Eastwood & Partners
CONSULTING ENGINEERS

E P

GEOTECHNICAL AND GEO-ENVIRONMENTAL SITE INVESTIGATION REPORT

PHASE 3 LOWFIELD ROAD, BOLTON ON DEARNE,

FOR

GLEESON DEVELOPMENTS LIMITED

ISSUE 1

37666-001

2 DECEMBER 2014

Eastwood & Partners, St Andrew's House, 23 Kingfield Road, Sheffield S11 9AS
Tel: 0114 255 4554 Fax: 0114 255 4330 mail@eastwoodandpartners.com www.eastwoodandpartners.com

GEOTECHNICAL AND GEO-ENVIRONMENTAL SITE INVESTIGATION REPORT

PHASE 3 LOWFIELD ROAD, BOLTON ON DEARNE

FOR

GLEESON DEVELOPMENTS LTD

ISSUE 1

Job No.	:	37666
Report Status	:	Issue 1
Document Date	:	2 December 2014
Approved	:	

P. Richardson

Also at:- Principle House, 121-123 Fleet Road, Fleet, Hampshire, GU51 3PD Tel: 01252 360580 Fax: 01252 360581

CONTENTS

APPENDICES

Appendix 1 *'Exploratory Hole Location Plan'*, Drawing Number 37666/006/A

Appendix 2 Envirocheck Report

Appendix 3 Trial Pit Logs TP1 to TP15 and Soakaway Pit Logs SA1 to SA4

Appendix 4 Infiltration Test Results

Appendix 5 Chemical Testing Results, Chemtech Report 53074(1)

Table of Assessment Values

1.0 EXECUTIVE SUMMARY

1. The site has an area of approximately 2.6 hectares and is located south of Lowfield Road, at Bolton On Dearne. The site is centred on National Grid Reference 446090, 402390 and comprises an undeveloped field.

2. The surface was covered with around 0.3 m of dark brown clayey sandy topsoil overlain by grass. No made ground was encountered on site. The natural ground comprises brown and light brown fine to coarse brown gravelly sand, occasionally clayey, to depths of between 0.5 m and 2.2 m bgl, over moderately strong sandstone, which was recovered as gravel and cobbles in a sand matrix.

3. For the low rise housing scheme proposed, the most suitable foundations are considered to be unreinforced strip or trench fill footings taken through any soft ground at a minimum depth of 750 mm below ground level. If competent sandstone is encountered at shallower depths, no further excavations are required.

4. Variable infiltration rates were recorded. Soakaways are not considered to be a viable solution for surface water drainage.

5. Service records show an underground electric cable and a gas pipe to cross the site from the north west to the south east. Strong rock is also expected at shallow depth.

6. Significant contamination was not encountered in the materials tested. Remedial measures are not considered necessary. The topsoil can be considered suitable for re-use.

7. DS-1 AC-1 sulphate precautions are appropriate for the below ground concrete on the site.

8. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority and your warranty provider.

2.0 INTRODUCTION

2.1 Terms of Reference

This report presents the findings of a geotechnical and geo-environmental site investigation carried out by Eastwood & Partners (Consulting Engineers) Ltd for, and on the behalf of Gleeson Developments Ltd. Any other parties using the information in this report do so at their own risk and any duty of care is excluded.

2.2 Context

No previous geotechnical or geo-environmental investigations are known to have been undertaken on the site in the past.

2.3 Aims and Objectives

The aims and objectives of this investigation were as follows:

- Assimilate Phase 1 data to derive an outline conceptual model identifying potential contaminants, pathways and receptors, as well as possible linkages between these;
- Obtain information enabling refinement and subsequent testing of the conceptual model;
- Carry out tiered risk assessment to establish the likely risks to future receptors, involving the use of generic assessment criteria and where unacceptable risks are identified, site specific assessment criteria within a detailed quantitative risk assessment;
- Identify feasible remediation options if unacceptable risks are highlighted;
- Develop an appropriate remediation strategy where remediation is required; and
- Detail the ground conditions and their geotechnical properties enabling outline foundation proposals to be made.

2.4 Scope of Investigation

This document is split into two sections. These constitute the findings of the Phase 1 and Phase 2 investigations, consecutively.

2.4.1 Phase 1

The Phase 1 investigation involved a review of information extracted from published documentation as well as that obtained from a site reconnaissance. Information regarding the current and former land uses both on and surrounding the site, as well as the environmental sensitivity of the site location as determined by factors including geology, hydrogeology and hydrology have been examined.

Information analysed in this section of the report has been obtained from a variety of sources and included the following:

- A Landmark Envirocheck Report. This includes historical Ordnance Survey maps, as well as information regarding environmental issues such as abstraction licenses, pollution incidences and waste facilities;
- Coal Authority Report;
- British Geological Survey maps and memoirs;
- A site walkover.

The results of the Phase 1 investigation were used to derive an outline conceptual model from which a preliminary risk assessment was made.

2.4.2 Phase 2

This part of the investigation consisted of intrusive works and laboratory analysis. The findings were used to test the conceptual model and produce a final risk assessment.

The intrusive works comprised trial pits which were excavated to enable:

- Examination of the upper few metres of ground;
- In situ description of soils, enabling any localised lateral and vertical changes in soil conditions to be logged;
- Assessment of any contamination identified using visual and olfactory methods;
- Collection of soil samples for chemical testing;
- Infiltration tests to be undertaken.

2.5 Limitations of Investigation

This report is based on the assumption that the site will be developed with houses up to three storeys in height, with private gardens. These will be of conventional construction and existing ground levels will not alter significantly. If this is not the case, then the advice given in this report may not be appropriate.

Where assessments of site areas affected in particular ways are given, these are approximate. All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, on the results of laboratory testing carried out as part of the investigation and information gained from a geological and historical desk study. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata and water conditions between or below investigation points. It should be noted that groundwater varies due to seasonal or other effects, and may at times differ from this measured during the investigation.

3.0 THE SITE

3.1 Description

The site has an area of approximately 2.6 hectares and is located south of Lowfield Road, at Bolton Upon Dearne. The site is centred on National Grid Reference 446090, 402390 and comprises an undeveloped field.

The '*Exploratory Hole Location Plan*', drawing 37205/006/A in Appendix 1, shows the features described.

3.2 History

Historical maps, obtained as part of the Envirocheck Report, have been reviewed to assess the previous use of the site and surrounding area. Copies of the maps are presented in Appendix 2.

3.2.1 The Site

The earliest historical map, dated from 1851 to 1855, indicates the site to comprise agricultural land with a field boundary that trends north east to south west across the centre of the site. By 1962 the field boundary has been removed. The site has remained undeveloped to the present day.

3.2.2 The Surrounding Area

The earliest historical map reviewed, dated from 1851 to 1855, records the surrounding area to be predominantly agricultural fields. Lowfield Lane runs approximately north west to south east around 50 m north of the site. At its closest, the River Dearne lies approximately 110 m from the site's southern boundary and flows towards the east/south east. The town of Bolton Upon Dearne lies around 300 m to the west of the site.

By 1893, the Midland and North-Eastern Railway line has been constructed approximately 160 m west of the site, running north to south.

In 1903, sewage works are labelled on the map, just east of the railway line, about 110 m south west of the site. Between 1903 and 1907, an old clay pit can be observed around 550 m north east of the site. The sewage works have expanded by 1930, and now located approximately 25 m from the south western corner of the site. Residential buildings and allotment gardens have also been constructed along the northern side of Lowfield Lane.

In the subsequent years, residential development has continued in the wider surrounding area.

In 1976, a factory has been constructed on the adjacent land about 150 m west of the site. By this time the original course of the River Dearne has been straightened. An embankment runs along the north side of the river channel, southeast of the site.

Between 2006 and 2014, the Lowfield Lakes complex has been constructed immediately south of the site. By the present day, the factory west of the site has been demolished and the area of the disused tips has been developed as parks and woodland.

3.3 Geology

The Geological Map Sheet 283 NE (1;10560 scale) shows the site to overlie Middle Coal Measures strata, comprising mainly interbedded mudstones and sandstones. The strata are anticipated to dip to the north east at less than 5°.

Faults are present within the Barnsley coal seam at depth but should not affect the development.

No superficial deposits are shown to overlie the site.

BGS borehole records have been reviewed for the local area. One historical borehole is located within the site, reference SE40SE64. This records around 45 feet (14 m) of Mexborough Rock sandstone, with a coal seam 0.75 m thick around 14 m below the base of the sandstone.

3.4 Hydrogeology

3.4.1 Groundwater Vulnerability

The Envirocheck Report states that the site overlies a Secondary A Aquifer, comprising permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

3.4.2 Water Abstractions

The Envirocheck Report indicates there are no groundwater abstractions within 250 m of the site.

3.5 Hydrology

The Envirocheck Report indicates that the nearest surface water feature is 13 m south west of the site. This is expected to refer to the Lowfield Lakes complex.

According to the Envirocheck Report, the site is not located within a Groundwater Source Protection Zone.

3.6 Mining

From the BGS borehole information, the site is expected to lie towards the base of Mexborough Rock. The shallowest named coal seam is therefore expected to be the Double Smuts coal, found in the BGS borehole to lie around 14 m below the base of the Mexborough Rock and 28 m below site. The seam was found to be 0.75 m thick. The geological memoir does not suggest that the seam is of good quality and it does not refer to it having been worked in the area. Even if the seam was worked, it is expected to lie at a depth at which grouting is not required. Precautions against the effects of shallow mining are therefore not considered necessary.

A Coal Authority report has been obtained and is enclosed in Appendix 2. This states that the site is within the likely zone of influence from workings in five seams of coal at 220 m to 690 m depth, and last worked in 1972. Any ground movement from these coal workings should have stopped by now.

The site is not within the likely zone of influence from any present or future underground coal workings, however, reserves of coal exist in the locality which could be worked at some time in the future subject to feasibility, licences and planning consents. There are no recorded mine shafts or entries within 20 m of the site boundary, although the Coal Authority records may not be complete. The Coal Authority Report states there is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property

The Coal Authority Report also states the site is within an area for which entitlement to withdraw support was published in 1942 and 1982. This has not yet been revoked, however, it is unlikely that underground seams will be mined further in the future, mainly due to the site's location in a built up area.

3.7 Ground Gas

The Envirocheck Report states that the site is in an intermediate probability radon area, as between 1 and 3% of homes are above the action level. However, the Envirocheck Report indicates that the site lies in an area where no radon precautions are required.

The Envirocheck Report indicates that the site is not within 500 m of an active or historic landfill. Deep made ground is not expected across the site, as there is no evidence of past development. Ground gas precautions are not considered necessary.

3.8 Pollution Incidents to Controlled Waters

The Envirocheck Report indicates there are six pollution incidents to controlled waters within 250 m of the site boundary. One was classified as a major incident. It occurred 98 m from the site on Lowfield Road. Unknown sewage was released into a freshwater stream/river in February 1989.

Four incidents were classed as significant. These occurred between 1989 and 1992, at distances of between 100 and 192 m from the site. One occurred on Lowfield Road and the others occurred on Road Bridge/Bolton Bridge B6098. The pollutants were either of treated or unknown sewage, and were received by a freshwater stream/river. The last incident occurred in 1992, 200 m from the site boundary. This was again at Road Bridge/Bolton Bridge B6098. It was a minor incident and the pollutant type received by a freshwater stream/river is unknown.

3.9 Discharge Consents

The Envirocheck Report indicates the nearest discharge consents to be registered to the sewage works, south west of the site.

3.10 Flooding

Information provided in the Envirocheck Report does not show the site to lie within a flood plain. However, a full flood risk assessment will be required due to the size of the site. Additionally, land adjoining the site to the south and east is shown on historical maps to be at risk from flooding.

4.0 OUTLINE CONCEPTUAL MODEL

The site is being considered for development with housing, with private gardens and areas of associated soft landscaping and hardstanding.

The site has not previously been developed. The topsoil and natural ground may contain naturally elevated heavy metals such as arsenic. Polycyclic aromatic hydrocarbons may also be present. The natural ground may contain sulphates.

The following table details the possible sources and associated contaminants of concern, pathways and receptors, highlighted by the Phase 1 investigation as potentially present.

4.1 Possible Significant Pollutant Linkages

Potential Contaminants	Pathway	Receptor
Heavy metals and PAHs in topsoil or any made ground.	Ingestion, inhalation, direct contact Migration through ground	Site workers, future residents, plants Principal aquifer
Naturally elevated levels of heavy metals in the natural ground	Ingestion, inhalation, direct contact Migration through ground	Site workers, future residents, plants Principal aquifer
Sulphates in natural ground and in any made ground	Direct contact Migration through ground	Below ground concrete
PAH in the natural ground and in any made ground	Direct contact Migration through ground	Water supply pipes

5.0 GROUND INVESTIGATION

5.1 Site Works

We visited site on 08 October 2014 and excavated fifteen trial pits, TP1 to TP15, using a JCB 3CX excavator in order to determine the underlying ground conditions. These reached depths of between 1.35 and 2.35 m below ground level. Four additional pits (referenced SA1 to SA4) were excavated on 09 October 2014 and used for soakaway testing.

Copies of the trial pit logs are presented in Appendix 3, and their positions are plotted on the Exploratory Hole Location Plan, Drawing number 37666/006A in Appendix 1.

5.2 Laboratory Testing

Ten samples of topsoil and three samples of natural ground were dispatched for chemical testing. Soil samples were taken in 500 g plastic tubs and 60 ml Amber jars. All samples were analysed at Chemtech Laboratories, using MCERTs accredited methodologies where available.

Laboratory testing results are presented in Appendix 5 and discussed further in Sections 8.0 to 9.0.

6.0 GROUND CONDITIONS

6.1 Surface Covering

The surface was covered with grass over around 0.3 m of dark brown clayey sandy topsoil.

6.2 Made Ground

No made ground was encountered within the exploratory holes.

6.3 Natural Ground

The natural ground comprises brown and light brown fine to coarse brown gravelly sand, occasionally clayey, to depths of between 0.5 m and 2.2 m bgl, over moderately strong sandstone, which was recovered as gravel and cobbles in a sand matrix.

6.4 Obstructions

No obstructions were encountered during the investigation.

Service records show an underground electric cable and a gas pipe to cross the site from the north west to the south east.

6.5 Groundwater

No groundwater was recorded during the excavations.

6.6 Evidence of Contamination

No visual or olfactory evidence of significant contamination was identified in any of the exploratory holes.

7.0 GEOTECHNICAL APPRAISAL

7.1 General

The ground conditions on site generally comprise around 0.3 m of topsoil over brown fine to coarse, occasionally clayey, gravelly sand, to depths of between 0.5 m and 2.2 m bgl, over sandstone recovered as gravel and cobbles in a sand matrix. No groundwater was encountered.

7.2 Foundations

For the low rise housing scheme proposed, the most suitable foundations are considered to be unreinforced strip or trench fill footings taken through any made or soft ground and founded at a minimum depth of 750 mm below ground level in sand. If competent sandstone is encountered at shallower depths, no further excavations are required.

7.3 Ground Slabs

A ground bearing slab may be considered where there is less than 600 mm of made ground beneath the floor slab, which appears to be the case for this site. If levels are to be raised, a reinforced suspended or precast concrete floor should be used.

7.4 Superstructure Precautions

Superstructure precautions are not considered to be required as a result of the ground conditions encountered within the trial pits.

7.5 Excavation Problems

Excavations may be difficult within the sandstone, which was found at depths as shallow as 0.5 m.

An underground electric cable and a gas pipe are crossing the site, and will need to be diverted.

The sides of trenches and excavations may be slightly unstable within the sand and temporary support may possibly be required in some areas.

Where excavations which workers are required to enter are over 1.2 m deep, or less where there is a risk of harm from collapse of the sides of the excavation, the sides should be supported or battered back to make them safe.

7.6 Roads

The natural ground encountered in the upper 600 mm generally comprised occasionally clayey, gravelly sand. This is likely to have a CBR value of at least 3%. It is recommended that this value is used as a guide only and that full scale CBR tests are undertaken along roadways prior to construction so that accurate values can be obtained to satisfy the Local Authority.

7.7 Surface Water Drainage

Four pits, referenced SA1 to SA4, were excavated for soakaway testing. The infiltration calculations and results are provided in Appendix 4. Eight infiltration tests were carried out across the four pits.

Test	Water Level	BR365 Infiltration Rate (m/sec)	Average Infiltration Rate (m/sec)
SA1 (1)	440 mm in 96 minutes	35×10^{-06}	N/A
SA1 (2)	400 mm in 172 minutes	20×10^{-06}	N/A
SA1 (3)	180 mm in 60 minutes	N/A	19×10^{-06}
SA2 (1)	400 mm in 194 minutes	20×10^{-06}	N/A
SA2 (2)	260 mm in 141 minutes	N/A	14×10^{-06}
SA3	390 mm in 290 minutes	10×10^{-06}	N/A
SA4 (1)	420 mm in 94 minutes	57×10^{-06}	N/A
SA4 (2)	230 mm in 110 minutes	N/A	13×10^{-06}

Generally, moderate to poor infiltration rates were recorded. Soakaways are therefore not considered to be a viable method of surface water drainage for the proposed development.

8.0 REFINEMENT OF OUTLINE CONCEPTUAL MODEL

8.1 Source Characterisation

An outline conceptual model, detailing the possible sources and associated contaminants of concern, potential pathways and receptors identified in the Phase 1 report, is set out in Section 4.0 above.

This section of the report documents the works undertaken to obtain information to test and refine this model enabling a risk assessment to be produced and, where significant risks are expected, remediation recommendations.

8.2 Gas Precautions

The site is in an area where no radon protections are required for new dwellings.

The Envirocheck Report indicates that the site is not within 500 m of a current or historic landfill. Made ground has not been encountered on site. Ground gas precautions are not considered to be necessary.

8.3 Unexpected Contamination

No visual or olfactory evidence of significant contamination was identified during the site investigation.

8.4 Chemical Testing

Ten samples of topsoil and three samples of natural ground were dispatched for chemical testing. Each of the samples was analysed for the suite of contaminants listed in the table below:

Contaminant Type	Actual Contaminants
Metals/Metalloids	Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Copper and Zinc
pH	pH
PAHs	Speciated PAH
Sulphates*	Water soluble sulphate, acid soluble sulphate and sulphur

*Natural ground only

8.5 Assessment Criteria

The proposed development of the site is for residential properties with private gardens. Therefore the assessment criteria relating to a residential end use have been used. Tables detailing the relevant assessment concentrations used are included in Appendix 5.

8.6 Chemical Test Results

8.6.1 Topsoil

None of the tested determinands exceeded their respective assessment values.

8.6.2 Natural Ground

None of the tested determinands exceeded their respective assessment values.

8.6.3 Sulphates

The site has been taken as a greenfield location in relation to the Aggressive Chemical Environment for Concrete calculations.

Tests for total sulphur indicate that the total potential sulphates for the natural ground are less than 0.03%, compared with upper class limit of 0.24% for class DS-1.

The concentrations of water soluble sulphate in the natural ground are below 10 mg/l, compared with the upper limit of Design Sulphate Class 1 of 500 mg/l.

pH levels for the natural ground samples varies between 6.9 and 7.4.

9.0 RISK ASSESSMENT

9.1 Human Health: Future Residents and Visitors

The results of the chemical testing undertaken indicate that the topsoil and natural ground on the site are not considered to pose a significant risk to the health of future residents, visitors or other site users.

The topsoil can be considered to be suitable for re-use in the proposed development.

9.2 Human Health: Construction Workers

Significant contamination was generally not encountered. Normal precautions, such as washing hands before eating, should be sufficient to mitigate any risk posed to construction workers. Any unusual, brightly coloured or odorous material encountered during construction should be brought to the attention of the site staff and investigated.

9.3 Plants

Significantly elevated concentrations of phytotoxic elements were recorded. Therefore, no significant risk to plants is anticipated from the soils on site.

9.4 Concrete

The chemical test results indicate DS-1 AC-1 sulphate precautions are appropriate for underground concrete.

9.5 Controlled Waters

No significant risks are expected to be posed to controlled waters.

9.6 Disposal of Material

If material needs to be removed, it should to be taken to a suitably licensed landfill or waste treatment facility. The costs of disposal and landfill tax can be substantial. The disposal of material should therefore be seen as a last resort with options such as treatment and reuse either on-site or off-site considered where possible.

The category of landfill which can accept the waste (inert, non-hazardous or hazardous) would need to be determined and will also have a significant effect on the costs. Additional testing may be required by the landfill operator and the acceptance of material is generally at their discretion.

10.0 CONTAMINATION - RECOMMENDATIONS AND APPROVALS

1. Significant contamination was not encountered in the materials tested. Remedial measures are not considered necessary. The topsoil can be considered suitable for re-use.

2. DS-1 AC-1 sulphate precautions are appropriate for the below ground concrete on the site.

3. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority and your warranty provider.