



## PRELIMINARY SLOPE STABILITY ASSESSMENT

### Employment Land Barnsley West

<b>Reference</b>	<b>4848-JPG-XX-XX-RP-G-0610-S2-P02</b>
<b>Date</b>	<b>June 2023</b>
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### Confidentiality Statement

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### Appendix A Figures and Drawings

Figure 1 - Site Location Plan

Figure 2 - Aerial Photo

JPG (Leeds) Limited. Commercial Boundary Plan. Barnsley West. Drawing Ref: 4848-JPG-ZZ-ZZ-DR-C-1001-S2-P02. Dated March 2023.

JPG (Leeds) Limited. Barnsley West. Proposed Earthwork Cut/Fill Analysis. Drawing No: 4848-JPG-ZZ-ZZ-DR-C-1201-S2-P04, dated March 2023.

JPG (Leeds) Limited. Barnsley West. Proposed Earthworks Levels. Drawing No: 4848-JPG-ZZ-ZZ-DR-C-1200-S2-P04, dated March 2023.

JPG (Leeds) Limited. Barnsley West. Slope Stability Assessment Site Sections Plan. Drawing ref. 4848-JPG-SW-00-DR-G-1321-S2-P03. Dated January 2021.

JPG (Leeds) Limited. Barnsley West. Slope Stability Assessment Site Sections. Drawing ref. 4848-JPG-SW-00-DR-G-1331-S2-P01. Dated April 2023.

### Appendix B Slope Stability Assessment Sections



## CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

Strata Sterling Barnsley West Limited  
Quay Point  
Lakeside  
DONCASTER  
DN4 5PL

This report has been prepared for the use and reliance of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of JPG (Leeds) Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

## DOCUMENT HISTORY

Revision	Date	Revision Details	Status	Author(s)	Approved
P01	05.06.2023	Final	Information	DMH	JBW
P02	09.10.2023	Final	Information	JBW	JDM



## **1.0 INTRODUCTION**

### **1.1 Background**

JPG (Leeds) Limited (JPG) has been instructed by the Strata Sterling Barnsley West Limited to assess the stability of the cut and fill embankments which will be formed as part of the earthworks associated with the Employment Land at Barnsley West.

### **1.2 Objective**

The objective of this report is to provide an assessment of the stability of the cut and fill embankments which will be created as a result of the earthworks associated with the proposed development plateaus and the attenuation ponds.

The proposed development plateaus and attenuation ponds will be constructed using appropriate site-won materials placed and compacted in accordance with a comprehensive earthworks specification. Where slopes do not achieve the appropriate factor of safety (FoS) and may be unstable, mitigation methodology is outlined to ensure landform stability.

The geotechnical parameters used in this assessment have been selected based on empirical data, the preliminary geotechnical test results available to date, geotechnical test results of similar materials from similar sites and engineering judgement.

### **1.3 Location**

The site is located approximately 3km to the west of Barnsley town centre. The approximate centre of the site is located at NGR 431833, 406683. The site is located to the north east of the M1 motorway and to the south of Hermit Lane.

A site location plan is presented as Figure 1 in Appendix A.

### **1.4 Site Description and Topography**

The site is irregular in shape and occupies an area of approximately 37 hectares. Ground levels are approximately 146m AOD in the west, generally falling to approximately 120m AOD in the north east. The site generally consists of sloping arable and grazing land, which is divided into fields by hedgerows, fences, and small watercourses.

The Hunters Cottage Open Cast Coal Site (OCCS) is located in the central and southeastern parts of the site. The Hunters Cottage Extension OCCS is located in the northwestern part of the site.

A steep valley with a drainage ditch at its base extends northwards from the south east; the drainage ditch is culverted where it passes below Hermit Lane. A second steep sided valley is present in the centre of the site and trends to the north.



The northern boundary is defined by Hermit Lane, beyond which is undeveloped farmland. A raised plateau of grassland is present to the east of the site, beyond which is the town of Pogmoor. The southern boundary is defined by the M1 motorway, beyond which is the town of Dodworth and the western boundary is defined by Higham Lane and the M1 motorway.

An aerial photograph of the site is presented as Figure 2 in Appendix A.

## 1.5 Development Proposals

It is proposed to develop the site for commercial end use. A plan outlining the proposed commercial red line boundary is referenced below, and provided in Appendix A.

- JPG Leeds Limited. Commercial Boundary Plan. Barnsley West. Drawing Ref: 4848-JPG-ZZ-ZZ-DR-C-1001-S2-P02. Dated March 2023.

## 1.6 Previous Reports

JPG have completed a desk study and a preliminary geoenvironmental ground investigation report for the overall Barnsley West development site and a coal mining risk assessment and a preliminary land slope stability assessment for the employment land only. Furthermore, a geoenvironmental ground investigation report was also completed for a parcel of land adjacent to the western boundary of the site where a roundabout is to be constructed. These reports are referenced below and should be read in conjunction with this report.

These reports are referenced below and should be read in conjunction with this report.

- JPG (Leeds) Limited. Geoenvironmental Desk Study Report. Barnsley West. Report Ref. 4848-JPG-XX-XX-RP-G-0604-S2-P04. Dated July 2019 for Strata Sterling Barnsley West Limited.
- JPG (Leeds) Limited. Preliminary Geoenvironmental Ground Investigation. Barnsley West. Report Ref: 4848-JPG-SW-XX-RP-G-0603-S2-P02. Dated July 2019 for Strata Sterling Barnsley West Limited.
- JPG (Leeds) Limited. Coal Mining Risk Assessment and Coal Recovery Report. Employment Land, Barnsley West. Report Ref: 4848-JPG-Z2-XX-RP-G-1102-S2-P03. Dated August 2019, for Strata Sterling Barnsley West Limited.
- JPG (Leeds) Limited. Geoenvironmental Ground Investigation. Higham Common Road Roundabout, Barnsley West. Report Ref: 4848-JPG-HC-XX-RP-G-0603-S2-P02. Dated October 2020 for Strata Sterling Barnsley West Limited.
- JPG (Leeds) Limited. Preliminary Geoenvironmental Ground Investigation. Barnsley West. Report Ref: 4848-JPG-SW-XX-RP-G-0603-S2-P02. Dated July 2019 for Strata Sterling Barnsley West Limited.
- JPG (Leeds) Limited. Preliminary Geoenvironmental Ground Investigation. Employment Land, Barnsley West. Report Ref: 4848-JPG-SW-XX-RP-G-0609-S2-P01. Dated March 2023, for Strata Sterling Barnsley West Limited.



## 1.7 Proposed Earthworks

A proposed earthwork cut/fill and earthwork levels drawings have been produced for the site. These drawings are referenced below, and copies are provided in Appendix A.

- JPG (Leeds) Limited. Barnsley West. Proposed Earthwork Cut/Fill Analysis. Drawing No: 4848-JPG-ZZ-ZZ-DR-C-1201-S2-P04, dated March 2023.
- JPG (Leeds) Limited. Barnsley West. Proposed Earthworks Levels. Drawing No: 4848-JPG-ZZ-ZZ-DR-C-1200-S2-P04, dated March 2023.

As part of the enabling works, it is proposed to construct four development plateaus along with three attenuation ponds. The attenuation ponds are proposed to be located in the northeastern corner of the site and adjacent to the eastern boundary.

It is proposed to excavate materials from the northeastern, southeastern and western parts of the site and re-engineer this material across the northern and central parts of the site.

The enabling works will result in four earthworks batters. The earthwork batters are proposed to be adjacent to majority of the northern boundary of the site, in the north eastern corner of the site, running along the eastern and southern boundaries of the site and in the centre of the site, splitting two of the proposed development plateaus.

## 1.8 Geotechnical Category

The proposed development has been categorized as Geotechnical Category 2 as defined by British Standard EN 1997-1:2004 Eurocode 7 – Geotechnical Design.

This is because the development includes conventional types of geotechnical structures, earthworks and loading conditions.



## 2.0 GEOENVIRONMENTAL GROUND INVESTIGATION REVIEW

### 2.1 General

A preliminary phase ground investigation was carried out in 2019 by JPG targeting the Employment Land area and the wider site to the north.

Subsequently, a site-specific ground investigation for Higham Common Road roundabout was carried out in June 2020 by JPG.

Both ground investigations comprised the excavation of trial pits and the drilling of rotary boreholes. The works included the installation and monitoring of extensometers and groundwater wells and submission of soil samples to the laboratory for geotechnical and chemical testing.

### 2.2 Review of JPG Ground Conditions

#### 2019 Ground Investigation – Employment Land Only

Topsoil, generally comprising soft to stiff dark brown, slightly sandy, slightly gravelly clay with rootlets was encountered in TP108 to TP110, TP112, BH108, BH109, BH109A, BH121, BH122 and BH125 to depths of between 0.10m bgl in TP108 and 0.50m bgl in BH122, with an average thickness of 0.25m.

The made ground within and immediately surrounding the Hunters Cottage OCCS typically comprised colliery spoil, which was described as compact or stiff in the rotary boreholes and as soft to firm, dark greyish brown, sandy, gravelly clay and/or dark brownish grey, clayey, sandy gravel in the trial pits. The colliery spoil made ground was encountered in TP109, TP110, TP112, BH108, BH109 and BH109A to depths of between 1.50m bgl in TP109 and 13.00m bgl in BH108.

The made ground outside the Hunters Cottage OCCS, typically comprised brown clay fill in the rotary boreholes and soft to stiff, greyish brown and orangish brown sandy, gravelly clay. The cohesive made ground was encountered in TP108 and BH121 to depths of 2.80m bgl and 0.50m bgl, respectively. The made ground encountered in TP108 could potentially be arisings associated with the construction of the M1 motorway to the south.

Residual soils, typically comprising firm to stiff, medium strength, orangish brown and grey, sandy, gravelly clay was encountered in TP108, TP109, TP110 and BH122 to depths of 3.40m bgl, 2.90m bgl, 2.90m bgl and 1.10m bgl, respectively.

The underlying bedrock geology comprised the Pennine Middle Coal Measures. The bedrock geology was recorded as thinly laminated, light grey, occasionally brown, de-structured mudstone to a depth of 3.30m bgl in TP109 and as grey and brown, interbedded mudstone, sandstone, and coal seams to a maximum proven depth of 40.00m bgl in BH121.



BH108, and BH109A were carried out within Hunters Cottage OCCS, in which the Top Haigh Moor coal seam was the deepest coal seam extracted by opencast techniques; these boreholes were extended below the base of the opencast to establish the rock cover over the underlying Low Haigh Moor coal seam. BH108 proved the base of the OCCS at 13.00m bgl and the base of the Low Haigh Moor coal seam at 23.40m bgl (0.80m thick). BH109A proved the base of the opencast at 11.20m bgl and the base of the Low Haigh Moor coal seam at 18.70m bgl (0.40m thick). Neither borehole encountered any underground coal workings. In both boreholes there is sufficient rock cover over the Low Haigh Moor coal seam so that if coal workings were present, they would not affect the surface stability of the site.

BH121, BH122 and BH125 were drilled outside the Hunters Cottage OCCS. None of the boreholes encountered underground coal workings.

BH121, drilled close to the western boundary of the proposed employment land, encountered coal seams between 6.30m and 8.00m (1.70m thick), between 14.60m and 15.00m bgl (0.40m thick), between 16.00m and 16.50m bgl, and between 29.20m and 29.50m bgl (0.30m thick). These coal seams have been interpreted as the Top Haigh Moor, the Low Haigh Moor (two leaves) and a thin coal seam. Based on the depths and thicknesses of the coal seams, if underground coal workings were present in the Top Haigh Moor, remedial action would be required. In addition, if both leaves of the Low Haigh Moor coal seam have been worked, remedial action will be required.

Based on the findings of the Higham Common Road Roundabout investigation located immediately to the west of the commercial area, five rotary boreholes were drilled with the Top Haigh Moor proven in all five boreholes and the Low Haigh Moor proven in four boreholes. In each borehole, the coal seams were proven to be intact. This provides further confidence that the shallow coal seams on the western flank have not been worked by underground means.

BH122 was drilled close to the northern boundary of the employment land. A very thin coal seam (0.10m thick) was encountered at 8.10m bgl. A thick bed of coal (2.30m thick) was encountered between 15.40m and 17.70m bgl and may represent either the Gawber or Top Haigh Moor coal seam, the uncertainty due to the nearby fault.

BH125 was drilled close to the eastern boundary of the employment land. Coal seams were encountered between 3.30m and 4.30m bgl (1.00m thick), between 15.50m and 15.80m bgl (0.30m thick), between 23.90m and 24.00m bgl (0.10m thick), between 25.10m and 25.50m bgl (0.40m thick) and between 36.60m and 36.90m bgl (0.30m thick). The coal seams are considered to represent the Gawber, a thin seam, the Swallow Wood (two leaves) and the Top Haigh Moor. Only the Gawber coal seam poses a potential risk to the surface stability of the site, based on coal seam thickness and depth at this location.



## 3.0 SLOPE STABILITY ASSESSMENT

### 3.1 General Overview

As stated previously, as part of the enabling works, it is proposed to construct development plateaus and attenuation ponds.

In order to assess the stability of the slopes a ground model has been developed and geotechnical parameters assigned to each strata type using empirical data, preliminary geotechnical test results to date, geotechnical test results of similar materials from similar sites and engineering judgement.

A plan showing the locations of the proposed slopes and lines of cross-section has been provided. This shows the profiles of the existing ground level, proposed ground level and the base of opencast along each section. This drawing is referenced below, and a copy is provided in Appendix A.

- JPG (Leeds) Limited. Barnsley West. Slope Stability Assessment Site Sections Plan. Drawing ref. 4848-JPG-SW-00-DR-G-1321-S2-P03. Dated January 2021.
- JPG (Leeds) Limited. Barnsley West. Slope Stability Assessment Site Sections Plan. Drawing ref. 4848-JPG-SW-00-DR-G-1331-S2-P01. Dated April 2023.

### 3.2 Design Parameter Values

Geotechnical (soil/rock) parameters are based on empirical data, the preliminary geotechnical test results to date, geotechnical test results of similar materials from similar sites and engineering judgement. A summary of the geotechnical parameters which have been selected for use in the model are provided in Table 3.2.1.

**Table 3.2.1 – Geotechnical Parameters**

Stratum	Strength Type	Unit Weight (kN/m <sup>3</sup> )	Saturated Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Angle of Friction (degrees)
Untreated Colliery Spoil – Made Ground	Mohr-Coulomb	20	21	0	20
Weathered Bedrock - Pennine Middle Coal Measures (PMCM)	Mohr-Coulomb	18	19	1	27
Bedrock - PMCM	Mohr-Coulomb	22	23	5	40
Engineered Fill Material	Mohr-Coulomb	20	21	0	30

As part of the detailed design, prior to development, sensitivity analysis of the geotechnical parameters is recommended to assess the likely effects of future changes to the ground conditions, i.e. climate change and increased weathering of clay soils.



## 4.0 SLOPE STABILITY ANALYSIS RESULTS

### 4.1 Methods of Analysis and Design

The Rocscience "Slide2" (v 9.027) software package has been used to assess the stability of the slopes.

Four cross sections, as shown on the JPG drawing referenced below and presented in Appendix A, have been selected for analysis.

- JPG (Leeds) Limited. Barnsley West. Slope Stability Assessment Site Sections. Drawing Ref. 4848-JPG-SW-00-DR-G-1321-S2-P03. Dated January 2021.

These four sections are considered to represent a range of cases, including the 'worst case', i.e. the steepest sections of slope with high groundwater and untreated colliery spoil present.

Slope stability section 01 is oriented approximately north to south, in the southeastern corner of the site. It is proposed to construct a cut embankment, up to 9m of cut into untreated colliery spoil, to create a plateau for an attenuation pond.

Slope stability section 02 is oriented north to south, in centre of the site. It is proposed to construct a cut and fill embankment, up to 12m of cut and 3m of fill, to create an embankment between two plateaus.

Slope stability section 03 is oriented approximately north to south, adjacent to the northern boundary. It is proposed to construct a filled embankment, up to 11m of fill, to create an embankment to a development plateau.

Slope stability section 04 is oriented approximately east to west, in the north eastern corner of the site. It is proposed to construct a cut embankment, up to 12m of cut into the natural, to create a plateau for an attenuation pond.

The analysis has been carried out using the Bishop and Janbu Simplified Methods.

For cuttings, a minimum FoS of 1.45 is considered applicable, while for fill embankments a minimum FoS of 1.55 is considered applicable. Additionally, any mixed slopes, i.e. embankments above cuttings, a minimum FoS of 1.55 is also applied.

The Factor of Safety is derived from Tables 13.1, 13.2, 13.5 and 13.6 of the ICE *Earthworks, A Guide* (second edition, 2017).

The analysis has been carried out based on the proposed slope profiles following completion of the earthworks.



## 4.2 Assumptions

The following assumptions have been made when carrying out the analysis:

- Based on the current assessment of the ground conditions, only site-won cohesive materials will be used in the construction of the embankments.
- Based on the observed groundwater characteristics, the groundwater strikes encountered during the ground investigations have been used in this assessment.
- Based on the absence of site-specific laboratory results or on-site geotechnical data, the effective stress parameters have been taken from test results of similar materials from similar sites, engineering judgement and empirical data.
- The analysis does not take into account the long-term changes in pore water pressure due to construction, rainfall infiltration or climate change.
- Sensitivity analysis, i.e. changes to geotechnical parameters, has not been carried out as part of this assessment.
- Steady state groundwater finite element modelling has not been carried out as part of this assessment.
- It is assumed that if any reprofiling of existing slopes is required, then any loose, soft or potentially unstable materials shall be removed.
- On slope stability Section 02, a unit with a length of 80m and a load of 50kN/m<sup>2</sup> has been placed 5m from the crest of the cut and fill embankment.
- On slope stability Section 03, a road with a length of 5.5m and a load of 20kN/m<sup>2</sup> has been placed 5m from the crest of the fill embankment and a unit with a length of 75m and a load of 50kN/m<sup>2</sup> has been placed 15m from the crest of the fill embankment.
- On slope stability Section 04, a road with a length of 5.5m and a load of 20kN/m<sup>2</sup> has been placed 10m from the crest of the cut embankment and residential dwellings with a length of 52m and a load of 10kN/m<sup>2</sup> has been placed 18m from the crest of the cut embankment.
- All loads have a vertical orientation, and the distribution load is constant.
- It is assumed that no loading will be placed within 5m from the crest of the embankments.

## 4.3 Results of the Assessment

### Slope Stability Section 01 (FoS 1.45)

Analysis of slope stability section 01 confirms a minimum FoS of 1.092 in accordance with both the Bishop and Janbu simplified methods. The minimum FoS is noted for a potential global failure in the untreated colliery spoil.



### **Slope Stability Section 02 (FoS 1.55)**

Analysis of slope stability section 02 and section 02 plus a unit loading has confirmed a minimum FoS of 1.119 in accordance with both the Bishop and Janbu simplified methods. The minimum FoS is noted for a potential global failure in the untreated colliery spoil, beneath the thin layer of engineered fill.

### **Slope Stability Section 03 (FoS 1.55)**

Analysis of slope stability section 03 and section 03 plus a unit and road loading confirms a minimum FoS of 1.727 for both the Bishop and Janbu simplified methods. The model suggests the fill embankment is favourable.

### **Slope Stability Section 04 (FoS 1.45)**

Analysis of slope stability section 04 and section 04 plus a residential and road loading confirms a minimum FoS of 2.014 and 1.907 for the Bishop and Janbu simplified methods, respectively. The model suggests the cut embankment is favourable.

## **5.0 CONCLUSION**

Based on the results of this assessment, slope stability sections 01 (cut embankment) and 02 (cut and fill embankment) did not achieve the required Factor of Safety (FoS), and therefore pose a risk to the development from instability. Slope stability sections 03 and 04 did achieve the required FoS.

In order to achieve the required FoS in slope stability sections 01 and 02, mitigation measures should be incorporated into the detailed design of these cut and fill embankments. The mitigation measures can include, but not be limited to, the following:

- Where the required FoS is not achieved due to untreated colliery spoil remaining under the slope, then mitigation measures could include the removal and re-engineering of all the untreated colliery spoil, locally.
- Where the re-engineered material does not achieve suitable effective stress parameters, consideration should be given to improving the materials to achieve better effective stress parameters or using alternative materials in the construction of the slopes.
- Redesign/reprofiling the cut and fill embankments orientations, i.e. shallower gradients. During any reprofiling works, any loose, soft or potentially unstable materials should be removed.
- Introducing surface protection to the slope in order to mitigate against shallow and minor failures.
- Geogrid reinforcement can be installed to create reinforced earth embankments.



- Where shallow groundwater levels are present, vertical and horizontal interceptor drains may be installed and/or granular fill to form a capillary break layer at the base of the embankment. Where groundwater may break out of the proposed slope, e.g. on the sides of the proposed attenuation ponds or where natural springs occur, impermeable barriers may be required or groundwater level lowered by diverting.

At detailed design stage, each slope will need to be assessed and the requirement for mitigation built into the design to ensure future slope stability. The proposed embankments and cuttings can be achieved using site-won materials if the mitigation measures outlined above are incorporated into the design.

## **6.0 RECOMMENDATIONS**

In order to undertake the detailed design of the proposed slopes, further assessment of the geotechnical properties of the materials proposed to be used in the embankment construction (to include effective stress parameters), the groundwater regime and the loading arrangement, is required.

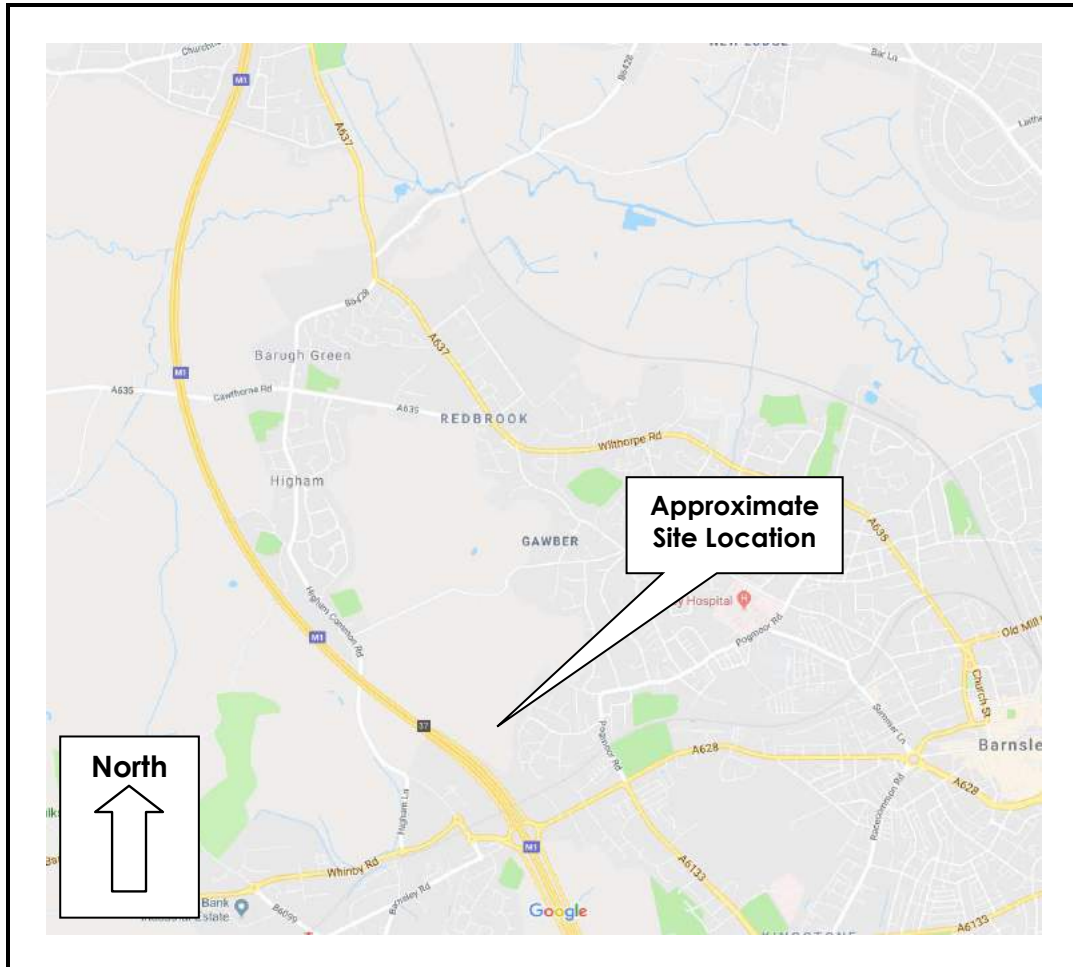
Additional ground investigation of the soils/rock below the proposed embankments will also be required. Where embankments are located over significant thicknesses of backfilled opencast materials, the geotechnical properties of these soils will need to be confirmed/verified following treatment and/or improvement.

On completion of the earthworks, it is recommended that further ground investigation is carried out to confirm that the mitigation measures recommended for the high groundwater table have been successful in lowering the groundwater to a level where it no longer poses a risk to the long-term stability of the earthworks.



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## Appendix A Figures and Drawings



**Figure 1 – Site Location Plan**

<b>Site</b>	<b>Employment Lane, Barnsley West</b>
<b>Client</b>	<b>Strata Sterling Barnsley West Limited</b>
<b>Job Number</b>	<b>4848</b>
<b>Scale</b>	<b>NTS</b>



**Figure 2 – Aerial Photograph**

<b>Site</b>	<b>Employment Lane, Barnsley West</b>
<b>Client</b>	<b>Strata Sterling Barnsley West Limited</b>
<b>Job Number</b>	<b>4848</b>
<b>Scale</b>	<b>NTS</b>

### DO NOT SCALE (A1)

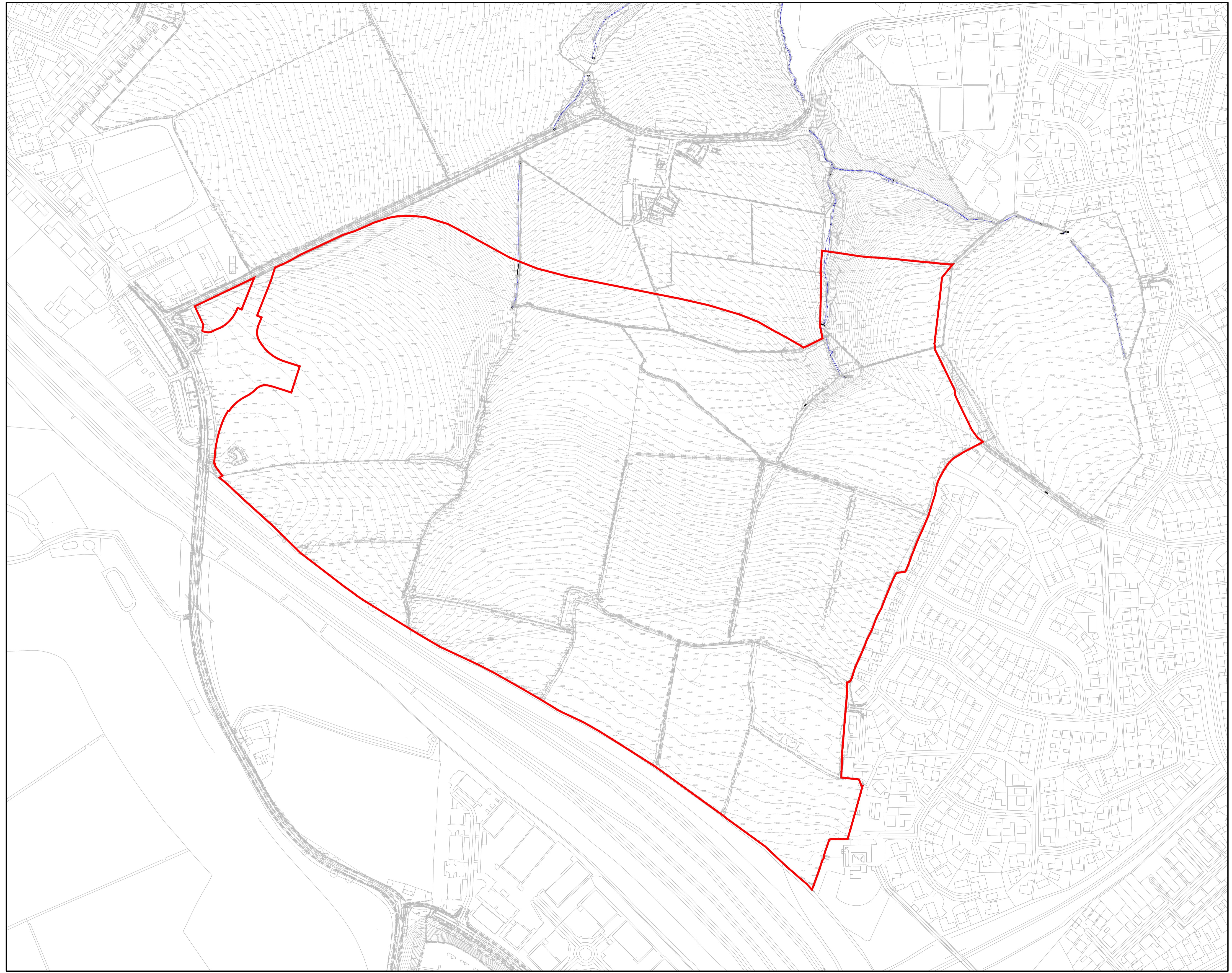
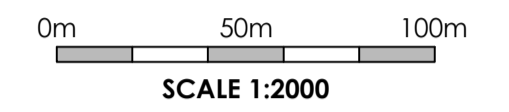
#### NOTES

#### GENERAL NOTES

1. ALL MATERIALS AND WORKMANSHIP IS TO COMPLY WITH JPG CONSULTANTS STANDARD SPECIFICATION & ALL RELEVANT BRITISH & EUROPEAN STANDARDS.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, M & E CONSULTANTS AND JPG CONSULTANTS DRAWINGS.
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ENGINEER IMMEDIATELY SO THAT CLARIFICATION CAN BE SOUGHT PRIOR TO COMMENCEMENT OF WORKS.

#### LEGEND

— COMMERCIAL BOUNDARY



P02	REDLINE BOUNDARY UPDATED	10/10/23	JDM	LSC
P01	FIRST ISSUE	30.03.23	JDM	EBH

REV	DESCRIPTION	DATE	CHK	BY
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Project  
BARNSELY WEST

Drawing Title  
COMMERCIAL BOUNDARY PLAN

#### INFORMATION



**DO NOT SCALE (A0)**  
**NOTES**

- EARTHWORKS NOTES**
1. JPG PROPOSED EARTHWORKS ANALYSIS IS INDICATIVE ONLY. IT IS BASED ON THIRD PARTY INFORMATION AND THEREFORE JPG DO NOT ACCEPT RESPONSIBILITY FOR VARIATIONS IN THE ACTUAL DEPTH OF SITE STRIP OR ANY OTHER CRITICAL EARTHWORKS PARAMETERS THAT MAY EFFECT FINAL CUT AND FILL VOLUMES.
  2. ISOPACHYTE COLOUR BANDINGS DENOTE APPROXIMATE CUT AND FILL VOLUMES BETWEEN THE EXISTING SITE STRIP AND PROPOSED FORMATION LEVELS. REFER TO EARTHWORKS ANALYSIS TABLE.
  3. AREAS NOT SHADED WITH ISOPACHYTE COLOUR BANDINGS HAVE NOT BEEN INCLUDED IN THE CUT/FILL ANALYSIS.
  4. ALL RETAINING WALL LOCATIONS SHOWN ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN.
  5. APPROXIMATE EARTHWORK VOLUMES HAVE BEEN DETERMINED BASED ON THE FOLLOWING CAVEATS:
    - NO BULKING FACTORS HAVE BEEN ACCOUNTED FOR
    - ARRIVES FROM DRAINAGE AND FOUNDATION EXCAVATIONS HAVE NOT BEEN ACCOUNTED FOR
    - REMOVED MATERIAL FROM EXISTING BUILDINGS/STRUCTURES HAVE NOT BEEN ACCOUNTED FOR

**EARTHWORKS ANALYSIS**

**PROPOSED SITE STRIP**  
 ALLOW FOR A 200mm DEEP SITE STRIP.  
 TOTAL AREA = 367097m<sup>2</sup>  
 TOTAL VOLUME = 73419m<sup>3</sup>  
 SITE STRIP MATERIAL DEEMED TO BE UNSUITABLE FOR RE-USE AS ENGINEERING FILL  
 TOPOGRAPHICAL SURVEY INFORMATION USED IN THE EARTHWORKS ANALYSIS TAKEN FROM: HAYCOCK & TODD LAND SURVEYS, DRAWING NO. 58315.

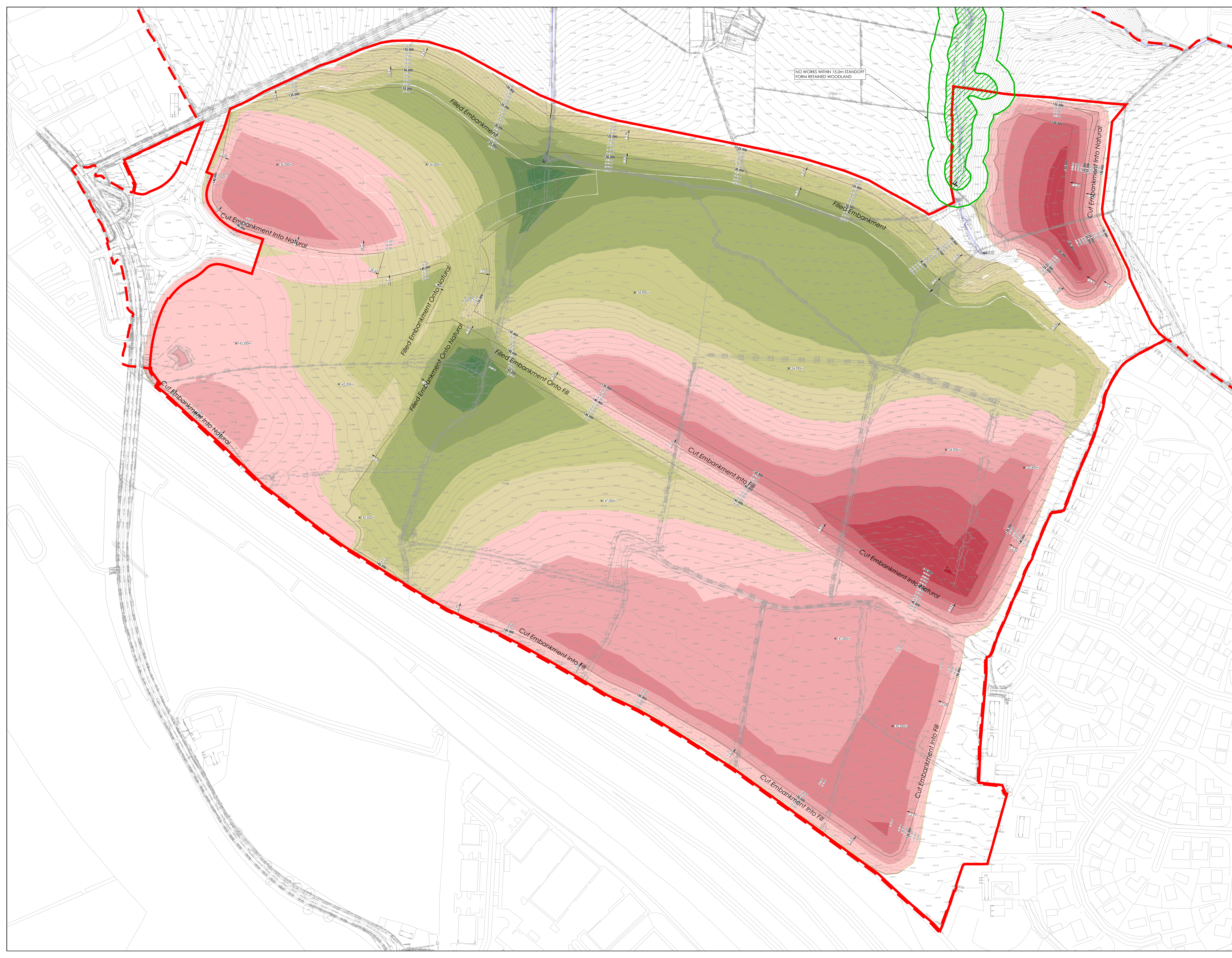
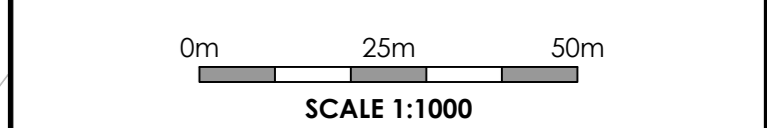
**ANALYSIS BETWEEN PROPOSED SITE STRIP & PROPOSED PLATFORM LEVELS**

2D AREA	367097m <sup>2</sup>
CUT	485422m <sup>3</sup>
FILL	735041m <sup>3</sup>
NET (SHORTFALL)	49619m <sup>3</sup>
MAXIMUM CUT DEPTH	-12.780m
MAXIMUM FILL DEPTH	14.140m

**SURFACE LEVEL DATA**

MIN. LEVEL	MAX. LEVEL	COLOUR
-15.000m	-12.500m	[Dark Red]
-12.500m	-10.000m	[Red]
-10.000m	-7.500m	[Light Red]
-7.500m	-5.000m	[Pink]
-5.000m	-2.500m	[Light Pink]
-2.500m	0.000m	[White]
0.000m	2.500m	[Light Green]
2.500m	5.000m	[Green]
5.000m	7.500m	[Dark Green]
7.500m	10.000m	[Forest Green]
10.000m	12.500m	[Dark Forest Green]
12.500m	15.000m	[Black]

- LEGEND**
- 5.000 DENOTES PROPOSED MAJOR CONTOURS
  - 1.000 DENOTES PROPOSED MINOR CONTOURS
  - 1:40 DENOTES PROPOSED GRADIENTS
  - DENOTES DEVELOPABLE PLATEAU



REV	DESCRIPTION	DATE	CHK	BY
P04	REVISED TO SUR PLANNING COMMENTS	04.10.23	JDM	LSG
P03	REVISED TO LATEST LEVELS	17.04.23	CPH	LSG
P02	REVISED TO LATEST LEVELS	11.04.23	CPH	LSG
P01	FIRST ISSUE	10.03.23	CPH	LSG

Project  
 BARNSELEY WEST

Drawing Title  
 PROPOSED EARTHWORKS  
 CUT & FILL ANALYSIS

**INFORMATION**