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RESIDENTIAL AND COMMERCIAL DESIGN CONSULTANTS

Strata Sterling Barnsley West Ltd

Barnsley West

EARTHWORKS STRATEGY

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1. Introduction

- 1.1 Queensberry Design Ltd has been commissioned by Strata Sterling Barnsley West Ltd to undertake an Earthworks Strategy for a proposed mixed-use development at Barnsley West. The purpose of this document is to describe the earthworks strategy from ground constraints to proposed level design.
- 1.2 This assessment covers the residential area of the Barnsley West scheme information considering the adjacent (but within the application redline) employment site can be viewed within the JPG Earthworks Design Statement ref: 4848-JPG-XX-XX-RP-G-0611-S2-P01.
- 1.3 This strategy will draw on conclusions of reports and assessment carried out by both Lithos and JPG consulting, Queensberry Design Ltd does not hold any liability on information regarding ground conditions or ground treatment.

2. Site Description

- 2.1 The residential part of the development is circa 68.23 hectares in size and is located 3km west of Barnsley Town Centre, at a national grid reference of SW 31632 07538.
- 2.2 For the purposes of development description on locality refer to phasing plan in appendix 2.
- 2.3 The site is located north of the M1 motorway and south of the A635 Barugh Green Road, between Higham and Gawber.
- 2.4 Hermit Lane, an unclassified road crosses the site in an east-west direction through phase R6 Hermit Lane is operational on open to the public. Hermit House is located south of Hermit Lane.
- 2.5 A valley intersects the middle of the site between R4 and R6 the valley is steep with gradient up to 1:2. The valley is occupied by mature woodland with a small watercourse at the base flowing in a north-east direction.

Site Levels

- 2.6 A topographical survey has been carried out and can be viewed in Appendix 1.
- 2.7 Levels fall in a north, north-eastern direction, site level are generally steep and undulating. The high point of the residential development is the southern tip in the R7 area at a level of 141.50m AOD. The R7 area falls in northern direction to a level of 129.00m AOD levels then drop significantly to the watercourse north of R7.
- 2.8 Site levels continue to fall in a north, northeastern direction in cell R6 from a level of 124.00 – 101.00m AOD. Levels within the northern tip of R6 fall sometimes nearly vertically to the watercourse.
- 2.9 The watercourse dissecting R6 and R4 is in within a valley at its highest point the drop within the valley is circa 7.0m
- 2.10 Site levels north of Hermit Lane are of a more constant gradient, however site walls are significant with 31m level difference from Hermit Lane falling towards Barugh Green Road.

3. Summary of Ground Conditions

- 3.1 The site is split into three areas, land transfer 1, land transfer 2 and Pogmoor a summary of the ground conditions is as follows.

Land transfer 1

- 3.2 Land transfer 1 area covers cells R1 and R2 the area can be divided into 4 areas based on ground conditions; land inside of former open cast; land outside of the former open cast sites but with some made ground; land outside the former open cast sites with significant (>2.0m) made ground; and land outside the former open cast sites with minimal/no made ground.

Made Ground

- 3.3 Made ground can be categorised four type which are present across all four site areas.
- Made ground topsoil: comprising of silty clay with some gravel of mudstone, siltstone and occasional sandstone, coal and pottery.
 - Cohesive made ground: comprising of light brown mottled grey clay with occasional gravel of mudstone and some siltstone.
 - Cohesive Opencast backfill: comprising of clay with gravel of mudstone, siltstone and occasional coal, pottery, brick and sandstone, a low to high cobble content (mudstone and siltstone) and a low to medium small boulder content (mudstone and siltstone).
 - Granular Opencast backfill: comprising clayey/silty gravel of mudstone and occasional siltstone, mudstone, coal, brick and pottery with a medium to high cobble content (mudstone and siltstone) and a low to high small boulder content (mudstone and siltstone).

Natural Ground

- 3.4 Natural soils were encountered outside the opencast.
- Topsoil: encountered in area A typically 0.3m in depth comprising of sandy silty clay with occasional gravel of mudstone and siltstone.
 - Cohesive residual soil: comprising of firm to stiff clay with gravel of mudstone and occasionally siltstone and sandstone.
 - Granular residual soil: comprising clayey gravel of mudstone or siltstone.

Rock

- 3.5 Bedrock comprises of three types.
- Mudstone: comprising moderately weak to medium strong dark grey mudstone with closely spaced thin laminations and siltstone laminations.
 - Siltstone: comprising medium strong grey thinly to thickly laminated siltstone.
 - Sandstone: comprising strong to very strong thinly cross laminated fine-grained sandstone.

Mining

- 3.6 Based on desk studies about 60% of the total area of land transfer 1 has been subject to opencast coal extraction.
- 3.7 The opencast area is surrounded by highwalls which are generally cut 30° to 45° through residual soils and then at steeper angles 60° to 80° through coal measures bedrock.
- 3.8 The average depth of opencast is 7.0 to 8.0m.

Land transfer 2

- 3.9 Land transfer 2 area covers cells R3, R4, R5 and R6 intrusive investigation is pending in this area, however given this area was subject to the open casting at a similar time and has similar geology the ground conditions are expected to be similar as land transfer 1 area.

Mining

- 3.10 Most of the site about 70% of the total site area has been subject to opencast coal extraction. The Craven II opencast occupied the north and centre of the site reaching depths of between 20m and 44m. Additionally, the Hunters Cottage Extension opencast was formerly present in the far south and extracted coal to approximately 10m depth.
- 3.11 The shallowest recorded underground mineworkings are within the Flockton Thick Coal at c. 130m depth. Given a maximum recorded depth of c. 44m in the Craven II opencast, any mineworkings within the Flockton Thick seam should be at sufficient depth as to not pose a risk to surface stability.
- 3.12 Unrecorded mineworkings within the Dunsil, Gawber and Thin coals in the south of the site cannot be discounted and further investigation would be required.
- 3.13 A number of mine entries are recorded on site although based on information obtained from the Coal Authority it is highly likely these have been removed during opencast operations and therefore no longer pose a risk to development.

Pogmoor

- 3.14 Pogmoor area covers cell R7 intrusive investigation is pending in this area, however given this area was subject to the open casting at a similar time and has similar geology the ground conditions are expected to be similar as land transfer 1 area.

Mining

- 3.15 This site is located within a Coal Mining Development High Risk Area.
- 3.15.1 About 65% of the total site area (and about 80% of the proposed development footprint) has been subject to opencast coal extraction of the Barnsley Coal Seam. Opencasting has taken place historically (likely c. 1920) across the west of the site (close to the seam outcrop) and in the late 1950's across the majority of the site, with the deepest areas of opencast being in the southeast and reaching around 15.5m depth.
- 3.16 Outside the footprint of the opencast, notably to the south and east, the Barnsley Coal Seam remains in place at between around 10.0m and 16.0m depth and has been heavily worked by underground methods. Underground workings are considered to pose a significant potential risk to surface stability.
- 3.17 Mine entries comprising day holes/adits may remain in place along/beyond the western boundary (along Farm House Lane), although it is likely that many of these, including a shaft in the centre-south) have been removed by opencasting.
- 3.18 The next shallowest coal is the Dunsil Coal Seam which lies about 14.0m below the Barnsley Coal and the base of the former opencast. No evidence of underground workings has been encountered in the Dunsil Coal and, given the seam thickness (c. 0.5m) any workings (if present) would not be considered likely to pose a significant risk to surface stability.

4. Site Remediation

- 4.1 Due to the mining past ground remediation is required across the majority of the residential development area, currently due to further investigation being required in land transfer 2 and Pogmoor areas a detailed strategy is only available for land transfer 1 (cells R1 and R2).
- 4.2 Given open cast mining was carried across the site a similar time the treatment strategy will likely be the same across the development area, with differing depths of excavation.
- 4.3 The remediation proposals have been assessed against the levels design produced by Queensberry Design Ltd, it should be noted the remediation will leave the site similar to its current level (pre-works) rather than carrying out ground remediation and then cutting and filling to create a development platform which could then be left for years before being developed.
- 4.4 Works associated with the open cast mining will briefly consist of:
- Regrade earthworks to ensure that there is a minimum of 3.0m engineered fill below finished ground levels, including the benefit of pre-load affect in areas of cut.
 - Prior to filling back to finished ground level, the sub-formation will be rolled to the specification.
- 4.5 The required depth of site turnover to provide suitably engineered material for future development depends on the cut and fill depths and also the depth of existing made ground, as the table below from the construction specification details:

Site Area	Depth of existing MG	Turnover requirements
A	< 0.9m	<ul style="list-style-type: none"> • None – topsoil strip only
B – Areas of Cut	1.1m to 2.5m	<ul style="list-style-type: none"> • Full thickness of MG
B – Areas of Upfill *	1.1m to 2.5m	<ul style="list-style-type: none"> • Full thickness of MG where the height of engineered upfill is <1m • Over-excavate 1m below existing ground level where the height of engineered upfill is 1m to 2m
C & D – Areas of Cut	>2.5m up to c. 12.5m	<ul style="list-style-type: none"> • Over-excavate 1m below finished ground levels where cut is >3m • Over-excavate 2m below finished ground levels where cut is >2m but <3m • Over-excavate 3m (or to natural strata whichever is shallower) below finished ground levels where there is up to 1m of cut.
C & D – Areas of Upfill *	>2.5m up to c. 12.5m	<ul style="list-style-type: none"> • Over-excavate 3m (or to natural strata whichever is shallower) below finished ground levels where there is up to 1m of engineered fill. • Over-excavate a minimum of 2m from existing ground levels where height of engineered upfill is 1m to 2m • Over-excavate a minimum of 1m from existing ground levels where height of engineered upfill is 2m to 3m • Where the height of engineered upfill is >3m, the existing ground (following topsoil strip) should be proof rolled prior to upfilling.

Note * Upfill above existing ground levels minus topsoil thickness

- 4.6 All works associated with ground remediation consisting of, excavation, fill materials, types of compaction and testing shall be in accordance with the engineering specification.

5. Proposed Level and cut/fill

- 5.1 Site levels have been designed by Queensberry Design Ltd, the principle behind the level design to provide a balance of materials, by setting site levels approximately between 0.0 – 1.0m above existing ground level.
- 5.2 This will allow for the re-placement of as dug material from development cells, back within the development cell, thus reducing the need to export or import material to or from site.
- 5.3 The level design aims to tie into the boundary levels without large heights of cut or fill eliminating the need for retaining walls or large embankments along the boundaries.
- 5.4 Currently the proposal has circa 75% of the finished ground level across the site \pm 1.0m of existing ground levels.
- 5.5 As the level design ties with the existing boundary level large portions of the development can be left open until such time a developer starts work on a development cell.
- 5.6 Doing this negates the need to carry out a large bulk earthworks exercise after the ground remediation discussed in section 4, reducing negative impacts on the local community due to reduced construction time and movement of large plant.
- 5.7 As discussed in section 4, works required associated with the past mining activities can be done leaving ground levels near existing providing benefits to the developer and local community by having no large temporary changes in level for a long period of time before being developed.
- 5.8 The proposal levels can be reviewed in appendix 3 which can be viewed against a comparison to existing level in appendix 4 and comparison against previously submitted levels in appendix 5.

Appendix 1 - Topographical Survey

