to the performance of the whole system, as shown in **Table 17**:

Table 17 – Hierarchy of Techniques

Technique	Example
Prevention	Good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping)
Source Control	Runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements)
Site Control	Water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site)
Regional Control	Integrate runoff management systems from a number of sites (e.g. into a detention pond)

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a holistic approach using a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be shared between developments. Guidance on SuDS designs, operation and maintenance can be found in the SuDS Manual, CIRIA C753[42].

[40] Department for Environment, Food & Rural Affairs and Environment Agency (2015) Cost estimation for SUDs Retrieved: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/long-term-costing-tool-for-flood-and-coastal-risk-management Accessed January 2023

[41] Department for Environment, Food & Rural Affairs (2004) Interim Code of Practice for Sustainable Drainage Systems Retrieved: https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf Accessed January 2023

[42]CIRIA (2015) The SuDS Manual (C753) Retrieved: https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx Accessed January 2023

10.2 Why use SuDS?

Traditionally, built environments have utilised piped drainage systems to manage storm water and convey surface water run-off away from developed areas as quickly as possible. Typically, these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers storm water from developed areas, the alteration of natural drainage processes can potentially impact on downstream area by increasing flood risk, reduction in water quality, loss of water resource and detriment to wildlife. Therefore, receiving watercourses have greater sensitivity to rainfall intensity.

Certain measure can be taken to protect more sensitive areas by reducing or prohibiting infiltration. In marginal areas, where polluted water may have an impact on the groundwater, runoff can pass through one or more treatment stages depending on the potential level of pollution and hydro-geological conditions. If all infiltration was prohibited, it is likely that a SuDS attenuation system would still represent an improved system over a traditional piped system enabling an improvement to the quality of the surface water runoff.

Current planning policy outlines that runoff rates post-development must not exceed the existing pre-development rates. In addition, opportunities should be sought to achieve greenfield runoff rates.

10.3 The SuDS Hierarchy

Where possible, preference should be given to multi-functional sustainable drainage systems, and to solutions that allow surface water to be discharged according to the following hierarchy of drainage options[37]:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system; and
4. to a combined sewer.

10.4 Infiltration SuDS

SuDS Techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment, which is of particular importance to mineral sites. Various SuDS techniques are available and operate on two main principles:

- Infiltration
- Attenuation

All systems generally fall into one of these categories, or a combination of the two.

Infiltration SuDS rely on discharges to the ground, where suitable ground conditions are available. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

Various infiltration SuDS techniques are available for directing the surface water runoff top ground. Development pressures and maximisation of the developable area may reduce the area available for infiltration systems but this should not be a limiting factor for the use of SuDS. Either sufficient area is required for infiltration or a combined approach with attenuation could be used to manage surface water runoff. Attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water

feature. BGS have created a dataset to identify the suitability of ground conditions in Great Britain where the compatibility for infiltration SuDS are categorised.[43]

Infiltration measures include the use of permeable surfaces and other systems that are generally located below ground.

[43] British Geological Survey (2020) Suitability of the subsurface for infiltration SuDS in Great Britain Retrieved: https://www.bgs.ac.uk/download/suitability-of-the-subsurface-for-infiltration-suds-in-great-britain/ Accessed January 2023

Appendices

Appendix A – Study Area

Appendix B – Study Area

Appendix C – EA Main Rivers

Appendix D – EA Bedrock Geology

Appendix E – EA Flood Map for Planning

Appendix F – Flood Zone 3b

Appendix G - Climate Change Allowance 1 in 100 year + 20% or 30% and 1 in 100 year and 1 in 1000 year flood extents

Appendix H – EA Flood Warning Areas

Appendix I – EA Risk of Flooding from Surface Water

Appendix J - Areas Susceptible to Groundwater Flooding

Appendix K – Groundwater Source Protection Zones

Appendix L – EA Aquifer Designation

Appendix M - EA Historical Flooding and National Highways Hotspot Historical Flooding

Appendix N – Canal Network

Appendix O – Proposed Mineral Sites

Appendix P – Inset Overview

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