soiltechnics

environmental and geotechnical consultants

Proposed residential development
Montague Street
Rushden

Ground Investigation Report

Cedar Barn, White Lodge, Walgrave, Northamptonshire NN6 9PY

[redacted]

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Proposed residential development
Montague Street, Rushden
Northamptonshire
NN10 9TS

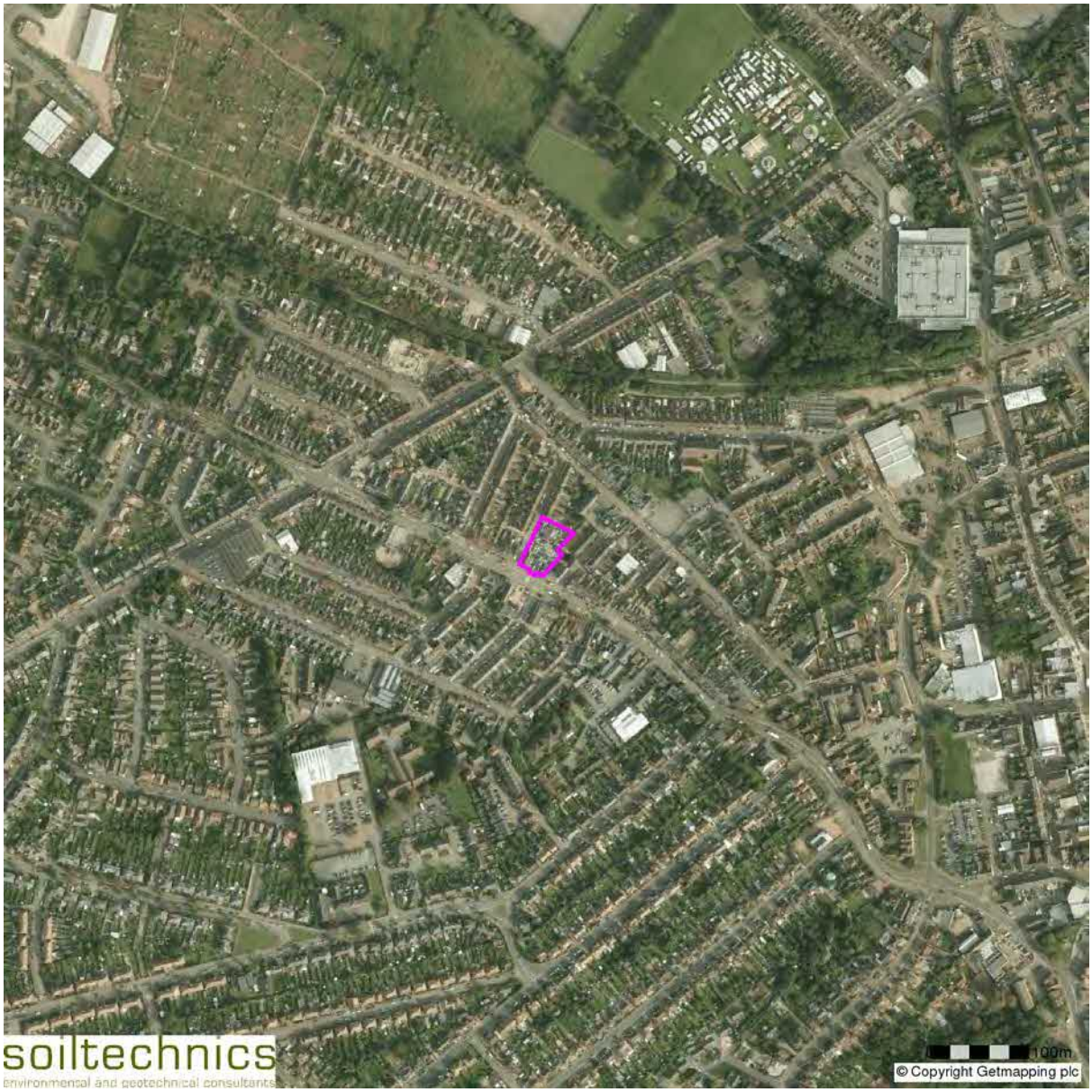
GROUND INVESTIGATION REPORT

[redacted]

Report originators

[redacted]

Aerial photograph of site



Report status and format

Report section	Principal coverage	Report status	
		Revision	Comments
1	Executive summary		
2	Introduction		
3	Desk study information and site observations		
4	Fieldwork		
5	Ground conditions encountered		
6	Laboratory testing		
7	Chemical contamination		
8	Gaseous contamination		
9	Landfill issues		
10	Further investigations		
11	Remediation statement		
12	Drawings		

List of drawings

Drawing	Principal coverage	Status	
		Revision	Comments
01	Site location plan		
02	Plan showing existing site features, development proposals and location of exploratory holes		
02a-02c	Plan showing site features recorded on historical maps in 1900, 1966 and 1993 respectively		
03	Plan showing site development proposals and location of exploratory points		
04	Section showing construction of standpipes installed in boreholes DTS02 & DTS04		

List of appendices

Appendix	Content
A	Definitions of geo-environmental terms used in this report
B	Borehole records (driven tube sampler)
C	Copies of laboratory test result certificates – concentrations of chemical contaminants
D	Analysis and summary of test data in relation to concentrations of chemical contaminants
E	Conceptual models for chemical contamination
F	Copies of Statutory Undertakers replies
G	Copy of desk study information produced by Envirocheck

1 Executive summary

1.1 General

1.1.1 We recommend the following executive summary is not read in isolation to the main report which follows.

1.2 Site description, history and development proposals

1.2.1 The site is located within a predominantly residential and commercial area to the west of Rushden town centre. At the time of our investigation, the site was occupied by a used car dealership which comprised of car storage yard, garage and workshop and associated office building.

1.2.2 A review of historical maps indicates the site has been developed since at least 1884. A garage is recorded on the site after c1960.

1.2.3 We understand the scheme will comprise the construction of eleven two storey houses together with associated gardens and hardstandings.

1.3 Ground conditions encountered

1.3.1 The exploratory excavations encountered Made Ground overlying Head deposits, which in turn overlie the Blisworth Limestone Formation

1.3.2 Groundwater was not encountered in any of the exploratory excavation.

1.4 Chemical and gaseous contamination

1.4.1 Due to elevated concentrations of organic and inorganic contaminants in the Made Ground and the presence of asbestos, remedial measures are required to render the site suitable for the proposed residential end use.

1.4.2 Leachable concentrations of organic contaminants pose a risk to the underlying Principal aquifer. Further investigations and/or remediation are required.

1.4.3 We recommend that underground fuel storage tanks are removed under a contamination watching brief.

1.4.4 Measures to protect against ground gases (methane, carbon dioxide and radon) are not required for new buildings at the site.

2 Introduction

2.1 Objectives

2.1.1 This report describes a ground investigation carried out for a proposed housing development at Montague Street, Rushden, Northamptonshire NN10 9TS.

2.1.2 The objective of the ground investigation was to establish an evaluation of potential chemical and gaseous contamination of the site leading to the production of a risk assessment in relation to contamination.

2.1.3 The investigation has also been produced to support a planning application for the site by satisfying National Planning Policies Framework sections 120 and 121 or if the project has the benefit of a planning permission, potentially discharge conditions which relate to ground conditions.

2.2 Client instructions and confidentiality

2.2.1 The investigation was carried out in March 2016 and reported in May 2016 acting on instructions received from Sidey Design Architecture on behalf of our client, Mike Wells Cars Limited

2.2.2 This report has been prepared for the sole benefit of our above named instructing client, but this report, and its contents, remains the property of Soiltechnics Limited until payment in full of our invoices in connection with production of this report.

2.2.3 Our original investigation proposals were outlined in our letter to Sidey Design Architecture Ltd. of 19th May 2015. The investigation generally followed our original investigation proposals. The investigation process was also determined to maintain as far as possible the original investigation budget costs.

2.3 Site location and scheme proposals

2.3.1 The National Grid reference for the site is 495180, 266930. A plan showing the location of the site is presented on Drawing 01.

2.3.2 We understand the scheme will comprise the construction of eleven two storey houses together with associated gardens and hardstandings.

2.3.3 We have received drawings of the proposed scheme with the layout presented on Drawing 03.

2.4 Report format and investigation standards

2.4.1 Sections 2 to 6 of this report describe the factual aspects of the investigation with Section 7 provides a risk assessment of chemical contamination based on readily available historic records, inspection of the soils and laboratory testing. Section 8 provides a similar risk assessment in relation to gaseous contamination with Section 9 discussing issues relating to classification of waste soils for disposal and reuse.

2.4.2 This investigation integrates contamination aspects. The investigation was carried out generally, and where practical following the recommendations of BS10175: 2011 'Investigation of potentially Contaminated Sites – Code of Practice'. In view of the client's requirement for rapid implementation of the investigation, the following elements, defined in BS10175, have been completed and incorporated in this report.

a) Phase I Preliminary investigation (desk study and site reconnaissance)
b) Phase II Exploratory and main (intrusive) investigations

2.4.3 The extent and result of the preliminary investigation (desk study) is reported in Section 3. Fieldwork combined the exploratory investigation and main investigation stages into one phase with the extent of these works described in Sections 4 and 6 of this report. Any supplementary investigations deemed necessary are identified in Section 10. Section 11 provides information on any remedial strategy and specification if required.

2.5 Status of this report

2.5.1 This report is final based on our current instructions.

2.5.2 This investigation has been carried out and reported based on our understanding of best practice. Improved practices, technology, new information and changes in legislation may necessitate an alteration to the report in whole or part after publication. Hence, should the development commence after expiry of one year from the publication date of this report then we would recommend the report be referred back to Soiltechnics for reassessment. Equally, if the nature of the development changes, Soiltechnics should be advised and a reassessment carried out if considered appropriate.

2.6 Report distribution

2.6.1 This report has been prepared to assist in the design and planning process of the development and normally will require distribution to the following parties, although this list may not be exhaustive:

Table summarising parties likely to require information contained in this report

Party	Reason
Client	For information / reference and cost planning
Developer / Contractor / project manager	To ensure procedures are implemented, programmed and costed
Planning department	Potentially to discharge planning conditions
Environment Agency	If ground controlled waters are affected and obtain approvals to any remediation strategies
Independent inspectors such as NHBC / Building Control	To ensure procedures are implemented and compliance with building regulations
Project design team	To progress the design
Principal Designer (PD)	To advise in construction risk identification and management under the Construction (design and management) regulations

Table 2.6.1

3 Desk study information and site observations

3.1 General

3.1.1 We have carried out a desk study which was limited to a review of readily available information including:

a) Review of published Ordnance Survey maps dating back to 1884 at various published scales

b) Inspection of geological maps produced by the British Geological Survey together with relevant geological memoirs

c) Consultation with Statutory Undertakers

d) Site reconnaissance

e) Other relevant published documents

3.1.2 We have obtained old Ordnance Survey maps using the Envirocheck database system. In addition to retrieval of historical and current Ordnance Survey data, Envirocheck provide information compiled from outside agencies including: -

Ordnance Survey	Centre for Ecology and Hydrology
Environment Agency	Countryside Council for Wales
Scottish Environment Protection Agency	Scottish Natural Heritage
The Coal Authority	Natural England
British Geological Survey	Health Protection Agency

3.1.3 The study did not extend to research of meteorological information or consultation with other interested parties such as English Heritage (ancient monuments), Ordnance Survey (survey control points), Planning Authorities or Archaeological Units.

3.1.4 A copy of records produced by Envirocheck is presented in Appendix G. Envirocheck produce a wealth of factual database information. Although we can provide a discussion on each of the database topics, this would produce a very lengthy document, but some of these discussions would not be relevant to the aims of this report. As a consequence we have extracted some of the relevant topics and discussed them in this section of the report.

3.1.5 The data presented in the following report sections has primarily been extracted from the Envirocheck report.

3.2 Description of the site

3.2.1 The site is located within a predominantly residential area to the west of Rushden town centre. Topography in the area generally falls to the northeast, towards Wash Brook, the channel of which is located 344m to the north-east.

3.2.2 At the time of our investigations, the site was occupied by a used car sales business occupying an area of approximately 0.17 hectares. Site buildings comprised of a single storey office and vehicle workshop in the northern area, with a two storey masonry constructed building in the south-western corner, used for retail with accommodation at first floor level. The workshop was mainly comprised of an area for vehicle inspection and did not present inspection pit, the floor slab was observed in good and clean conditions. A storage area located behind the site office contained tools, timber pallets, empty liquid containers and drums. The majority of the site was covered in a mix of concrete, bituminous and compacted coarse gravel hardstandings. No vegetation was present on site.

3.2.3 Site levels generally present a slight inclination towards the north in line with the overall topography of the area. Site boundaries are defined by a timber fence of up to 2m in height to the northern and north-eastern boundary with a steel fence defining the western and southern boundary.

3.2.4 The site is bound to the west by Montague Street, to the south by Wellingborough Road and to the north and east by residential properties.

3.2.5 The photographs below show the site features at the time of our investigations.

Photograph 1

The site looking west showing workshop and garage

Photograph 2

The site looking south showing northern and central areas of the site with workshop to the west

Photograph 3

Photograph showing interior of existing workshop

Photograph 4

Photograph showing storage area located behind site office

3.2.2 A plan showing observed site features and location of exploratory points is presented on Drawing 02.

3.3 Injurious and invasive weeds and asbestos

3.3.1 Injurious and invasive weeds

3.3.1.1 The following weeds are controlled under the Weeds Act 1959:

- Common Ragwort
- Spear Thistle
- Creeping or Field Thistle
- Broad leaved Dock
- Curled Dock

3.3.1.2 Whilst it is not an offence to have the above weeds growing on your land, you must:

- Stop them spreading to agricultural land, particularly grazing areas or land used for forage, like silage and hay
- Choose the most appropriate control method for the your site
- Not plant them in the wild

Should you allow the spread of these weeds to another parties land, Natural England could serve you with an Enforcement Notice. You can also be prosecuted if you allow animals to suffer by eating these weeds.

3.3.1.3 In addition to the above, you must not plant in the wild or cause certain invasive and non-native plants to grow in the wild as outlined in the Wildlife and Countryside act 1981. It is an offence under section 14(2) of the act to 'plant or otherwise cause to grow in the wild' any plants listed in schedule 9, part II. This can include moving contaminated soil or plant cuttings. The offence carries a fine or custodial sentence of up to 2 years. The most commonly found invasive, non-native plants include:

- Japanese knotweed
- Giant hogweed
- Himalayan balsam
- Rhododendron ponticum
- New Zealand pigmyweed

You are not legally obliged to remove these plants or to control them. However, if you allow Japanese knotweed to spread to another parties land, you could be prosecuted for causing a private nuisance.

3.3.1.4 The presence of such weeds on site may have considerable effects on the cost / timescale in developing the site. Japanese knotweed can cause significant damage to buildings, roads and pavements following development, if untreated prior to development.

3.3.1.5 Our investigations exclude surveys to identify the presence of injurious and invasive weeds. We did not observe any obvious evidence the above species, however, we recommend specialists in the identification and procedures to deal with injurious and invasive weeds are appointed prior to commencement of any works on site or if appropriate purchase of the site.

3.3.2 Asbestos

3.3.2.1 Our investigations exclude surveys to identify the presence or indeed absence of asbestos on site. It should be noted that we did observe potential asbestos containing materials on site. Asbestos containing possible materials were observed forming the roof of the existing garage building and back shed building. We took precautions to avoid disturbance of these materials during our on-site activities and recommend a specialist be appointed to confirm or otherwise the presence of asbestos.

3.3.2.2 The presence of asbestos on site may have considerable effects on the cost / timescale in developing the site. There is good guidance in relation to Asbestos available on the Health and Safety Executive (HSE) web site.

3.4 History of the site

3.4.1 An attempt to trace the history of the site has been carried out by obtaining copies of old Ordnance Survey maps provided by Envirocheck. The recent history of the site based on published Ordnance Survey maps is summarised on the following table: -

Summary description of site history from Ordnance Survey maps

Date	Onsite	Offsite
1884-1885	Buildings recorded to be located at southern end of site.	Rushden village centre is located 600m to the south-east of the site. Surrounding areas generally in agricultural use. In addition, "Limekiln" is recorded 120m to the south of the site.
1900-1901	New buildings recorded at central and northern areas of the site.	Significant residential development in surrounding areas. 'Gas works' is recorded 750m to the north-east of the site and sewage works 700m to the north west. Sand pits are recorded 600m and 800m to the south and north-west of the site respectively. 'Wax factory' recorded 500m to the west. Higham Ferrers railway line recorded 175m to the north. "Limekiln" is no longer recorded.
1926-1927	No significant changes observed.	Further residential development has occurred in surrounding areas. "Boot and Shoe Factory" and associated tank recorded 15m to the east, 200m and 250m to the south and south-west respectively.
1938-1952	No significant changes observed.	Further residential development recorded 200m and beyond to the south and south-west.
1959-1965	Buildings at central and northern areas no longer recorded. 'Garage' is now recorded on site.	'Warehouse' is recorded 75m to the south-west, with 'Engineering works' recorded 110m to the south-east of the site. The Rushden/Higham Ferrers conurbation has extended to the north and south.

Summary description of site history from Ordnance Survey maps		
Date	Onsite	Offsite
1977-1990	No significant changes observed.	Further residential developments recorded in surrounding areas.
1993-2016	Buildings no longer recorded in the south-eastern area of the site.	New industrial development recorded to 750m to the north-west.

Table 3.4.1

3.4.2 Drawing showing existing onsite features together with historical overlie extracted from old Ordnance Survey maps in 1900, 1966 and 1993 are presented in Drawings 02a/b/c.

3.5 Geology and geohydrology of the area

3.5.1 Geology of the area

3.5.1.1 Envirocheck reproduce geological map extracts taken from the British Geological Survey (BGS) digital geological map of Great Britain at 1:50,000 scale (ref Appendix G). A summary of the recorded geological information for the site is presented in the table below:

Summary of Geology and likely aquifer containing strata					
Strata	Bedrock or superficial	Approximate thickness	Typical soil type	Likely permeability	Aquifer designation
Blisworth Limestone Formation	Bedrock	4 - 8m	Limestone	Permeable	Principal aquifer
Rutland Formation	Bedrock	8 – 12m	Mudstone	Marginally permeable	Secondary B aquifer

Table 3.5.1

(r) recorded aquifer designation
(a) assumed aquifer designation

3.5.1.2 Superficial deposits are the youngest geological deposits formed during the Quaternary, which extends back about 2.6 million years. They rest on older deposits or rocks referred to as bedrock. Soil types and assessments of permeability are based on geological memoirs, in combination with our experience of investigations in these soil types.

3.5.1.3 Principal aquifers are defined as deposits exhibiting high permeability capable of high levels of groundwater storage. Such deposits are able to support water supply and river base flows on a strategic scale.

3.5.2 Water abstractions

3.5.2.1 The closest groundwater abstraction point lies 462m to the west of the site with water abstracted for industrial processing. The closest surface water abstraction point lies 642m to the north of the site with water abstracted for general agriculture purposes.

3.5.3 Coal mining and brine extraction

3.5.3.1 The site is not recorded to be within an area affected by past or present coal mining, or minerals worked in association with coal or brine extraction (within the Cheshire Brine Compensation District).

3.5.4 Shallow mining and natural subsidence hazards

3.5.4.1 The British Geological Survey present hazard ratings for shallow mining and natural subsidence hazards. The site has the following ratings;

Table summarising mining and subsidence hazards

Hazard	Rating
Mining hazard in non-coal mining areas	No hazard
Potential for collapsible ground stability hazard	No hazard
Potential for compressible ground stability hazard	No hazard
Potential for ground dissolution stability hazard	Very low
Potential for landslide ground stability hazard	Very low
Potential for running sand ground stability hazard	No hazard
Potential for shrinking or swelling clay ground stability hazard	No hazard

Table 3.5.4

3.5.4.2 In addition to the above hazard ratings, a report completed by Ove Arup and Partners in December 1991, commissioned by the Department of the Environment (DoE) indicates where mining should be borne in mind when considered planning and development of land. The site is not recorded as lying in an area of conclusive rock mining as indicated by the report.

3.5.5 Borehole records

3.5.5.1 The British Geological Survey (BGS) retain records of boreholes formed from ground investigations carried out on a nationwide basis. The location of boreholes with records held by the BGS is recorded on the borehole map contained in Appendix H. We do not normally obtain copies of these records but can do on further instructions. There is normally a charge made by the BGS for retrieving and copying these records.

3.6 Landfill and infilled ground

3.6.1 One registered and two historic landfill sites are recorded in the area. The following table summarises the available records:

Summary of landfill sites

Landfill name	Type	Location	Waste authorised	Licence status
EMGAS, Shirley Road	Historical	693m NE	Inert	Non active
Not supplied	Historical	885m NW	Not supplied	Not supplied
Not supplied	Registered	963m NE	Ferrous and non-ferrous metal, tyres, batteries	Operational

Table 3.6.1

3.6.2 Old Ordnance Survey maps indicate seven quarry sites located within 1000m from the site which have apparently been backfilled. Nearest quarry site is located 763m to the south of the site and is recorded for extraction of sand. In addition, an area recorded as "limekiln" is recorded located 120m to the south of the site.

3.7 Radon

3.7.1 With reference to the Building Research Establishment (BRE) publication "Radon: guidance on protective measures for new buildings" (2007), the site is located where no protection is recommended.

3.7.2 The Building Research Establishment publication applies to all new buildings, conversions and refurbishments whether they are for domestic or non-domestic use.

3.7.3 It is noteworthy that the BRE and BGS / HPA information is based on statistical analysis of measurements made in dwellings in combination with geological units, which are known to emit radon. Therefore there is a risk for actual radon levels at the site to exceed the levels assessed by the BGS / HPA / BRE. Currently, the only true method of checking actual radon levels is by measurement within a building on the site over a period of several months. It should be noted that it is not currently a requirement of the Building Regulations to test new buildings for radon, however the BRE recommends testing on completion or occupation of all new buildings (domestic and non-domestic), extensions and conversions. Should you wish to undertake radon monitoring following completion of the development, we can provide proposals.

3.8 Flood risk

3.8.1 The site is not located within a fluvial flood plain. The site is not located within an area at risk of surface water flooding.

3.8.2 It should be noted that this information does not constitute a site specific Flood Risk Assessment (FRA), and a full FRA may be required for the development to support a planning application or satisfy planning conditions.

3.9 Enquiries with statutory undertakers

3.9.1 We have contacted the following Statutory Undertakers (SUs) to obtain copies of their records in order to avoid damaging their apparatus during our fieldwork activities: -

a) BT Openreach Ltd
b) National Grid
c) Anglian Water
d) Western Power Distribution

3.9.2 Copies of responses received prior to publication of this report are presented in Appendix F. These records have been obtained solely for the purposes described above. Some of these records have been obtained from the Internet and from our database without contacting the statutory undertaker direct. Occasionally, SU information is recorded on drawings larger than A3, and thus cannot be easily presented in this report. In such cases we will copy the correspondence but not incorporate the drawing in this report, and maintain the records on our office file.

3.9.3 In addition, we have visited the Linesearch web site (www.linesearch.org) which provides a report on national grid networks (National Gas and Electricity Transmission Networks). Again a copy of their report is presented in Appendix F.

3.9.4 Normally Statutory Undertakers drawings record the approximate location of their services. We recommend further on site investigations be undertaken to confirm the position of the apparatus and thus establish the effect on the proposed development and the necessity or otherwise for the permanent or temporary diversion of the service to allow the construction of the development to safely and successfully proceed.

3.9.5 It should be noted that statutory undertakers' records normally exclude private services.

3.10 Enquiries with local environmental health officers

3.10.1 We have contacted Local Authority Environmental Health Officers who report no issues associated with land contamination in the area local to the site.

4 Fieldwork

4.1 General

4.1.1 Fieldwork comprised the excavation of seven boreholes. Fieldwork was carried out on 18th March 2016.

4.1.2 A plan of the site showing observed/existing site features and position of exploratory points is presented on Drawing 02. The position of exploratory points relative to site development proposals is presented on Drawing 03. The position of exploratory points shown on these plans is approximate only and confirmation of these positions is subject to dimensional surveys, which is considered outside our brief.

4.1.3 The extent of fieldwork activities and position of exploratory points were determined by Soiltechnics.

4.1.4 Exploratory points were positioned to avoid known locations of underground services, to avoid possible location of proposed foundations but were also positioned to provide a reasonable coverage of the site. Prior to commencement of exploratory excavations an electronic cable locating tool was used to scan the area of the excavation. If we received a response to this equipment then the excavation would be relocated.

4.1.5 All soils exposed in excavations were described in accordance with BS EN ISO 14688 'Identification and Classification of soil' and BS EN ISO 14689 'Identification and classification of rock'.

4.2 Site restrictions

4.2.1 As the majority of the areas outside of the buildings were occupied by cars, locations of investigatory points were agreed prior fieldwork activities and limited to these positions.

4.3 Driven tube sampling

4.3.1 Boreholes DTS01 to DTS07 were formed using driven tube sampling equipment. Driven tube sampling comprises driving 1m long steel sample tubes which are screw coupled together or coupled to extension rods and fitted with a screw on cutting edge. The sample tubes are of various diameters, generally commencing with 100mm and reducing, with depth, to 50mm and include a disposable plastic liner which is changed between sampling locations in order to limit the risk of cross contamination. On completion of excavation the liner containing the sample is cut open and the soil sample logged by a geo-environmental engineer.

4.3.2 Samples for determination concentration of chemical contaminants are taken from samples obtained in the disposable tubes as sub-samples using stainless steel sampling equipment, which is cleaned with de-ionised water.

4.3.3 The driven tube sampler obtains samples under category A allowing laboratory test quality classes 3 to 5 as described in BS EN ISO 22475-1:2006.

4.3.4 Surface concrete was either broken out or cored prior to excavation of boreholes DTS03 and DTS04. The concrete surface was reinstated on completion.

4.3.5 Combined gas and groundwater monitoring standpipes were installed in boreholes DTS02 and DTS04. The standpipes were installed following the recommendations of BS8576:2013 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)'. Details of the standpipe installation are recorded on Drawing 04.

4.3.6 Records of boreholes formed using driven tube sampling techniques are presented in Appendix B.

4.4 Sampling strategy

4.4.1 Environmental

4.4.1.1 Details of sampling with respect to contamination issues are described in Section 8.

4.4.2 Sample retention

4.4.2.1 Samples are stored for a period of one month following issue of this report unless otherwise required.

5 Ground conditions encountered

5.1 Soils and rocks

5.1.1 The exploratory excavations encountered a profile of soils considered to be Made Ground overlying Head and/or the Blisworth Limestone Formation.

5.1.2 Made Ground was encountered in all exploratory locations to depths in the range of 0.60m to 1.0m. Made Ground soils generally comprised of firm, low to medium strength brown to dark brown mottled dark grey slightly silty gravelly sandy clay. Gravels consisted of angular to sub-rounded fine to coarse flint, occasional fragments of brick, concrete, tile, charcoal and rare bituminous coated material. Locally in DTS03, Made Ground deposits consisted of red brown and grey gravels of brick and concrete.

5.1.2 Head deposits were encountered in all exploratory locations with the exception of DTS03 to depths in the range of 1.7m to 2.2m where the full thickness was proven. Head deposits generally comprised of firm to stiff height to very high strength brown to light brown slightly silty slightly sandy slightly gravelly clay. Gravel consisted of fine to coarse sub-angular to rounded flint and angular fine to coarse limestone.

5.1.3 The Blisworth Limestone Formation was encountered in all locations to depths beyond the limit of the boreholes. The Blisworth Limestone deposits generally comprised of weathered fine and coarse soils grading into probably bedded limestone. The weathered limestone comprised of light brown to light grey clayey sand and gravel or firm to stiff light brown to orange brown slightly silty sandy gravelly clay with gravel of angular tabular limestone. Bedded limestone was encountered as extremely weak to weak light grey limestone.

5.2 Groundwater

5.2.1 No groundwater inflows were observed in any of the exploratory excavations.

5.2.2 It should be noted that water levels will vary depending generally on recent weather conditions and only long term monitoring of levels in standpipes will provide a measure of seasonal variations in groundwater levels.

6 Laboratory testing

6.1 Chemical testing

6.1.1 Laboratory testing was carried out as deemed necessary and carried out using the following techniques:

Using inductively coupled plasma mass spectrometry (ICP-MS), determination of concentration of metals, semi-metals and soluble sulphate

Using gas chromatography flame ionisation detection methods (GC–FID), determination of concentration of petroleum hydrocarbons (TPH)

Using gas chromatography flame ionisation detection methods (GC–FID), determination of concentration of polycyclic aromatic hydrocarbons (PAH)

Screening for presence/absence of asbestos in soils

Using electromagnetic measurement, determination of pH

Following methods described in the Environment Agency publication 'Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures' (April 2005) – suite of testing in accordance with Table 2.1.

6.2.2 Laboratory testing was carried out by an independent specialist testing house, which operates a quality assurance scheme. Copies of laboratory test result certificates are presented in Appendix C.

7 Chemical contamination

7.1 Contaminated land, regulation and liabilities

7.1.1 Statute

7.1.1.1 Part IIA of the Environment Protection Act 1990 became statute in April 2000. The principal feature of this legislation is that the hazards associated with contaminated land should be evaluated in the context of a site-specific risk based framework. More specifically contaminated land is defined as:

> *"*any land which appears to the local authority in whose area it is situated to be in such a condition, by reasons of substances in, on or under the land, that:
>
> a) Significant harm is being caused or there is a significant possibility of such harm being caused; or
> b) Pollution of controlled waters is being or is likely to be caused*"*.

7.1.1.2 Central to the investigation of contaminated land and the assessment of risks posed by this land is that:

i) There must be contaminants(s) at concentrations capable of causing health effects (Sources).
ii) There must be a human or environmental receptor present, or one which makes use of the site periodically (Receptor); and
iii) There must be an exposure pathway by which the receptor comes into contact with the environmental contaminant (Pathway).

7.1.1.3 In most cases the Act is regulated by Borough or District Councils and their role is as follows:

i) Inspect their area to identify contaminated land
ii) Establish responsibilities for remediation of the land

iii) See that appropriate remediation takes place through agreement with those responsible, or if not possible:
- by serving a remediation notice, or
- in certain cases carrying out the works themselves, or
- in certain cases by other powers

iv) keep a public register detailing the regulatory action which they have taken

7.1.1.4 For "special" sites the Environment Agency will take over from the Council as regulator. Special sites typically include:-

- Contaminated land which affects controlled water and their quality
- Oil refineries
- Nuclear sites
- Waste management sites

7.1.2 Liabilities under the Act

7.1.2.1 Liability for remediation of contaminated land would be assigned to persons, organisations or businesses if they caused, or knowingly permitted contamination, or if they own or occupy contaminated land in a case where no polluter can be found.

7.1.3 Relevance to predevelopment conditions

7.1.3.1 For current use, Part IIA of the Environmental Protection Act 1990 provides the regulatory regime. The presence of harmful chemicals could provide a 'source' in a 'pollutant linkage' allowing the regulator (local authority or Environment Agency) to determine if there is a significant possibility of harm being caused to humans, buildings or the environment. Under such circumstances the regulator would determine the land as 'contaminated' under the provision of the Act requiring the remediation process to be implemented.

7.1.4 Relevance to planned development

7.1.4.1 The developer is responsible for determining whether land is suitable for a particular development or can be made so by remedial action. In particular, the developer should carry out an adequate investigation to inform a risk assessment to determine:

a) Whether the land in question is already affected by contamination through source – pathway – receptor pollutant linkages and how those linkages are represented in a conceptual model
b) Whether the development proposed will create new linkages e.g. new pathways by which existing contaminants might reach existing or proposed receptors and whether it will introduce new vulnerable receptors, and
c) What action is needed to break those linkages and avoid new ones, deal with any unacceptable risks and enable safe development and future occupancy of the site and neighbouring land?

7.1.4.2 Building control bodies enforce compliance with the Building Regulations. Practical guidance is provided in Approved documents, one of which is Part C, 'Site preparation and resistance to contaminants and moisture' which seeks to protect the health, safety and welfare of people in and around buildings, and includes requirements for protection against harm from chemical contaminants.

7.1.5 Pollution of controlled waters

7.1.5.1 Part IIA of the Environment Protection Act 1990, defines pollution of controlled waters as

> 'The entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter'

7.1.5.2 Paragraphs A36 and A39 of statutory guidance (DETR 2000) further define the basis on which land may be determined to be contaminated land on the basis of pollution of controlled waters.

> 'Before determining that pollution of controlled waters is being, or likely to be, caused, the Local Authority should be satisfied that a substance is continuing to enter controlled waters, or is likely to enter controlled waters. For this purpose, the local authority should regard something as being likely when they judge it more likely than not to occur'
>
> 'Land should not be designated as contaminated land where:
>
> a) A substance is already present in controlled waters:
> b) Entry into controlled waters of that substance from the land has ceased, and
> c) It is not likely that further entry will take place.
>
> Substances should be regarded as having entered controlled waters where:
>
> a) They are dissolved or suspended in those waters; or
> b) If they are immiscible with water, they have direct contact with those waters, or beneath the surface of the waters'

7.1.5.3 Controlled waters are defined in statute to be:

> 'territorial waters which extend seawards for 3 miles, coastal waters, inland freshwaters, that is to say, the waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and groundwaters, that is to say, any waters contained in underground strata.'

7.1.6 Further information

7.1.6.1 The above provides a brief outline as regards current statute and planning controls. Further information can be obtained from the Department for the Environment, Food and Rural Affairs (DEFRA) and their Web site www.defra.gov.uk.

7.2 Objectives and procedures

7.2.1 Objectives

7.2.1.1 This report section discusses investigations carried out with respect to chemical contamination issues relating to the site. The investigations were carried out to determine if there are any liabilities with respect to Part IIA of the Environment Protection Act. As stated in Section 2.4.2, the investigation process followed the principles of BS10175: 2011 'Investigation of potentially contaminated sites – Code of Practice', with the investigation combining a desk study (preliminary investigation) together with the exploratory and main investigations (refer BS10175: 2011 for an explanation).

7.2.1.2 This section of the report produces 'Conceptual models' based on investigatory data obtained to date. The conceptual model is constructed by identification of contaminants and establishment of feasible pathways and receptors. The conceptual model allows a risk assessment to be derived. Depending upon the outcome of the risk assessment it may be necessary to carry out remediation and/or further investigations with a view to eliminating, reducing or refining the risk of harm being caused to identified receptors. If appropriate, our report will provide recommendations in this respect.

7.2.1.3 Clearly we must consider the current pre-development condition, establishing risks which may require action to render the site safe to all relevant (current) receptors meeting the requirements of current legislation (Part IIA of the Environmental Protection Act 1990).

7.2.1.4 Definition of terms used in the preceding paragraph and subsequent parts of this section of the report are presented in Appendix A.

7.2.2 Procedure to assess risks of chemical contamination

7.2.2.1 For the purposes of presenting this section of this report, we have adopted the following sequence in assessing risks associated with chemical contamination.

Table outlining sequence to assess risk associated with chemical contamination

Conceptual model element	Contributory information	Outcome
Receptor	Development categorisation	Identification of receptors at risk of being harmed Method of analysing test data Criteria for risk assessment modelling
Pathways	Geology and ground conditions Development proposals	Identification of critical pathways from source to receptor
Source	Previous site history Desk study information Site reconnaissance Fieldwork observations	Testing regime Identification of a chemical source Analysis of test data and other evidence

Table 7.2.2

7.2.2.2 We have adopted, in general, the procedures described in CIRIA C552 'Contaminated land risk assessment - a guide to good practice' in deriving a risk assessment. Initially we have carried out a 'phase 1 assessment' based on desk study information and site reconnaissance, to produce an initial conceptual model and thus a preliminary risk assessment. This model / assessment is then used to target fieldwork activities and laboratory testing, with the results of this part of the investigation used to allow a phase 2 assessment to be produced by updating the conceptual model and refining the risk assessment.

7.3 Development characterisation and identified receptors

7.3.1 Site characterisation

7.3.1.1 The nature of the site has a significant influence the likely exposure pathways between potentially contaminated soils and potential receptors. The following table summarises elements which characterise the site based on site observations and desk study information.

Summary of site characteristics		
Element	Source / criteria	Characteristic
Current land use	Observations	Site currently used as a car dealership including a vehicle workshop
Future land use	Advice	Residential development which includes domestic gardens
Site history	Desk study	Residential developments recorded since 1884. Garage recorded on site since c1960
Geology	Desk study /Site investigation	Made Ground soils overlying Blisworth Limestone
Ground water	Aquifer potential	Principal aquifer within Blisworth Limestone
	Abstractions	Nearest located 462m to the west for industrial uses.
	Source protection zone	Site not within source protection zone
Surface waters	Location	Nearest located 344m to the NE of the site
	Abstractions	Nearest located 642m to the north of the site

Table 7.3.1

7.3.2 Identified receptors

7.3.2.1 The principal receptors subject to harm caused by any contamination of the proposed development site are as follows.

Principle Receptor	Detail
Humans	Users of the current site
	End user of the developed site
	Construction operatives and other site investigators
Vegetation	Plants and trees, both before and after development
Controlled waters	Surface waters (Rivers, streams, ponds and above ground reservoirs)
	Ground waters (used for abstraction or feeding rivers / streams etc)
Building materials	Materials in contact with the ground

Table 7.3.2

This section of the report assesses those receptors listed above.

7.3.3 Human receptors

7.3.3.1 The Contaminated Land Exposure Assessment (CLEA) model can be used to derive guideline values, against which land quality data can be compared to allow an assessment of the likely impacts of soil contamination on humans. The parameters used within the model can be chosen to allow guideline values to be derived for a variety of land uses and exposure pathways. For example, a construction worker is likely to be exposed in different ways and for different durations than an adult in a residential setting.

7.3.3.2 On the basis that the current site is restricted to commercial activities, an adult is considered to be the appropriate critical receptor. Following completion of the proposed residential development, the critical site user (receptor) is considered to be a child under the age of 6 years. This criterion has been used in the conceptual model for the current and future site use. Our assessment also considers construction operatives as adult receptors.

7.3.4 Vegetation receptors

7.3.4.1 Soil contaminants can have an adverse effect on plants if they are present at sufficient concentrations. The effects of phytotoxic contaminations include growth inhibition, interference with natural processes within the plant and nutrient deficiencies.

7.3.4.2 Vegetation is not currently present on site. On the assumption that new planting will be incorporated into the proposed development, vegetation will be a sensitive receptor under future site conditions.

7.3.5 Water receptors

7.3.5.1 The site is overlying a principal aquifer located within the Blisworth Limestone, groundwater is therefore a potential sensitive receptor. The nearest surface water is located 344m to the north–east of the site. This watercourse is considered too remote from the site to act as a potential sensitive surface water receptor.

7.3.6 Summary of identified receptors

7.3.6.1 Based on the above assessments, the following table summarises identified and critical receptors.

Table summarising identified (viable) receptors				
Principle Receptor	Detail	Viable and critical receptors		
		Viability and justification		Critical receptor
Humans	Users of the current site	Yes	Used car sales	Adult
	End user of the developed site	Yes	Residential development with gardens	Child
	Construction operatives and other site investigators	Yes		Adult
Vegetation	Current site	No	Not present	Vegetation
	Developed site	Yes	Proposed vegetation and gardens	Vegetation
Controlled waters	Surface waters (Rivers, streams, ponds and above ground reservoirs)	No	Nearest located 344m	Surface waters
	Groundwaters (used for abstraction or feeding rivers / streams etc.)	Yes	Principal aquifer within Blisworth Limestone	Groundwater
Table 7.3.6				

7.4 Identification of pathways

7.4.1 Pathways to human receptors

7.4.1.1 Guidance published by the Environment Agency in Science Report SC050021/SR3 'Updated technical background to the CLEA model' provides a detailed assessment of pathways and assessment and human exposure rates to source contaminants. In summary, there are three principal pathway groups for a human receptor:

Table summarising likely pathways	
Principal pathways	Detail
Ingestion through the mouth	Ingestion of air-borne dusts
	Ingestion of soil
	Ingestion of soil attached to vegetables
	Ingestion of home grown vegetables
Inhalation through the nose and mouth.	Inhalation of air-borne dusts
	Inhalation of vapours
Absorption through the skin.	Dermal contact with dust
	Dermal contact with soil
Table 7.4.1	

7.4.1.2 The site is currently occupied by a car dealership and associated workshop for minor vehicle repairs. Based on this, pathways to current site users do not include those associated with consumption of soil attached to vegetables or home grown vegetables.

7.4.1.2 All exposure pathways will be present following completion of the proposed residential development.

7.4.1.3 A summary of our pathway assessment is presented in Section 7.4.4.

7.4.2 Pathways to vegetation

7.4.2.1 Guidance published by the Environment Agency in Science Report SC050021/SR (Evaluation of models for predicting plant uptake of chemicals from soil) provides a detailed assessment of plant uptake pathways. In summary, plants are exposed to contaminants in soils by the following pathways:

Passive and active uptake by roots.
Gaseous and particulate deposition to above ground shoots.
Direct contact between soils and plant tissue.

7.4.2.2 All of the above routes of exposure are considered to be present for vegetation.

7.4.3 Pathways to controlled waters

7.4.3.1 A number of pathways exist for the transport of soil contamination to controlled waters. A summary of these pathways is presented below:

Percolation of water through contaminated soils.
Near-surface water run-off through contaminated soils.
Saturation of contaminated soils by flood waters.

7.4.3.2 Percolation of water through contaminated soils is considered as a potential pathway to the underlying Principal aquifer as soils on site are generally permeable.

7.4.3.3 The site does not lie within a floodplain therefore saturation by floodwaters is not a viable exposure pathway

7.4.4 Summary of identified likely pathways

7.4.4.1 Based on the above assessments, the following table summarises likely pathways of potential chemical contaminants at the site to identified receptors.

Table of likely pathways		
Receptor group	Critical receptor	Pathway
Proposed site users	Child	Ingestion air-borne dusts
		Ingestion of soil.
		Ingestion of soil attached to vegetables
		Ingestion of home grown vegetables
		Inhalation air-borne dusts
		Inhalation of vapours
		Dermal contact with dust
		Dermal contact with soil
Current site users and construction operatives	Adult	Ingestion of air-borne dusts
		Ingestion of soil
		Inhalation of air-borne dusts
		Inhalation of vapours
		Dermal contact with dust
		Dermal contact with soil
Vegetation		Root uptake, deposition to shoots and foliage contact.
Controlled waters	Groundwater	Percolation of water through contaminated soils

Table 7.4.4

7.5 Assessment of sources of chemical contamination

7.5.1 Introduction

7.5.1.1 Initially, potential sources of contamination are assessed using the following elements of the investigation process.

History of the site
Desk study information
Site reconnaissance
Geology
Fieldwork

These elements will dictate a relevant soil/water testing regime to quantify possible risks of any identified contaminative sources which may harm identified receptors.

7.5.2 Source assessment – History of the site

7.5.2.1 The history of the site and its immediate surroundings based on published Ordnance Survey maps is described in Section 3.

7.5.2.2 Based on published historical maps, the site is recorded as a 'Garage' since c1972. This site use is included in Industry profiles - 'Road vehicle fuelling, service and repair (garages and filling stations)', published by the Department of the Environment, which provides an indication of the type of chemical contaminants likely to be used by the industry.

7.5.2.3 Clearly, the possibility of potential soil contamination from this land use would be dependent upon the management of the potential contaminants within the business. An assessment of the likelihood of this land use impacting the site is summarised in the table below:

Table summarising results of source assessment based on DoE Industry Profile 'Road vehicle fuelling, service and repair (garages and filling stations)'

Historical/ current activity	Contaminant(s)	Risk assessment	Probability of source	Testing required?
Garage repairing services	Metals, TPH, asbestos	Vehicle repair facilities present on site	Likely	Yes
Workshops	Metals, TPH, PAH	Workshop present on site	Likely	Yes
Vehicle washing areas	Acids/alkalis, TPH	No vehicle washing area noted on site	Low likelihood	No
Paint shops	Metals, solvents	Evidence of spraying not observed on site	Low likelihood	No
Refuelling	TPH, BTEX	Underground fuel tanks present	Possible	Yes

Table reference 7.5.2.3

7.5.2.4 Historical maps indicate the presence of a fuel pump island in the north-western part of the site. We understand from the current site occupier that underground fuel storage tanks remain in-situ in this area of the site, and that the tanks have been decommissioned by filling with concrete. We were unable to access any fill-point covers to the tanks in order to verify this for ourselves.

7.5.2.5 It is noteworthy that apparent residential buildings occupied the majority of the site prior to c1960. It is possible that these properties had basements which would likely have been backfilled during redevelopment of the site.

7.5.2.6 Historical site features as recorded on 1900, 1966 and 1993 Ordnance Survey maps are overlaid onto the existing site features on Drawings 02a, 02b and 02c.

7.5.3 Source assessment – Desk study information

7.5.3.1 Envirocheck presents a detailed database of environmental information in relation to the site including;

Pollution incidents
Landfill sites
Trading activities

7.5.3.2 Based on the Envirocheck data (refer Appendix G) the site has no recorded history of any pollution event or is located in close proximity to a landfill site.

7.5.3.3 The Trade Directory records the site as occupied by a car dealership.

7.5.4 Source assessment – Site reconnaissance

7.5.4.1 A full description of the site and observed adjacent land uses is provided in Section 3 of this report. A plan summarising observations made on site during our site reconnaissance visit is presented on Drawing 02.

7.5.4.2 At the time of our investigation, the site was occupied by a used car dealership, including a vehicle workshop. An area for the storage of liquid containers and drums was present in the northern part of the site. Likely contaminants associated with these on-site sources and an assessment of the likelihood of the sources impacting the site is presented in table 7.5.2.3 above.

7.5.5 Source assessment – Geology

7.5.5.1 The geological map of the area indicates the topography local to the site is formed in deposits of the Blisworth Limestone Formation. Typically, and in our experience, the Blisworth Limestones do not exhibit any abnormal concentrations of naturally occurring chemical contaminants.

7.5.6 Source assessment - Fieldwork observations

7.5.6.1 Made Ground soils containing materials such as brick, slate, charcoal and concrete were encountered in exploratory excavations across the site, indicating the possible presence of a source of chemical contamination.

7.5.6.2 Slight hydrocarbon odours were noted in boreholes DTS04 and DTS07 at depths of 0.2m and 0.3m respectively.

7.5.6.3 Fragments of potential asbestos containing material were noted near surface in borehole DTS01.

7.5.6.4 No evidence for the presence of hydrocarbons (i.e. odours or staining of soils) was noted at depth in boreholes DTS03 and DTS04, located adjacent to the suspected location of underground fuel storage tanks.

7.5.6.5 Based on the paragraphs above, we have identified the following potential sources of contamination:

Table summarising results of source assessment

Source	Origin of information	Possible contaminant	Probability of risk occurring	Likely extent of contamination
On site				
Made Ground soils affected by hydrocarbon contamination	Site investigations /Desk study	TPHs	Likely	Site wide
Past site uses-residential properties	Desk study	PAHs, TPHs	Low likelihood	South and eastern areas of the site
Past site use-formed garage	Desk study	PAHs, TPHs, BTEX Asbestos, Metals	Likely	Site wide
Underground storage tanks	Desk study, site investigations	TPHs	Possible	North-eastern quadrant
Current use of the site	Desk study, site investigations	PAHS, TPHs, BTEX, Asbestos, Metals	Likely	Site wide

Table reference 7.5.7

7.6 Initial Conceptual Model

7.6.1 Based on our assessment of potential contaminative sources, identified receptors and viable pathways to receptors described in preceding paragraphs, we have produced an initial conceptual model in the form of a table which is presented in Appendix E.

7.6.2 Based on the conceptual model there are risks which exceed the low category which in our opinion are unacceptable, and require either remedial action or further investigation by laboratory testing of soil / water samples to refine the risk assessment.

7.7 Laboratory testing

7.7.1 Testing regime – Human receptors

7.7.1.1 In order to carry out a quantitative assessment, five samples were submitted for measurement of commonly occurring organic and inorganic contaminants. In addition, and based on our source assessment, five samples were submitted for measurement of total petroleum hydrocarbons and BTEX compounds (benzene, toluene, ethylbenzene and xylenes.

7.7.1.2 Five samples were also submitted for screening for the presence/absence of asbestos and asbestos containing material.

7.7.1.3 Obviously, additional testing (quantity and types) would allow a more accurate risk assessment to be made. The results of laboratory determination of concentration of chemical contaminants are presented in Appendix C. The following table summarises the scheduled testing, in relation to soil types and identified receptors under consideration of the conceptual model.

Table summarising scheduled testing (human receptors)

Sample origin	Sample type	Strata	Targeted sampling	Non targeted sampling	Scheduled testing	Critical receptor
DTS01 0.2m	Soil	Made Ground		✓	Metal, PAHs, Asbestos	All human receptors
DTS02 0.2m				✓	Metal, PAHs, Asbestos	
DTS03 0.3m			✓		TPHs	
DTS04 0.2m				✓	Metal, PAHs, Asbestos,	
DTS04 0.2m			✓		TPHs	
DTS05 0.1m				✓	Asbestos	
DTS06 0.3m				✓	Metal, PAHs, Asbestos, TPHs	
DTS06 0.5m				✓	TPHs	
DTS07 0.3m				✓	Metal, PAHs, Asbestos, TPHs	

Table 7.7.1.4

7.7.2 Testing regime – Water receptors

7.7.2.1 With reference to our source assessment and initial conceptual model, a total of six samples were submitted for measurement of leachable concentrations of organic and inorganic contaminants including three samples submitted for measurement of leachable TPH. The following table summarises the scheduled testing in relation to soil types and identified receptors under consideration of the conceptual model:

Table summarising scheduled testing (water receptors)

Sample origin	Sample type	Strata	Targeted sampling	Non targeted sampling	Scheduled testing	Critical receptor
DTS01 0.2m	Leachate	Made Ground		✓	Metal, PAHs	Controlled waters
DTS02 0.2m				✓	Metal, PAHs	
DTS03 0.3m			✓		TPHs	
DTS04 0.2m			✓		TPHs	
DTS06 0.3m				✓	TPHs	
DTS07 0.3m				✓	Metal, PAHs	

Table 7.7.2.1

7.7.2.2 It should be noted that we have only scheduled three samples for laboratory determination of leachable concentrations of contaminants described above. This in our opinion is the minimum to assist in the risk assessment. Further laboratory testing would increase the accuracy of the risk assessment.

7.7.3 Criteria for assessment of test data – Human receptors

7.7.3.1 Assessment of laboratory test data has been carried out with reference to current nationally recognised documents listed in the final page of Appendix A. Due to changes in guidance on contaminated land, items 6-8 and item 10 in the document listing above have been withdrawn. In the absence of alternative guidance however we have used these documents. Where new guidance is available, this has been followed in preference to superseded guidance.

7.7.3.2 The Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have derived Suitable for Use Levels (S4ULs) which are presented in 'The LQM/CIEH S4ULs for Human Health Risk Assessment' (2015). S4ULs have been used as a screening tool to assess the risks posed to the health of humans from exposure to soil contamination in relation to appropriate land uses. Where published S4ULs are not available, we have adopted C4SLs (Category for Screening Levels) produced by DEFRA or SGVs (Soil Guideline Values) as appropriate. In the absence of any of these criteria we have adopted Soil Screening Values (SSV) derived by Soiltechnics and by Atkins (SSV^{ATK}). The CLEA model used to derive SSVs has been used with toxicology data presented by the EA, LQM/CIEH and Atkins (in that order of preference). SSVs produced by Atkins are presented on their $ATRISK^{SOIL}$ website.

7.7.3.3 S4ULs, C4SLs, SGVs, SSVs and SSV^{ATK}s represent 'intervention values'; indications to an assessor that soil concentrations above these levels might present an unacceptable risk to the health of site users. These guideline values have been produced using conceptual exposure models, which use assumptions and are applied to differing end uses of land. If the values are exceeded, it does not necessarily imply there is an actual risk to health and site-specific circumstances should be taken into account. Conversely, where a critical pathway or chemical form of the contaminant has not been evaluated, a risk may be present even if the adopted guideline value has not been exceeded.

7.7.3.4 For evaluation of test data in relation to polycyclic aromatic hydrocarbon (PAH), phenols and total petroleum hydrocarbon (TPH) contamination, we have compared measured concentrations with corresponding S4ULs. The S4UL fractions are dependent on the Soil Organic Matter (SOM) content of the soils. We have adopted the relevant guideline values based on SOM testing.

7.7.3.5 We have followed procedures outlined by the CIEH to compare measured concentrations of metals and PAH contaminants against guideline values. TPH contamination results are compared directly with the relevant guideline values. The guidance presents an approach to data analysis and includes the examination of data for potential outliers, assessment of the normality of the test data and the calculation of a 95% Upper Confidence Limit (UCL). The UCL provides an estimate of the population mean, based on test data, with a 95% confidence that the actual mean does not exceed this value. The UCL is compared to the guideline value for the site.

7.7.3.6 We have adopted a commercial/industrial land use for current site users and a residential with gardens land use for proposed end users of the site.

7.7.4 Criteria for assessment of test data – Construction operatives

7.7.4.1 In the absence of guidelines we have adopted industrial guideline values for assessment of construction operatives.

7.7.5 Criteria for assessment of test data – Vegetation

7.7.5.1 Guidance published by Forest Research in "BPG Note 5 - Best Practice Guidance for Land Regeneration" suggests that a residential without plant uptake or industrial/commercial CLEA model should be adopted for this receptor although specific guideline values are provided for copper and zinc at 130mg/kg and 300mg/kg respectively. As a practice we have adopted the industrial / commercial CLEA model for assessment of test data for vegetation.

7.7.5.2 It is difficult to quantify the phytotoxity of a contaminant as large variations exist between plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Due to the complexities of the effects of soil contamination on different plant species, we recommend that the test results presented in this report are passed to a landscape architect for the selection of suitable planting.

7.7.6 Criteria for assessment of test data – Controlled waters

7.7.6.1 For interpretation of test data in relation to water receptors we have directly compared measured values with the Environmental Quality Standards (EQS) and UK Drinking Water Standards (UKDWS). In the absence of EQS or UKDWS we have adopted World Health Organisation Drinking Water Guidelines (WHODWG).

7.7.7 Evaluation of test data – Human receptors

7.7.7.1 Tables summarising and analysing test data are presented in Appendix D. The following table summarises the outcome of the analyses.

Table Summarising assessment of test data for Human receptors

Analysis tables	Receptor group	Critical receptor	CLEA model	Inorganic contaminants	Organic contaminants
1 and 2	Current site users and construction operatives	Adult	Industrial/ commercial	No exceedances	No exceedances
3 and 4	Future site users	Child	Residential with plant uptake	Beryllium, lead	Benzo(a)pyrene, benzo(a) anthracene, benzo(b) fluoranthene, chrysene, dibenzo(a,h) anthracene

Table 7.7.7.1

7.7.7.2 With reference to tables 3 and 4 in Appendix D, analysis of chemical test data with respect to critical (child) receptors for current and future site uses indicates all measured concentrations of selected contaminants are below relevant adopted guideline values with the exception of beryllium, lead and a number of PAH congeners.

7.7.7.3 Beryllium was measured at concentrations in the range of <1.0 to 2.2mg/kg with 2 of 5 samples exceeding the S4UL of 1.7mg/kg. The mean value of 1.5mg/kg is below the S4UL while the 95% UCL of 2.8mg/kg exceeds the S4UL. The elevated concentrations of beryllium were measured in samples of Made Ground from boreholes DTS04 and DTS07. Both samples were noted to display hydrocarbon odours.

7.7.7.4 Lead was measured at concentrations in the range of 22.0 to 430mg/kg with 3 of 5 samples exceeding the lower bound C4SL of 82mg/kg. The mean value and 95% UCL also exceed the C4SL. The elevated concentrations of lead were measured in samples of Made Ground from borehole DTS01, DTS04 and DTS07.

7.7.7.5 Elevated concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene and dibenzo(a,h)anthracene were measured in samples of Made Ground from across the site.

7.7.7.6 Asbestos (chrysotile and crocidolite) was detected in a sample of Made Ground from borehole DTS01.

7.7.7.7 Concentrations of TPH were measured at below residential S4ULs values.

7.7.7.8 Based on the above, concentrations of inorganic and organic contaminants and the presence of asbestos in Made Ground soils pose a potential risk to the health of future site users. Further investigation and/or remediation is required, which is discussed further in Section 7.8.2 below.

7.7.8 Evaluation of test data – Vegetation

7.7.8.1 Comparison of test data with guideline values is presented on Tables 5 and 6 in Appendix D. None of the measured concentrations exceed the adopted guideline values with the exception of lead, copper, benzo(a)pyrene and dibenzo(a,h)anthracene.

7.7.8.2 It is difficult to quantify the phytotoxity of a contaminant as large variations exist between plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Due to the complexities of the effects of soil contamination on different plant species, we recommend that the test results presented in this report are passed to a landscape architect for the selection of suitable planting.

7.7.9 Evaluation of test data – Controlled waters

7.7.9.1 Inorganic contaminants

7.7.9.1.1 With reference to table 7 in Appendix D, none of the measured concentrations of inorganic contaminants exceed the relevant guideline outlined in Section 7.7.6.

7.7.9.2 Organic contaminants (polycyclic aromatic hydrocarbons)

7.7.9.2.1 For the analysis of PAH contamination, the sum of the following contaminants has been compared to a UKDWS.

Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(ghi)perylene
Indeno(1,2,3-cd)pyrene

7.7.9.2.2 The summed concentration of the PAH ‘suite’ exceeds the UKDWS in a sample of Made Ground from borehole DTS01. The leachable concentration of benzo(a)pyrene also exceed its respective guideline value within this sample.

7.7.9.3 Organic contaminants (total petroleum hydrocarbons)

7.7.9.3.1 The leachable concentration of TPH exceeds the UKDWS in a sample of Made Ground from borehole DTS03.

7.7.9.4 Summary

7.7.9.4.1 Based on the above, leachable concentrations of PAH and TPH pose a potential risk to controlled waters. This is discussed further in Section 7.8 below.

7.8 Updated conceptual model

7.8.1 Having now completed analysis of laboratory testing, we can now update our conceptual model which is presented in Appendix E.

7.8.2 Human receptors

7.8.2.1 Concentrations of organic and inorganic contaminants have been measured at above guideline values for the proposed residential end use. Asbestos has also been identified within the Made Ground at one location.

7.8.2.2 As the site is currently covered with buildings and hardstandings, soils will need to be imported to site to provide a growth medium in gardens and landscaped areas. The presence of soil contaminants at above guideline values means that the soils will need to be placed to a suitable thickness (as specified in Section 7.9 below).

7.8.3 Construction operatives

7.8.3.1 Exposure to asbestos in soils poses a potential risk to the health of construction operatives. These risks should be assessed through the construction phase health and safety plan.

7.8.4 Water receptors

7.8.4.1 Leachable organic contaminants have been measured at elevated concentrations at two exploratory locations (DTS01 and DTS03). These contaminants are considered to pose a risk of harm to the underling principal aquifer. The current level of testing does not afford a sufficient degree of confidence that similar leachable concentrations are not present elsewhere on site. At this stage, we recommend one of the following actions is taken:

1. Removal of Made Ground soils from all garden, landscaped and permeable hardstanding areas.

   OR

2. Additional leachate testing of Made Ground soils to delineate zone of elevated leachable organic contaminants. It should be noted that removal of Made Ground may still be required following the results of additional leachate testing.

7.8.5 Underground storage tanks (UST)

7.8.5.1 The results of investigations to date do not indicate the presence of any significant near surface fuel spills in the areas around the underground storage tanks, or in soils adjacent to the tanks. It has not however been possible to determine whether any leakage has occurred directly below the tanks. We recommend that removal of the tanks is carried out under a watching brief to assess the presence and/or significance of any hydrocarbon impacted soils.

7.9 Remedial action

7.9.1 Based on the above we recommend the following action is taken:-

a) Removal of Made Ground from garden, soft landscaped and permeable paved areas followed by importation of soils to restore levels and provide a growth medium in garden and landscaped areas. Details of the recommended remediation (in the form of a statement/specification) are provided in Section 11.

b) Removal of the UST by a suitably qualified contractor under a watching brief.

c) Adoption of adequate hygiene precautions for construction operatives.

7.9.2 Subject to a favourable outcome of additional leachate analysis, the requirement to remove Made Ground from garden, soft landscaped and permeable paved areas may not be necessary (refer Section 7.8.4).

7.10 Risk assessment summary and recommendations

7.10.1 Based on our assessments described above, we can provide the following summary and recommendations for each identified receptor.

7.10.2 Current site users

7.10.2.1 Ground conditions at the site pose a low risk to the health of current site users.

7.10.3 End users

7.10.3.1 Due to the presence of elevated concentrations of inorganic and organic contaminants and the presence of asbestos in Made Ground soils, remedial measures are required to reduce risks to the health of future site users, and to render the site suitable for residential use

7.10.4 Construction operatives and other site investigators

7.10.4.1 The risk of damage to health of construction operatives and other site investigators is, in our opinion, low. As a precautionary approach, however, we recommend adequate hygiene precautions are adopted on site. Such precautions would be:-

- Wearing protective clothing particularly gloves to minimise ingestion from soil contaminated hands.
- Avoiding dust by dampening the soils during the works.
- Wearing masks if processing produce dust.

7.10.4.2 Guidance on safe working practices can be obtained from the following documents

- The Health and Safety Executive Publication "Protection of Workers and the General Public during the Development of Contaminated Land" (HMSO) and

- "A Guide to Safer Working on Contaminated Sites" (CIRIA Report 132).

7.10.4.3 In addition, reference should be made to the Health and Safety Executive. In all cases work shall be undertaken following the requirements of the Health and Safety at Work Act 1974 and regulations made under the Act including the COSHH regulations.

7.10.4.4 If during the course of excavations hydrocarbon type odours become evident we recommend works are halted, and the air quality measured to determine if the excavation can be safely entered. If the air quality is unacceptable then appropriate personal protective equipment, will be required for human entry into the excavation. If elevated concentrations of airborne hydrocarbons / vapours are detected on site, we recommend Soiltechnics are advised to determine an appropriate course of action with respect to building construction.

7.10.5 Controlled waters

7.10.5.1 Remedial action (outlined in Section 7.9) is required in order to address identified risks to controlled waters.

7.10.6 Vegetation

7.10.6.1 We recommend that the test results presented in this report are passed to a landscape architect for the selection of suitable planting.

7.11 Statement with respect to National Planning Policy Framework

7.11.1 Providing the recommendations described above are satisfactorily completed, we are of the opinion the proposed development will be safe and suitable for use for the purpose for which it is intended, thus meeting the requirements of the National Planning Policy Framework section 121, and compliant with the Building Regulations Part C, 'Site preparation and resistance to contaminants and moisture'.

7.12 On Site Monitoring

7.12.1 We have attempted to identify the potential for chemical contamination on the site, however, areas, which have not been investigated at this stage, may exhibit higher levels of contamination. If such areas are exposed at any time during construction we will be pleased to re-attend site to assess what action is required to allow the development of safely proceed.

8 Gaseous contamination

8.1 Legislative framework

8.1.1 There is currently a complex mix of documentation relating to legislative and regulatory procedures on the issue of contamination and it is not considered a purpose of this report to discuss the detail of these regulations. Essentially, Government Policy is based on 'suitable for use approach', which is relevant to both the current and proposed future use of land. For current use Part IIA of the Environmental Protection Act 1990 provides the regulatory regime (see Section 8.1 above). The presence of harmful soil gases could provide a 'source' in a 'pollutant linkage' allowing the regulator (Local Authority) to determine if there is a significant possibility of harm being caused to humans, buildings or the environment. Under such circumstances the regulator would determine the land as 'contaminated' under the provision of the Act requiring the remediation process to be implemented with the Environment Agency responsible for enforcement.

8.1.2 The Town and Country Planning (General Development Procedure) Order 1995, requires the planning authority to consult with the Environment Agency before granting planning permission for development on land within 250 metres of land which is being used for deposit of waste, (or has been at any time in the last 30 years) or has been notified to the planning authority for the purposes of that provision.

8.1.3 Building control bodies enforce compliance with the Building Regulations. Practical guidance is provided in Approved documents, one of which is Part C, 'Site preparation and resistance to contaminants and moisture' which seeks to protect the health, safety and welfare of people in and around buildings and includes requirements for protection against harm from soil gas.

8.2 General

8.2.1 The following assessment relates to the potential for, and the effects of, gases generated by biodegradable matter. The potential for the development to be affected by radon gas is considered in Section 3 above. The principal ground gases are carbon dioxide (CO_2) and methane (CH_4). The following table provides a summary of the effects of these gases when mixed with air.

Significant gas concentrations in air		
Gas	Concentration by volume	Consequence
Methane	0.25%	Ventilation required in confined spaces
	5 - 15%	Potentially explosive when mixed with air
	30%	Asphyxiation
	75%	Death after 10 minutes
Carbon Dioxide	0.5%	8 hour long term exposure limit (LTEL) (HSE workplace limit)
	1.5%	15 min short term exposure limit (STEL) (HSE workplace limit)
	>3%	Breathing difficulties
	6 – 11%	Visual distortion, headaches, loss of consciousness, possible death
	>22%	Death likely to occur

Table 8.2.1

8.2.2 Following the current Building Regulations Approved Document C1, Section 2 'Resistance to Contaminants' (2004 incorporating 2010 and 2013 amendments) a risk assessment approach is required in relation to gaseous contamination based on the source-pathway-receptor conceptual model procedure. We have adopted procedures described in the following reference documents for investigation and assessments of risk of the development being affected by landfill type gases (permanent gases) and if appropriate the identification of mitigation measures.

BS10175:2011 'Investigation of potentially contaminated sites- Code of Practice'
BS8576:2013 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)'
BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'
CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings' (2007)
NHBC report No 10627-R01(04) 'Guidance on development proposals on sites where methane and carbon dioxide are present' (January 2007)
CL:AIRE Research Bulletin RB17 'A pragmatic approach to ground gas risk assessment' (November 2012)

Whilst we have followed the guidance and recommendations of BS8576, we have used BS8485:2015 to derive recommendations for protective works where considered necessary supplemented by NHBC report No 10627-R01 (04).

8.2.3 An assessment of the risk of the site being affected by ground gases is based on the following aspects:

a) Source of the gas
b) Investigation information
c) Migration feasibility
d) Sensitivity of the development and its location relative to the source

8.3 Assessment of source of gases

8.3.1 General sources

8.3.1.1 The following table summarises the common sources of ground gases and parameters affecting the generation of ground gases:

Source and control of gases	
Type	Parameters affecting the rate of gassing
Landfills	Portion of biodegradable material, rate reduces with time
Mineworkings	Flooding reduces rate of gassing
Dock silt	Portion of organic matter
Carbonate deposits	Ground / rainwater (acidic) reacts with some carbonates to produce carbon dioxide.
Made Ground	Thickness of Made Ground and proportion of degradable organic matter
Naturally deposited soils/rocks	Thickness of Made Ground and proportion of degradable organic matter

Table 8.3.1

The rate of decomposition in gas production is also related to atmospheric conditions, pH, temperature, and water content / infiltration.

8.3.1.2 As the site is not within a dockland environment or an area affected by mineworkings, and near surface soils do not exhibit high carbonate content, then potential gas sources are limited to landfills and/or soils with a high proportion of organic matter.

8.3.2 Landfill and infilled ground sources

8.3.2.1 Waste Management Paper 27 (1991) produced by the Department of the Environment 'Control of Landfill Gases' contains the recommendation to avoid building within 50m of a landfill site actively producing large quantities of landfill type gases and to carry out site investigations within a zone 250m beyond the boundary of a landfill site. No distinction is made between sites of differing ground conditions, but the paper does not advocate the site is safe beyond the 250m zone, dependant, of course, upon the type of landfill and potential for migration of landfill gases.

8.3.2.2 Envirocheck reports one registered landfill site located 693m to the south west of the site. Records indicate the site was licenced for receipt of inert wastes (soils and demolition waste), and licence has now lapsed. Such materials are unlikely to generate any significant quantities of landfill type gases. In addition, we have reviewed old Ordnance Survey maps which indicate the presence of "limekilns" 120m to the south of the site on maps prior to 1900. Although these activities represent a type of quarrying activity, considering a worst case scenario of the site being backfilled with putrescible materials, it is considered very unlikely such a source would be still generating landfill-type gases in any significant quantities.

8.3.2.3 Envirocheck reports a number of mineral sites within 1000m of the subject site. The closest site is recorded 763m to the south of the site and was licenced for the extraction of common sand and operations have ceased. This site has subsequently been redeveloped for residential use.

8.3.2.4 Based on the above assessment, we have not identified any potential sources of ground gas associated with landfilling/filled ground worthy of further consideration.

8.3.3 Soil conditions

8.3.3.1 Made Ground thicknesses are insubstantial and generally less than 1m (including hardstandings). The percentage of organic matter was measured in 5 samples of Made Ground. Organic matter was measured in the range of 0.57 to 7.8%, with a mean value of 3.4%. The Made Ground was noted to be relatively homogenous with noticeable instances of anthropogenic material (e.g. brick and concrete, but no observed easily degradable material such as wood, paper, textile or waste food. With reference to Figure 6 in BS8576:2013 'Guidance on investigations for ground gas – permanent gases and volatile organic compounds', Made Ground displaying these properties would fall within the 'very low generation potential of source' category, indicating that monitoring might not be necessary.

8.3.3.2 Based on an assessment of 'deep' geological conditions we are of the opinion that although site is located over Blisworth Limestone deposits it is unlikely that the subject site would be affected by significant quantities of carbon dioxide and methane generated by soils/rocks at depth.

8.3.4 Source assessment summary

8.3.4.1 The following table summarises the possibility of a source of landfill type gases.

Source assessment summary

Potential source origin	Viability of source	Evidence
Landfills	Low likelihood	Desk study information
Mineworkings	Unlikely	Desk Study information Geological conditions not amenable
Dock silt	Unlikely	Site remote from dockland environment
Carbonate deposits	Low likelihood	Blisworth Limestone at depth
Made Ground	Unlikely	Made Ground <1m thickness and low organic matter
Naturally deposited soils/rocks	Unlikely	Soils exposed in exploratory excavations do not exhibit high concentrations of organic matter

Table 8.3.4

8.4 Conclusion

8.4.1 Based on the above there is no evidence to demonstrate that there is a potential source rendering the site at a significant risk of being affected by ground gases (carbon dioxide / methane), sufficient to cause significant harm to human end users of the site, construction operatives or indeed buildings. On this basis, it is not considered necessary to consider possible pathways for migration of ground gases, and indeed implementation of further investigations to measure concentrations of ground gases. Again on the basis of evidence provided above, mitigation measures against ingress of ground gases into the proposed development are not considered necessary.

8.5 Statement with respect to National Planning Policy Framework

8.5.1 Based on investigations completed to date with respect to gaseous contamination, we are of the opinion the proposed development will be safe and suitable for use for the purpose for which it is intended (without the need for any remedial action) thus meeting the requirements of the National Planning Policy Framework section 121, and compliant with the Building Regulations Part C, 'Site preparation and resistance to contaminants and moisture'.

9 Landfill issues

9.1 Disposal of soils off site

9.1.1 Disposal of waste soils must comply with the Landfill Directive and amendments to the 'Landfill (England and Wales) Regulations'. Essentially, this requires the 'waste producer' to classify soils for off-site disposal to an appropriately licensed landfill facility. Laboratory testing on soils from the site would be required to allow such classification in accordance with current Environment Agency waste acceptance criteria and procedures. We can carry such testing and an assessment of soil classification for disposal on further instructions.

9.2 Landfill tax

9.2.1 Disposal of soils to landfill sites is normally subject to landfill tax with rates varying from year to year based on government policy. Current information on rates of landfill tax can be obtained from the HM Revenue and Customs website www.hmrc.gov.uk

9.3 Reuse of Soils - Materials Management Plans

9.3.1 Where soils are to be moved and reused onsite, or are to be imported to the site, a Waste Exemption or an Environmental Permit is required.

9.3.2 An alternative is the use of a Materials Management Plan (MMP) to determine where soils are and are not considered to be a waste. By following 'The Definition of Waste: Development Industry Code of Practice' published by CL:AIRE (produced in 2008 and revised in March 2011), soils that are suitable for reuse without the need for remediation (either chemical or geotechnical) and have a certainty of use, are not considered to be waste and therefore do not fall under waste regulations. In addition, following this guidance may present an opportunity to transfer suitable material between sites, without the need for Waste Exemptions or Environmental Permits.

9.3.3 MMPs offering numerous benefits, including maximising the use of soils onsite, minimising soils going to landfill and reducing costs and time involved in liaising with waste regulators.

9.3.4 We can provide further advice on this and provide fees for producing a Materials Management Plan on further instructions.

10 Further investigations

10.1 As discussed in Section 7.8.4, further investigations may enable the delineation of leachable contamination, thus allowing the zoning of remedial measures in relation to controlled waters.

10.2 As discussed in Section 7, we recommend that removal of underground storage tanks is carried out under a watching brief to assess the presence and/or significance of any hydrocarbon impacted soils.

10.3 The removal of Made Ground and/or confirmation of thickness of capping placed in garden/landscaped areas will be required during the construction phase. Soils destined for importation to site for use in garden/landscaped areas must be assessed as to their suitability for use prior to importation.

10.4 We would be pleased to provide proposals with costings for the above on further instruction.

11 Remediation strategy and specification

11.1 Introduction

11.1.1 This remediation statement has been produced with a view to isolating and clarifying remedial measures outlined in our main ground investigation report for the site. The objective of remediation works described in this report is to render the site 'fit for purpose' in relation to the proposed development.

11.1.2 This remediation statement only considers the process of remedial action in terms of addressing contamination recognised to date. If during development, contamination not previously identified, is found to be present at the site, then an addendum method statement will be required, and the appropriate measures taken on site.

11.1.3 All sampling and laboratory analysis associated with the recommended remediation will be undertaken following nationally recognised guidelines and standards that are appropriate at the point of investigation. Laboratory analysis must be commissioned with testing houses that are suitably experienced and are MCERTS accredited with a quality assurance system.

11.1.4 This statement has been prepared to assist in the process of the proposed development, and it normally will require distribution to the following parties prior to implementation, although this list may not be exhaustive:

Table summarising parties likely to require information contained in this section of the report

Party	Reason
Client	For information / reference and cost planning
Developer / Contractor / project manager	To ensure procedures are implemented, programmed and costed
Planning department	Potentially to discharge planning conditions
Independent inspectors such as NHBC / Building control	To ensure procedures are implemented and compliance with building regulations
Project design team	To allow for remedial measures in the design
Project landscape consultant	To ensure compatibility of cover system proposed in this document with landscape requirements
Supplier of remediation materials	To ensure compliance with specification.

11.2 Summary of results of investigations leading to recommendations for remediation

11.2.1 Investigations and assessment of chemical contamination is described primarily in Section 7. A summary of chemical contamination at the site is detailed below.

11.2.2 Evaluation of contamination - human receptors

11.2.2.1 Inorganic and organic contaminants were measured at concentrations above soil guideline values within the Made Ground. These contaminants are considered to pose a risk of causing harm to end-users at the site (particularly the critical human receptor) and thus remediation is considered appropriate.

11.2.3 Evaluation of contamination - water receptors

11.2.3.1 Leachable organic contaminants have been measured at elevated concentrations in samples of Made Ground. Further investigation and/or remediation are required in order to address the identified risk to controlled waters.

11.3 Remediation strategy

11.3.1 Human receptors

11.3.1.1 The provision of buildings and hardstanding areas across the site will sever the pathway to end-users by preventing human access to contaminated soils.

11.3.1.2 In proposed garden/landscaped areas, we recommend one of the following measures is carried out:

a) Provision of a capping layer of clean imported soil in potentially productive garden areas and soft landscaped areas

OR

b) Excavation and off-site disposal of Made Ground soils from within proposed garden and landscaped areas followed by placement of clean imported soils to restore levels and provide a growth medium

11.3.1.3 Where Made Ground soils remain in-situ within garden areas, the capping layer (cover system) will sever the pathway between contaminants and end-users, thus minimising the risk of human contact with soils containing contaminants which have the potential to cause harm to human health. The capping layer will be a minimum of 600mm thick in any productive garden areas, and areas likely to be accessible to young children (considered the critical human receptor) on a regular (daily basis). In our opinion, this may be reduced to 300mm in landscaped areas.

11.3.1.4 Whilst the capping solution is widely accepted regulating Local Authorities (Environmental Health Departments) have differing views as to the minimum thickness required which range from 300mm to 600mm. The Building Research Establishment publication 'cover systems for land regeneration - thickness cover for systems for contaminated land' indicates that 600mm of capping would be required at the site, though in our opinion this could be reduced to 300mm in non-productive garden and landscaped areas, however this needs to be checked with the Local Authority. Knowledge of the concentrations of contaminants within the imported capping material may also enable a reduction of the overall capping layer, but this would be subject to further analysis (following determination of the preferred imported soil source and provision of certifying laboratory test results) and again, subject to acceptance from the Local Authority.

11.3.1.5 Alternatively, within the footprint of garden and landscaped areas, Made Ground soils can be fully excavated to expose the naturally deposited Blisworth Limestone soils. Following removal of the Made Ground, clean imported soils would be used to restore levels and provide a growth medium. Removal of Made Ground will negate the requirement for a minimum thickness of capping as specified in Section 11.3.1.3 above. It should be noted that, following the results of additional investigations, removal of Made Ground from garden and landscaped areas may be required in order to address risks to controlled waters (see Section 11.3.2 below).

11.3.2 Controlled waters

11.3.2.1 We recommend one of the following actions is taken:

1. Removal of Made Ground soils from all garden, landscaped and permeable hardstanding areas.

   OR

2. Additional leachate testing of Made Ground soils to delineate zone of elevated leachable organic contaminants. It should be noted that removal of Made Ground may still be required following the results of additional leachate testing.

11.3.3 Underground storage tanks (UST)

11.3.3.1 The results of investigations to date do not indicate the presence of any significant near surface fuel spills in the areas around the underground storage tanks, or in soils adjacent to the tanks. It has not, however, been possible to determine whether any leakage has occurred directly below the tanks. We recommend that removal of the tanks is carried out under a watching brief to assess the presence and/or significance of any hydrocarbon impacted soils.

11.4 Specification for imported capping materials

11.4.1 General

11.4.1.1 All imported capping materials (cover systems) shall be sampled and tested to demonstrate they are 'fit for purpose' before being brought onto site. We recommend that supporting documentation is forwarded to an independent consultant for review.

11.4.2 Capping materials

11.4.2.1 Capping materials shall comprise topsoil to a minimum thickness of 150mm, over subsoil, alternatively the capping can comprise topsoil.

11.4.2.2 Topsoil shall comprise a material which will allow plants to grow healthily. Topsoil shall be general purpose grade in accordance with BS3882:2015 'Specification for topsoil' unless otherwise specified by the consultant landscape architect for the project. Testing shall be carried out to demonstrate compliance for general purpose topsoil (or other topsoil specified by others) with test criteria provided in table 2 of BS3882 with at least one sample tested per source. Topsoil shall be stored, handled and place following the recommendations of BS3882.

11.4.3 Rate of testing / sampling

11.4.3.1 If different sources are to be utilised for topsoil/capping, each source shall be investigated.

11.4.3.2 Capping materials shall be from a source where at least 3 representative soil samples have been taken, subject to a minimum rate of at least 1 sample per 250m^3

11.4.4 Testing regime

11.4.4.1 Human receptors

11.4.4.1.1 The testing regime really is dependent upon the history of the site where the capping materials are sourced. Past historical uses (from a potential chemical contamination viewpoint) of the source site will dictate the required testing regime potentially requiring additional testing to target / investigate concentrations of contaminants used at the source site where they are harmful to human health. At this stage we cannot specify the scope and indeed the need for such site specific testing as the source of the imported fills is not known.

11.4.4.1.2 As a minimum testing shall be scheduled to measure the concentrations of commonly occurring inorganic and organic contaminants (listed in Table 11.4.7 below where guideline values are available).

11.4.4.2 Water receptors

11.4.4.2.1 The materials forming the cover system, may exhibit a degree of permeability, and thus the potential for any chemical contaminants contained in the soils to leach and thus migrate towards groundwater resources, although the risk of this occurring is dependent upon the location of the water table and indeed the permeability of the soils above the water table. Conversely, leachable contaminants could migrate laterally from cover system towards surface water resources. In order to minimise this risk, the soils forming the cover system shall be tested to determine leachable concentrations of potential contaminants. As with testing regimes associated with human health, the testing regime really is dependent upon the history of the site where the capping materials are sourced. At this stage we cannot specify the scope and indeed the need for such site specific testing as the source of the imported fills is not known.

11.4.4.2.2 As a minimum testing shall be scheduled to measure the leachable concentrations of commonly occurring inorganic and organic contaminants where they are considered a risk to harming water receptors (listed in Table 11.4.7 below where leachate guideline values are available).

11.4.5 Maximum concentrations (Human receptors)

11.4.5.1 The Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have derived Suitable for Use Levels (S4ULs) which are presented in 'The LQM/CIEH S4ULs for Human Health Risk Assessment' (2015). S4ULs have been used as a screening tool to assess the risks posed to the health of humans from exposure to soil contamination in relation to appropriate land uses. Where published S4ULs are not available, we have adopted C4SLs (Category 4 Screening Levels) produced by DEFRA or SGVs (Soil Guideline Values) as appropriate. In the absence of any of these criteria we have adopted Soil Screening Values (SSV) derived by Soiltechnics and by Atkins (SSV^{ATK}). The CLEA model used to derive SSVs has been used with toxicology data presented by the EA, LQM/CIEH and Atkins (in that order of preference). SSVs produced by Atkins are presented on their $ATRISK^{SOIL}$ website.

11.4.5.2 S4ULs, C4SLs, SGVs, SSVs and SSV^{ATK}s represent 'intervention values'; indications to an assessor that soil concentrations above these levels might present an unacceptable risk to the health of site users. These guideline values have been produced using conceptual exposure models, which use assumptions and are applied to differing end uses of land. If the values are exceeded, it does not necessarily imply there is an actual risk to health and site-specific circumstances should be taken into account. Conversely, where a critical pathway or chemical form of the contaminant has not been evaluated, a risk may be present even if the adopted guideline value has not been exceeded.

11.4.5.3 For evaluation of test data in relation to polycyclic aromatic hydrocarbon (PAH) and phenol contamination, we have compared measured concentrations with corresponding S4ULs. The S4UL fractions are dependent on the Soil Organic Matter (SOM) content of the soils. We have adopted the lowest S4UL (1% SOM) as an initial screening value.

11.4.6 Maximum concentrations (water receptors)

11.4.6.1 For interpretation of test data in relation to water receptors measured concentrations of leachable contaminants shall be directly compared with the Environmental Quality Standards (EQS) as published by the Environment Agency. In the absence of EQS UK Drinking Water Standards shall be adopted.

11.4.7 Maximum concentrations (summary)

11.4.7.1 The following table summarises the maximum concentrations of chemical contaminants which shall not be exceeded in imported capping materials.

Table summarising maximum concentration of contaminants in soils used for capping

Contaminant	Maximum allowable concentration and test criteria (Human Receptors) (Total concentration)		Maximum concentration (µg/l) (leachate concentration)
	C4SL (mg/kg)	S4UL (mg/kg)	
Inorganic contaminants			
Arsenic	-	37	50
Barium	-	-	700
Boron	-	290	2000
Beryllium	-	1.7	-
Cadmium (pH to 7.4)	-	11	5
Copper	-	2400	1
Chromium	-	910	5
Cyanide (total)	-	34	50
Lead	82	-	4
Mercury	-	1.2	1
Nickel		180	50
Nitrate	-	-	50000
Selenium	-	250	10
Sulfate	-	-	400000
Sulfide	-	-	0.25
Vanadium	-	410	20
Organic contaminants			
Acenaphthene	-	210	
Acenaphthylene	-	170	
Anthracene	-	2400	
Benzo(a)anthracene	-	7.2	
Benzo(a)pyrene	-	2.2	
Benzo(b)fluoranthene	-	2.6	
Benzo(g,h,i)perylene	-	320	
Benzo(k)fluoranthene	-	77	
Chrysene	-	15	
Dibenzo(a,h)anthracene	-	0.24	
Fluoranthene	-	280	
Fluorene	-	170	
Indeno(1,2,3-cd)pyrene	-	27	
Naphthalene	-	2.3	
Phenanthrene	-	95	
Phenols	-	280	
Pyrene	-	620	

Table 11.4.7

11.4.8 Information required

11.4.8.1 It is important that the imported capping material will minimise the risks of causing harm to human end users of the site. It is necessary to demonstrate the imported capping materials are 'fit for purpose', and relevant and current test result certificates are an important part of the necessary compliance documentation. Compliance documentation will be provided to other interested parties such as:-

- Local authority planning department to discharge planning permissions
- Checking bodies such a NHBC and Building Control (For compliance with building regulations)
- Potential purchasers of the buildings (and their legal advisors)
- Environment Agency (controlling body for ground / surface water resources)

Based on the above it is important to provide compliance documentation prior to importation to site, thus avoiding abortive works and delays to the construction programme with its potential financial penalties.

11.4.8.2 Compliance documentation shall include the following

- Copies of test result certificates signed by a MCERTS accredited laboratory which is signed and dated.
- Source and supplier of the capping material.
- Delivery notes confirming the material originates from the stated source (will form part of the subsequent validation reporting)

11.5 Verification report

11.5.1 The thickness of the completed cover system will require verification by an independent consultant. We can carry out such investigations on further instructions.

11.5.2 Following completion of remedial works detailed above, a closure report which provides details of all work undertaken as part of the remediation process will have to be prepared. The closure report will include details of imported materials to form the cover system, its thickness and thus verification of its fitness for purpose. The report should also include copies of transfer notes for soils exported from and imported to site.

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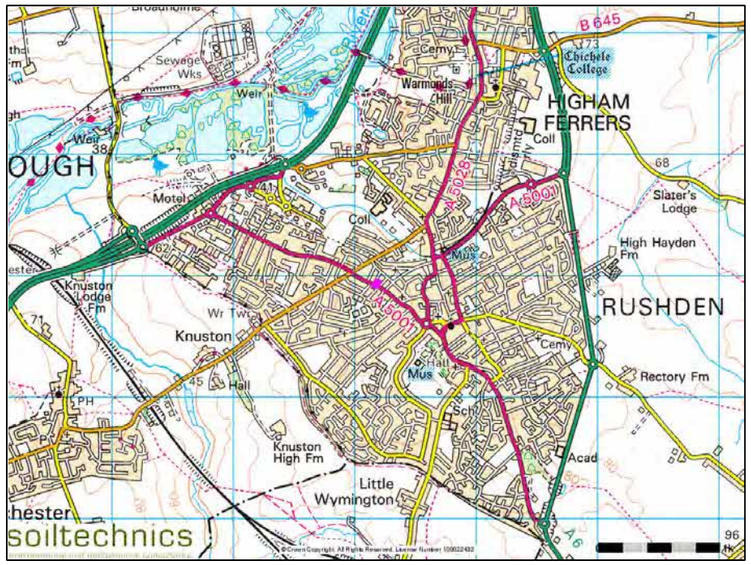
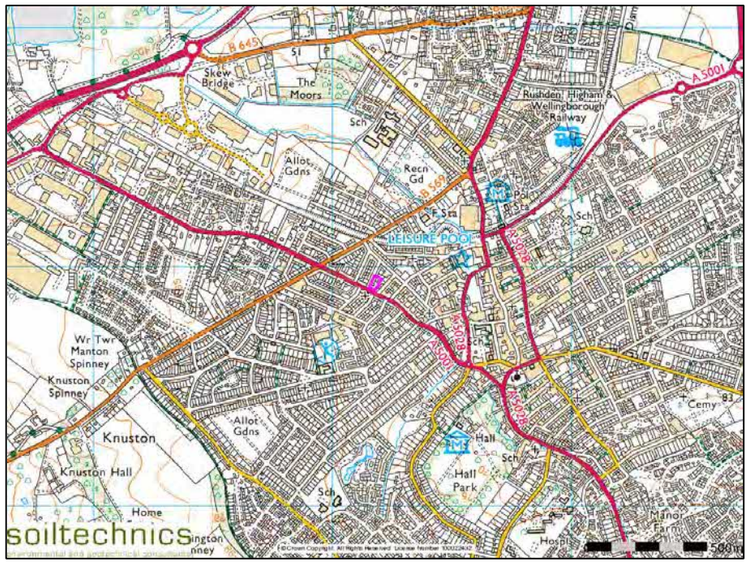
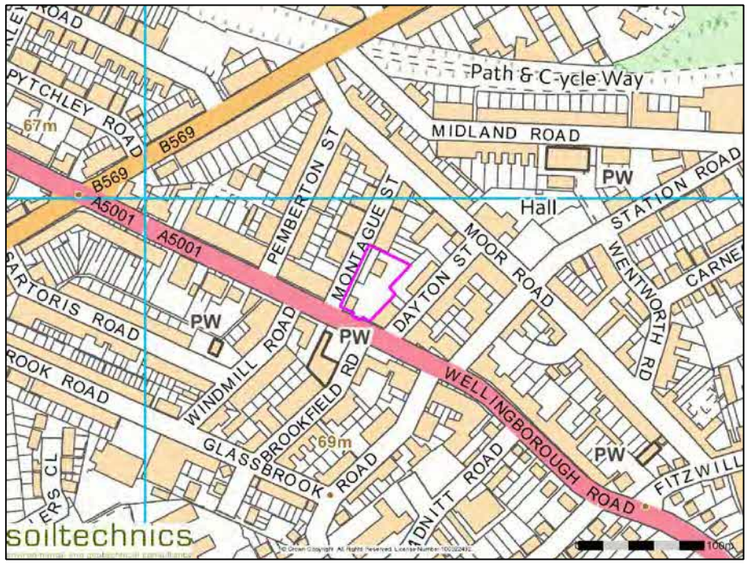


Neighbourhood extract from Ordnance Survey map



Town extract from Ordnance Survey map



Detail extract from Ordnance Survey map

Title	Scale	Drawing number
Site location plan	Not to scale	01

Proposed residential development
Montague Street, Rushden

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Residential properties

Residential properties

DTS03

Storage area for used tyres, timber, pallets, liquid containers and drums

Shed

Concrete surfacing

DTS07

Office

Concrete surfacing

Access

DTS04

Workshop

Gravel surfacing

Car park area

DTS06

Timber fence
height ~2m)

Approximate site boundary

Residential properties

Montague Street

DTS05

DTS01

Residential property

Gravel surfacing

DTS02

Residential and commercial properties

Wellingborough Road

Key

DTS — Approximate location of borehole formed by Driven Tube Sampling techniques

Title	Scale	Drawing number
Plan showing existing site features and location of exploratory points	1:250 at A3	02

Report Ref: STN3556B-G01
Revision: 0

May 2016

Proposed residential development
Montague Street, Rushden

soiltechnics
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DTS03
DTS07
DTS04
DTS06
DTS05
DTS01
DTS02

Approximate site boundary

Montague Street

Wellingborough Road

Key

DTS — Approximate location of borehole formed by Driven Tube Sampling techniques

Site existing buildings/structures observed during over site investigations

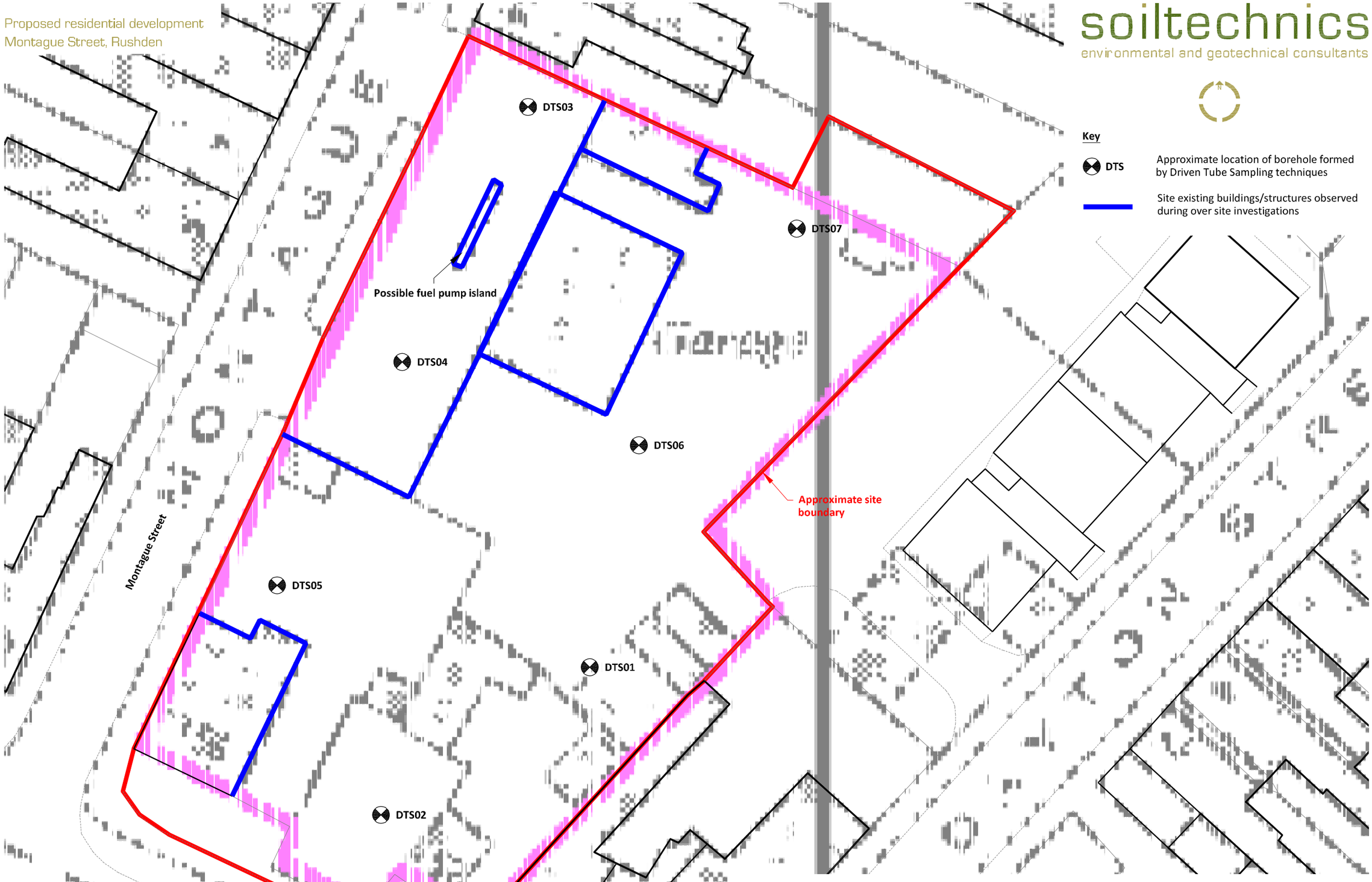
Title	Scale	Drawing number
Plan showing existing site features and historical features recorded on 1900 ordnance survey map with location of exploratory points	1:250 at A3	02a

Report Ref: STN3556B-G01
Revision: 0

May 2016

Proposed residential development
Montague Street, Rushden

soiltechnics
environmental and geotechnical consultants



Key

DTS — Approximate location of borehole formed by Driven Tube Sampling techniques

Site existing buildings/structures observed during over site investigations

Title	Scale	Drawing number
Plan showing existing site features and historical features recorded on 1966 ordnance survey map with location of exploratory points	1:250 at A3	02b

Report Ref: STN3556B-G01
Revision: 0

May 2016

Proposed residential development
Montague Street, Rushden

soiltechnics
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DTS03
DTS07
Possible fuel pump island
DTS04
DTS06
Approximate site boundary
DTS05
DTS01
DTS02
Montague Street
Wellingborough Road

Key

DTS — Approximate location of borehole formed by Driven Tube Sampling techniques

Site existing buildings/structures observed during over site investigations

Title	Scale	Drawing number
Plan showing existing site features and historical features recorded on 1993 ordnance survey map with location of exploratory points	1:250 at A3	02c

Report Ref: STN3556B-G01
Revision: 0

May 2016

Proposed residential development
Montague Street, Rushden

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Residential properties

Residential properties

DTS03

DTS07

Access

DTS04

DTS06

Approximate site boundary

Montague Street

DTS05

DTS01

DTS02

Residential properties

Residential and commercial properties

Wellingborough Road

Key

DTS — Approximate location of borehole formed by Driven Tube Sampling techniques

Extent of proposed gardens

Extent of proposed buildings

Title	Scale	Drawing number
Plan showing development layout and location of exploratory points	1:250 at A3	03

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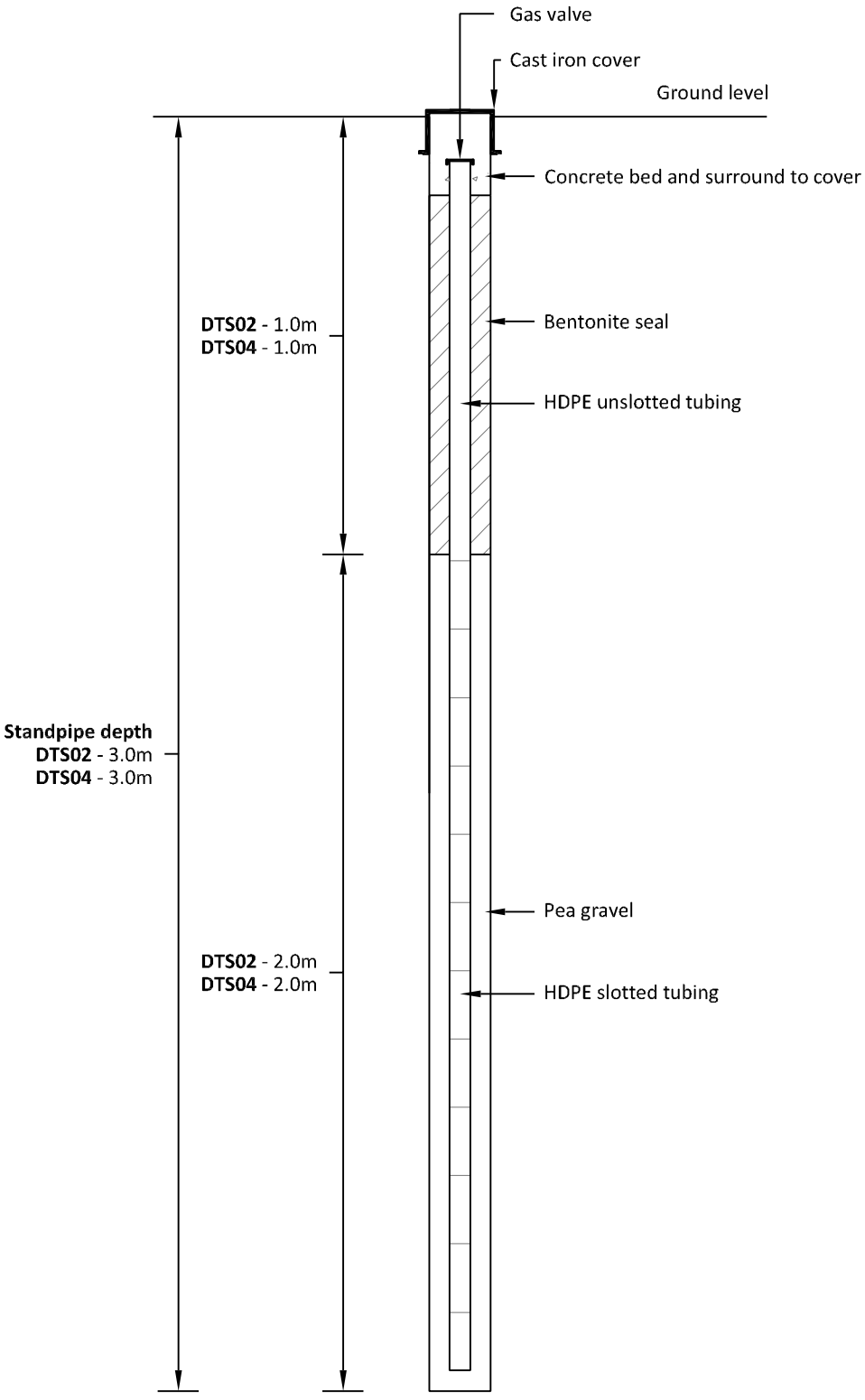

Title	Scale	Drawing number
Section showing construction of gas monitoring standpipes installed in boreholes DTS02 and DTS04	Not to scale	04

Definition of geo-environmental terms used in this report

Conceptual model
Textual and/or schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information obtained from the investigatory process.

Contamination
Presence of a substance which is in, on or under land, and which has the potential to cause harm or to cause pollution of controlled water.

Controlled water
Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three mile limit of territorial waters.

Harm
Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of humans, including property.

Pathway
Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.

Receptor
Persons, living organisms, ecological systems, controlled waters, atmosphere, structures and utilities that could be adversely affected by the contaminant(s).

Risk
Probability of the occurrence of, and magnitude of the consequences of, an unwanted adverse effect on a receptor.

Risk Assessment
Process of establishing, to the extent possible, the existence, nature and significance of risk.

Definition of environmental risk/hazard terms used in this report.

Based on CIRIA report C552 'Contaminated land risk assessment – A guide to good practice'.

Potential hazard severity definition

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures.
Mild	Pollution of non sensitive waters, minor damage to buildings or structures.
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non sensitive ecosystems or species.

Probability of risk definition

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.

Level of risk for potential hazard definition

Probability of risk	Potential severity			
	Severe	Medium	Mild	Minor
High Likelihood	Very high	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low Likelihood	Moderate	Low/Moderate	Low	Very low
Unlikely	Low/Moderate	Low	Very low	Very low

Refer sheet 2 for definitions of 'very high' to 'low'

Definition of environmental risk/hazard terms used in this report.

Based on CIRIA report C552 'Contaminated land risk assessment – A guide to good practice'.

Risk classifications and likely action required:

Very high risk
High probability that severe harm could arise to a designated receptor from an identified hazard OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.

High risk
Harm is likely to arise to a designated receptor from an identified hazard. This risk, if realised, is likely to result in substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.

Moderate risk
It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is likely that the harm would be relatively mild. Investigation is normally required to clarify risks and to determine potential liability. Some remedial works may be required in the long term.

Low risk
It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that this harm, if realised, would at worst normally be mild.

Very low risk
It is a low possibility that harm could arise to a designated receptor. On the event of such harm being realised it is not likely to be severe.

List of documents used in assessment of chemical contamination

No.	Title	Publication reference / publisher
1	Human health toxicological assessment of contaminants in soil	EA Science Report – SC050021/SR2
2	Updated technical background to the CLEA model	EA Science Report – SC050021/SR3
3	CLEA Software (Version 1.03 beta) Handbook	EA Science Report - SC050021/SR4
4	Guidance on comparing Soil Contamination Data with a Critical Concentration	CIEH
5	Generic Assessment Criteria for Human Health Risk Assessment	LQM/CIEH
6	Assessment of Risks to Human Health from Land Contamination: An overview of the development of soil guideline values and related research	R&D Publication, Contaminated Land Report CLR 7
7	Contaminants of Soil: Collation of Toxicological Data and Intake Values for Humans	R&D Publication, Contaminated Land Report CLR 9
8	The Contaminated Land Exposure Assessment Model (CLEA): Technical Basis and Algorithms	R&D Publication, Contaminated Land Report CLR 10
9	Model Procedures for the Management of Land Contamination	R&D Publication, Contaminated Land Report CLR 11
10	Contaminants in Soil: Collection of Toxicological Data and Intake Values for Human Values	R&D Publications, Tox. 6
11	Soil Guideline Values for Contamination (2002)	R&D Publications, SGV 10
12	Soil Guideline Values (2009)	EA Science Reports – SC050021

CIEH Chartered institute of Environmental Health
LQM Land Quality Management
EA Environment Agency

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Key to legends

Composite materials, soils and lithology

Topsoil	Made Ground	Boulders
Chalk	Clay	Coal
Cobbles	Cobbles & Boulders	Concrete
Gravel	Limestone	Mudstone
Peat	Sand	Sand and Gravel
Sandstone	Silt	Silt / Clay
		Siltstone

Note: Composite soil types are signified by combined symbols.

Key to 'test results' and 'sampling' columns

Test result	
Depth	Records depth that the test was carried out (i.e.: at 2.10m or between 2.10m and 2.55m)
Result	PID - Photo Ionisation Detector result (ppm equivalent Isobutylene) PP – Pocket penetrometer result (kN/m^2) HVP – Hand held shear vane result (kN/m^2) PP result converted to an equivalent undrained shear strength by applying a factor of 50. Where at least 3 results obtained at same depth then an average value may be reported.
	SPT – Standard Penetration Test result (uncorrected) SPT(c) – Standard Penetration Test result (solid cone) (uncorrected)

Sampling		
From (m) To (m)	Records depth of sampling	
Type	D	Disturbed sample
	B	Bulk disturbed sample
	ES	Environmental sample comprising plastic and/or glass container
	W	Water sample
	U (32)	Undisturbed sample 100mm diameter sampler with number of blows of driving equipment required to obtain sample

Water observations

Described at foot of log and shown in the 'water strike' column.

▼ = water level observed after specified delay in drilling

▽ = water strike

Standpipe details

Gravel filter

Arisings

Bentonite

Slotted pipe

Density

Density recorded in brackets inferred from density testing and soil descriptions from across the site (i.e.: [Medium dense]).

WELL	DESCRIPTION	LEGEND
	Coarse flint gravel hardstanding onto dark brown to brown SAND and GRAVEL consisting of flint, brick and concrete. Rare fragments of potential asbestos containing material observed. MADE GROUND	
	Firm medium strength brown mottled dark grey slightly silty slightly gravelly sandy CLAY. Gravel consists of brick, concrete and slate. MADE GROUND	
	Firm to stiff high to very high strength brown slightly silty slightly sandy slightly gravelly CLAY. Gravel consists of angular to sub-rounded fine to medium flint and angular fine to coarse limestone. HEAD	
	BOREHOLE TERMINATED AT 2.00m	


WELL

WELL	DESCRIPTION	LEGEND
	Grey unreinforced CONCRETE comprised of aggregates of angular to rounded ¡ ne to coarse Ñint and limestone. Less than 5% air voids. MADE GROUND	
	Red brown to grey GRAVEL consis¢ng of brick and concrete. MADE GROUND	
	S¢ brown slightly gravelly CLAY. Gravel consists of sub-rounded to rounded ¡ ne to coarse Ñint. MADE GROUND	
	Light brown to light grey weakly cemented SAND and GRAVEL. Sand is ¡ ne to medium. Gravel consists of angular to tabular ¡ ne to coarse limestone. BLISWORTH LIMESTONE FORMATION	
	BOREHOLE TERMINATED AT 2.00m	


WELL

WELL	DESCRIPTION	LEGEND
	Coarse flint gravel hardstanding onto very gravelly SAND. Gravel consists of flint, brick, limestone and concrete. MADE GROUND	
	Firm medium strength brown to dark brown slightly sandy gravelly CLAY with rare cobbles of concrete and brick. Gravel consists of sub-angular to rounded fine to coarse flint and occasional charcoal. MADE GROUND	
	Firm to stiff high strength brown slightly sandy slightly gravelly CLAY. Gravel consists of sub-rounded to rounded fine to coarse flint and occasional angular limestone. HEAD	
	...from 1.2m depth, angular limestone present.	
	LIMESTONE recovered as extremely weak to very weak angular tabular GRAVELS in stiff light brown CLAY matrix. BLISWORTH LIMESTONE FORMATION	
	BOREHOLE TERMINATED AT 2.00m	

WELL	DESCRIPTION	LEGEND
	Brown SAND and GRAVEL consisting of angular to rounded fine to coarse flint and angular fine to medium limestone. MADE GROUND	
	Firm to stiff dark grey becoming brown slightly silty slightly sandy gravelly CLAY. Gravel consists of sub-angular to rounded fine to medium flint and rare brick. MADE GROUND	
	...between 0.3m and 0.35m depth, hydrocarbon odour noted.	
	Stiff high to very high strength brown slightly sandy slightly gravelly CLAY. Gravel consists of sub-rounded to rounded fine to coarse flint. HEAD	
	...from 1m depth, occasional angular limestone.	
	BOREHOLE TERMINATED AT 2.00m	

WELL	DESCRIPTION	LEGEND
	Coarse flint gravel hardstanding onto firm dark grey slightly sandy slightly gravelly CLAY. Gravel consists of concrete, brick and flint. MADE GROUND	
	Dark grey BITUMINOUS COATED MATERIAL. MADE GROUND	
	Firm low strength brown to dark brown slightly gravelly CLAY. Gravel consists of sub-rounded to rounded fine to medium flint and occasional charcoal. Slight hydrocarbon odour noted at 0.3m depth. MADE GROUND	
	Firm to stiff medium to high strength brown slightly sandy slightly gravelly CLAY. Gravel consists of angular to rounded fine to coarse flint and angular limestone. HEAD	
	High strength light brown to orange brown and light grey slightly silty sandy very gravelly CLAY with occasional interlaminated very weak limestone. Gravel consists of angular limestone. BLISWORTH LIMESTONE FORMATION	
	Light brown slightly clayey SAND and GRAVEL consisting of angular limestone. BLISWORTH LIMESTONE FORMATION	
	BOREHOLE TERMINATED AT 3.00m	

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.:	16-06911-1
Initial Date of Issue:	08-Apr-2016
Client	Soiltechnics Limited
Client Address:	Cedar Barn White Lodge Walgrave Northampton Northamptonshire NN6 9PY
Contact(s):	Rachel Brown
Project	STN3556B - Montague Street, Rushden

Quotation No.:		**Date Received:**	23-Mar-2016
Order No.:	21187	**Date Instructed:**	23-Mar-2016
No. of Samples:	9		
Turnaround (Wkdays):	5	**Results Due:**	31-Mar-2016
Date Approved:	08-Apr-2016		

Approved By:

Details: Keith Jones, Technical Manager

Chemtest
The right chemistry to deliver results

Results - Leachate

Project: STN3556B - Montague Street, Rushden

Client: Soiltechnics Limited				**Chemtest Job No.:**	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911
Quotation No.:				**Chemtest Sample ID.:**	271619	271620	271621	271622	271625	271627
Order No.: 21187				Client Sample Ref.:	DTS01	DTS02	DTS03	DTS04	DTS06	DTS07
				Client Sample ID.:	1-001	1-007	1-013	1-021	1-034	1-028
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.20	0.20	0.30	0.20	0.30	0.30
				Date Sampled:	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
pH	U	1010		N/A	8.5	8.7				8.2
Nitrate	U	1220	mg/l	0.50	0.70	0.95				< 0.50
Sulphate	U	1220	mg/l	1.0	4.3	2.8				9.0
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050	< 0.050				< 0.050
Cyanide (Free)	U	1300	mg/l	0.050	< 0.050	< 0.050				< 0.050
Cyanide (Complex)	U	1300	mg/l	0.050	< 0.050	< 0.050				< 0.050
Sulphide	U	1325	mg/l	0.050	< 0.050	< 0.050				< 0.050
Arsenic (Dissolved)	U	1450	µg/l	1.0	3.7	1.2				< 1.0
Boron (Dissolved)	U	1450	µg/l	20	< 20	< 20				39
Beryllium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0				< 1.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080				< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0				< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	3.1	1.9				4.5
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50				< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0				< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	2.0	< 1.0				< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0				< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	1.6	< 1.0				< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	2.3	< 1.0				1.6
Aliphatic TPH >C5-C6	N	1675	µg/l	0.010			< 0.010	< 0.010	< 0.010	
Aliphatic TPH >C6-C8	N	1675	µg/l	0.010			< 0.010	< 0.010	< 0.010	
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Total Aliphatic Hydrocarbons	N	1675	µg/l	1.0			< 1.0	< 1.0	< 1.0	
Aromatic TPH >C5-C7	N	1675	µg/l	0.010			< 0.010	< 0.010	< 0.010	
Aromatic TPH >C7-C8	N	1675	µg/l	0.010			< 0.010	< 0.010	< 0.010	
Aromatic TPH >C8-C10	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aromatic TPH >C10-C12	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aromatic TPH >C12-C16	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Aromatic TPH >C16-C21	N	1675	µg/l	0.10			8.3	< 0.10	< 0.10	
Aromatic TPH >C21-C35	N	1675	µg/l	0.10			58	< 0.10	< 0.10	
Aromatic TPH >C35-C44	N	1675	µg/l	0.10			< 0.10	< 0.10	< 0.10	
Total Aromatic Hydrocarbons	N	1675	µg/l	1.0			67	< 1.0	< 1.0	
Total Petroleum Hydrocarbons	N	1675	µg/l	2.0			67	< 2.0	< 2.0	
Benzene	U	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	

Chemtest
The right chemistry to deliver results

Results - Leachate

Project: STN3556B - Montague Street, Rushden

Client: Soiltechnics Limited		**Chemtest Job No.:**			16-06911	16-06911	16-06911	16-06911	16-06911	16-06911
Quotation No.:		**Chemtest Sample ID.:**			271619	271620	271621	271622	271625	271627
Order No.: 21187		Client Sample Ref.:			DTS01	DTS02	DTS03	DTS04	DTS06	DTS07
		Client Sample ID.:			1-001	1-007	1-013	1-021	1-034	1-028
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.20	0.20	0.30	0.20	0.30	0.30
		Date Sampled:			18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Toluene	U	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	
Ethylbenzene	U	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	
m & p-Xylene	U	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	
o-Xylene	U	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0			< 1.0	< 1.0	< 1.0	
Naphthalene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1800	µg/l	0.10	0.64	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1800	µg/l	0.10	0.61	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1800	µg/l	0.10	17	< 0.10	0.63	< 0.10	< 0.10	< 0.10
Pyrene	U	1800	µg/l	0.10	13	< 0.10	0.80	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1800	µg/l	0.10	2.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	1800	µg/l	0.10	2.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1800	µg/l	0.10	3.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1800	µg/l	0.10	0.98	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1800	µg/l	0.10	2.7	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1800	µg/l	0.10	1.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1800	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1800	µg/l	0.10	2.6	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1800	µg/l	2.0	48	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030				< 0.030

Chemtest
The right chemistry to deliver results

Results - Soil

Project: STN3556B - Montague Street, Rushden

Client: Soiltechnics Limited		**Chemtest Job No.:**			16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911
Quotation No.:		**Chemtest Sample ID.:**			271619	271620	271621	271622	271623	271624	271625	271626	271627
Order No.: 21187		Client Sample Ref.:			DTS01	DTS02	DTS03	DTS04	DTS05	DTS06	DTS06	DTS06	DTS07
		Client Sample ID.:			1-001	1-007	1-013	1-021	1-016	1-033	1-034	1-035	1-028
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.20	0.20	0.30	0.20	0.10	0.10	0.30	0.50	0.30
		Date Sampled:			18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	Cement	-			-	-			-
Asbestos Identification	U	2192	%	0.001	Chrysotile Crocidolite	No Asbestos Detected			No Asbestos Detected	No Asbestos Detected			No Asbestos Detected
Asbestos by Gravimetry	U	2192	%	0.001	3.6								
Total Asbestos	N	2192	%	0.001	3.6								
Moisture	N	2030	%	0.020	7.3	6.4	16	16			14	15	21
Soil Colour	N	2040		N/A	Brown, Beige	Beige		Brown			Brown		Brown
Other Material	N	2040		N/A	Stones	Stones		Stones			Stones		Stones
Soil Texture	N	2040		N/A	Sand	Sand		Loam			Loam		Loam
pH	M	2010		N/A	8.5	8.7		8.6			8.1		8.1
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40		0.91			0.80		1.1
Cyanide (Complex)	M	2300	mg/kg	0.50	< 0.50	< 0.50		< 0.50			< 0.50		< 0.50
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50		< 0.50			< 0.50		< 0.50
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50		< 0.50			< 0.50		< 0.50
Arsenic	M	2450	mg/kg	1.0	30	13		25			19		26
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0		2.2			< 1.0		2.2
Cadmium	M	2450	mg/kg	0.10	0.40	0.14		0.25			0.13		2.4
Chromium	M	2450	mg/kg	1.0	37	5.1		24			21		46
Copper	M	2450	mg/kg	0.50	23	4.7		64			15		430
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10		2.1			0.16		0.35
Nickel	M	2450	mg/kg	0.50	28	3.7		30			21		42
Lead	M	2450	mg/kg	0.50	91	22		330			34		430
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20		< 0.20			< 0.20		0.21
Vanadium	U	2450	mg/kg	5.0	48	9.3		36			32		44
Zinc	M	2450	mg/kg	0.50	120	26		120			45		500
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50			< 0.50		< 0.50
Organic Matter	M	2625	%	0.40	2.6	0.57	3.1	4.1			1.7	1.0	7.8
Total Organic Carbon	M	2625	%	0.20			1.8	2.4			0.97	0.60	4.5
Aliphatic TPH >C5-C6	N	2680	mg/kg	0.010			< 0.010	< 0.010			< 0.010	< 0.010	< 0.010
Aliphatic TPH >C6-C8	N	2680	mg/kg	0.010			< 0.010	< 0.010			< 0.010	< 0.010	< 0.010
Aliphatic TPH >C8-C10	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	2680	mg/kg	0.10			< 0.10	< 0.10			2.7	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	2680	mg/kg	0.10			< 0.10	< 0.10			92	< 0.10	11
Aliphatic TPH >C35-C44	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	2680	mg/kg	1.0			< 1.0	< 1.0			95	< 1.0	11
Aromatic TPH >C5-C7	N	2680	mg/kg	0.010			< 0.010	< 0.010			< 0.010	< 0.010	< 0.010
Aromatic TPH >C7-C8	N	2680	mg/kg	0.010			< 0.010	< 0.010			< 0.010	< 0.010	< 0.010

Chemtest
The right chemistry to deliver results

Results - Soil

Project: STN3556B - Montague Street, Rushden

Client: Soiltechnics Limited		**Chemtest Job No.:**			16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911	16-06911
Quotation No.:		**Chemtest Sample ID.:**			271619	271620	271621	271622	271623	271624	271625	271626	271627
Order No.: 21187		Client Sample Ref.:			DTS01	DTS02	DTS03	DTS04	DTS05	DTS06	DTS06	DTS06	DTS07
		Client Sample ID.:			1-001	1-007	1-013	1-021	1-016	1-033	1-034	1-035	1-028
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.20	0.20	0.30	0.20	0.10	0.10	0.30	0.50	0.30
		Date Sampled:			18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016	18-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aromatic TPH >C8-C10	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	2680	mg/kg	0.10			< 0.10	< 0.10			< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	2680	mg/kg	0.10			< 0.10	1.1			< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	2680	mg/kg	0.10			38	32			1.7	< 0.10	28
Aromatic TPH >C21-C35	N	2680	mg/kg	0.10			150	110			16	< 0.10	500
Aromatic TPH >C35-C44	N	2680	mg/kg	0.10			18	11			< 0.10	< 0.10	10
Total Aromatic Hydrocarbons	N	2680	mg/kg	1.0			200	160			18	< 1.0	530
Total Petroleum Hydrocarbons	N	2680	mg/kg	2.0			200	160			110	< 2.0	550
Benzene	M	2760	µg/kg	1.0			< 1.0	< 1.0			< 1.0	< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0			< 1.0	< 1.0			< 1.0	< 1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0			< 1.0	< 1.0			< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0			< 1.0	< 1.0			< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0			< 1.0	< 1.0			< 1.0	< 1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	0.24	< 0.10		0.79			0.53		0.88
Acenaphthylene	N	2800	mg/kg	0.10	0.80	< 0.10		1.6			< 0.10		0.22
Acenaphthene	M	2800	mg/kg	0.10	1.5	< 0.10		< 0.10			< 0.10		0.29
Fluorene	M	2800	mg/kg	0.10	1.7	< 0.10		0.29			< 0.10		0.45
Phenanthrene	M	2800	mg/kg	0.10	37	1.0		9.4			0.27		4.4
Anthracene	M	2800	mg/kg	0.10	12	0.25		2.3			< 0.10		0.91
Fluoranthene	M	2800	mg/kg	0.10	59	1.7		29			0.63		9.0
Pyrene	M	2800	mg/kg	0.10	51	1.4		25			0.63		6.7
Benzo[a]anthracene	M	2800	mg/kg	0.10	26	0.55		17			0.25		4.8
Chrysene	M	2800	mg/kg	0.10	23	0.41		15			0.21		3.9
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	29	0.55		22			0.32		5.4
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	12	0.17		9.1			0.13		1.9
Benzo[a]pyrene	M	2800	mg/kg	0.10	30	0.56		22			0.32		5.2
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	19	0.41		16			0.19		3.7
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	2.9	< 0.10		2.2			< 0.10		0.28
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	15	0.34		12			0.16		2.6
Total Of 16 PAH's	N	2800	mg/kg	2.0	320	7.3		180			3.6		51
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30		< 0.30			< 0.30		< 0.30

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

soiltechnics
environmental and geotechnical consultants

Analysis of test data in relation to concentrations of inorganic chemical contaminants

Adopted Model: Industrial/Commercial
Receptor: Current site users and construction operatives

Test procedure			Summary of test data					Initial comparison	Outlier test					Normality test			UCL	
Contaminant	Guideline source	Guideline value mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth	Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Arsenic	S4UL	640	5	13.0	30.0	22.6	0	Mean value below guideline	y	0				normal	normal	n	35.6	Arsenic
Beryllium	S4UL	12	5	1.0	2.2	1.5	0	Mean value below guideline	y	0				not normal	not normal	n	2.8	Beryllium
Boron	S4UL	240000	5	0.4	1.1	0.7	0	Mean value below guideline	y	0				normal	normal	n	1.3	Boron
Cadmium	S4UL	190	5	0.1	2.4	0.7	0	Mean value below guideline	n	0				not normal	not normal	n	2.6	Cadmium
Chromium (III)	S4UL	8600	5	5.1	46.0	26.6	0	Mean value below guideline	y	0				normal	normal	n	57.2	Chromium (III)
Copper	S4UL	68000	5	4.7	430.0	107.3	0	Mean value below guideline	n	0				not normal	not normal	n	461.8	Copper
Cyanide (total)	ATK	34	5	0.5	0.5	0.5	0	Mean value below guideline	y	0				not normal	not normal	n	0.5	Cyanide (total)
Lead	C4SL (l)	1100	5	22.0	430.0	181.4	0	Mean value below guideline	y	0				normal	not normal	n	545.1	Lead
Mercury#	S4UL	1100	5	0.1	2.1	0.6	0	Mean value below guideline	n	0				not normal	not normal	n	2.3	Mercury#
Nickel	S4UL	980	5	3.7	42.0	24.9	0	Mean value below guideline	y	0				normal	normal	n	52.4	Nickel
Selenium	S4UL	12000	5	0.2	0.2	0.2	0	Mean value below guideline	n	0				not normal	not normal	n	0.2	Selenium
Vanadium	S4UL	9000	5	9.3	48.0	33.9	0	Mean value below guideline	y	0				normal	normal	n	63.3	Vanadium
Zinc	S4UL	730000	5	26.0	500.0	162.2	0	Mean value below guideline	n	0				not normal	normal	n	539.7	Zinc

S4UL Suitable for Use Level as published by LQM/CIEH
C4SL Category 4 Screening Level
C4SL (lower) (upper) Category 4 Screening Level for Lead at lower or upper bound of range
ATK Soil Screening Value derived by Atkins
BPG5 Guideline from BPG Note 5 as published by Forest Research

Assumed to be inorganic mercury as initial screening value

Title
Analysis of test data in relation to concentrations of inorganic chemical contaminants.

Table number
1

soiltechnics
environmental and geotechnical consultants

Analysis of test data in relation to concentrations of organic chemical contaminants

Adopted model: Industrial/Commercial
Receptor: Current site user

Test procedure			Summary of test data					Initial Screening	Outlier test				Normality test			UCL	
Contaminant	Guideline source	Guideline value* mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth / Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Acenaphthene	S4UL	97000	5	0.1	1.5	0.4	0	Mean value below guideline	n	0			not normal	not normal	n	1.6	Acenaphthene
Acenaphthylene	S4UL	97000	5	0.1	1.6	0.6	0	Mean value below guideline	y	0			normal	normal	n	1.8	Acenaphthylene
Anthracene	S4UL	540000	5	0.1	12.0	3.1	0	Mean value below guideline	n	0			not normal	not normal	n	12.9	Anthracene
Benzo(a)anthracene	S4UL	170	5	0.3	26.0	9.7	0	Mean value below guideline	y	0			normal	not normal	n	31.9	Benzo(a)anthracene
Benzo(a)pyrene	S4UL	35	5	0.3	30.0	11.6	0	Mean value below guideline	y	0			normal	normal	y	24.6	Benzo(a)pyrene
Benzo(b)fluoranthene	S4UL	44	5	0.3	29.0	11.5	0	Mean value below guideline	y	0			normal	normal	y	24.1	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	S4UL	4000	5	0.2	15.0	6.0	0	Mean value below guideline	y	0			normal	normal	n	19.6	Benzo(g,h,i)perylene
Benzo(k)fluoranthene	S4UL	1200	5	0.1	12.0	4.7	0	Mean value below guideline	y	0			normal	normal	n	15.4	Benzo(k)fluoranthene
Chrysene	S4UL	350	5	0.2	23.0	8.5	0	Mean value below guideline	y	0			normal	normal	n	28.2	Chrysene
Dibenzo(a,h)anthracene	S4UL	3.6	5	0.1	2.9	1.1	0	Mean value below guideline	y	0			normal	normal	y	2.4	Dibenzo(a,h)anthracene
Fluoranthene	S4UL	23000	5	0.6	59.0	19.9	0	Mean value below guideline	y	0			normal	normal	n	68.0	Fluoranthene
Fluorene	S4UL	68000	5	0.1	1.7	0.5	0	Mean value below guideline	n	0			not normal	not normal	n	1.8	Fluorene
Indeno(1,2,3-cd)pyrene	S4UL	510	5	0.2	19.0	7.9	0	Mean value below guideline	y	0			normal	normal	n	25.4	Indeno(1,2,3-cd)pyrene
Naphthalene	S4UL	460	5	0.1	0.9	0.5	0	Mean value below guideline	y	0			normal	normal	n	1.2	Naphthalene
Phenanthrene	S4UL	22000	5	0.3	37.0	10.4	0	Mean value below guideline	n	0			not normal	not normal	n	40.2	Phenanthrene
Phenols	S4UL	1500	5	0.3	0.3	0.3	0	Mean value below guideline	y	0			not normal	not normal	n	0.3	Phenols
Pyrene	S4UL	54000	5	0.6	51.0	16.9	0	Mean value below guideline	y	0			not normal	not normal	n	58.7	Pyrene

Notes

S4UL	Suitable for Use Level as published by LQM/CIEH
C4SL	Category 4 Screening Level
SGV	Soil Guideline Value as published by the Environment Agency 2009
SSV	Soil Screening Value as derived by Soiltechnics
ATK	Soil Screening Value derived by Atkins
*	Assuming a SOM of 2.5%

Title: Analysis of test data in relation to concentrations of organic chemical contaminants.
Table number: 2

soiltechnics
environmental and geotechnical consultants

Analysis of test data in relation to concentrations of inorganic chemical contaminants

Adopted Model: Residential
Receptor: Proposed site user

Test procedure			Summary of test data					Initial comparison	Outlier test				Normality test			UCL	
Contaminant	Guideline source	Guideline value mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth	Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Arsenic	S4UL	37	5	13.0	30.0	22.6	0	Mean value below guideline	y	0				normal	normal	n	35.6	Arsenic
Beryllium	S4UL	1.7	5	1.0	2.2	1.5	2	Mean value below guideline	y	0				not normal	not normal	n	2.8	Beryllium
Boron	S4UL	290	5	0.4	1.1	0.7	0	Mean value below guideline	y	0				normal	normal	n	1.3	Boron
Cadmium	S4UL	11	5	0.1	2.4	0.7	0	Mean value below guideline	n	0				not normal	not normal	n	2.6	Cadmium
Chromium (III)	S4UL	910	5	5.1	46.0	26.6	0	Mean value below guideline	y	0				normal	normal	n	57.2	Chromium (III)
Copper	S4UL	2400	5	4.7	430.0	107.3	0	Mean value below guideline	n	0				not normal	not normal	n	461.8	Copper
Cyanide (total)	ATK	34	5	0.5	0.5	0.5	0	Mean value below guideline	y	0				not normal	not normal	n	0.5	Cyanide (total)
Lead	C4SL (l)	82	5	22.0	430.0	181.4	3	Mean value above guideline		0								Lead
Mercury#	S4UL	40	5	0.1	2.1	0.6	0	Mean value below guideline	n	0				not normal	not normal	n	2.3	Mercury#
Nickel	S4UL	180	5	3.7	42.0	24.9	0	Mean value below guideline	y	0				normal	normal	n	52.4	Nickel
Selenium	S4UL	250	5	0.2	0.2	0.2	0	Mean value below guideline	n	0				not normal	not normal	n	0.2	Selenium
Vanadium	S4UL	410	5	9.3	48.0	33.9	0	Mean value below guideline	y	0				normal	normal	n	63.3	Vanadium
Zinc	S4UL	3700	5	26.0	500.0	162.2	0	Mean value below guideline	n	0				not normal	normal	n	539.7	Zinc

S4UL Suitable for Use Level as published by LQM/CIEH
C4SL Category 4 Screening Level
C4SL (lower) (upper) Category 4 Screening Level for Lead at lower or upper bound of range
ATK Soil Screening Value derived by Atkins
BPG5 Guideline from BPG Note 5 as published by Forest Research

Assumed to be inorganic mercury as initial screening value

Title: Analysis of test data in relation to concentrations of inorganic chemical contaminants.
Table number: 3

soiltechnics
environmental and geotechnical consultants

Analysis of test data in relation to concentrations of organic chemical contaminants

Adopted model: Residential
Receptor: Proposed site user

Test procedure			Summary of test data					Initial Screening	Outlier test				Normality test			UCL	
Contaminant	Guideline source	Guideline value* mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth / Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Acenaphthene	S4UL	510	5	0.1	1.5	0.4	0	Mean value below guideline	n	0			not normal	not normal	n	1.6	Acenaphthene
Acenaphthylene	S4UL	420	5	0.1	1.6	0.6	0	Mean value below guideline	y	0			normal	normal	n	1.8	Acenaphthylene
Anthracene	S4UL	5400	5	0.1	12.0	3.1	0	Mean value below guideline	n	0			not normal	not normal	n	12.9	Anthracene
Benzo(a)anthracene	S4UL	11	5	0.3	26.0	9.7	2	Mean value below guideline	y	0			normal	normal	y	20.5	Benzo(a)anthracene
Benzo(a)pyrene	S4UL	2.7	5	0.3	30.0	11.6	3	Mean value above guideline		0							Benzo(a)pyrene
Benzo(b)fluoranthene	S4UL	3.3	5	0.3	29.0	11.5	3	Mean value above guideline		0							Benzo(b)fluoranthene
Benzo(g,h,i)perylene	S4UL	340	5	0.2	15.0	6.0	0	Mean value below guideline	y	0			normal	normal	n	19.6	Benzo(g,h,i)perylene
Benzo(k)fluoranthene	S4UL	93	5	0.1	12.0	4.7	0	Mean value below guideline	y	0			normal	normal	n	15.4	Benzo(k)fluoranthene
Chrysene	S4UL	22	5	0.2	23.0	8.5	1	Mean value below guideline	y	0			normal	normal	n	28.2	Chrysene
Dibenzo(a,h)anthracene	S4UL	0.28	5	0.1	2.9	1.1	2	Mean value above guideline		0							Dibenzo(a,h)anthracene
Fluoranthene	S4UL	560	5	0.6	59.0	19.9	0	Mean value below guideline	y	0			normal	normal	n	68.0	Fluoranthene
Fluorene	S4UL	400	5	0.1	1.7	0.5	0	Mean value below guideline	n	0			not normal	not normal	n	1.8	Fluorene
Indeno(1,2,3-cd)pyrene	S4UL	36	5	0.2	19.0	7.9	0	Mean value below guideline	y	0			normal	normal	n	25.4	Indeno(1,2,3-cd)pyrene
Naphthalene	S4UL	5.6	5	0.1	0.9	0.5	0	Mean value below guideline	y	0			normal	normal	n	1.2	Naphthalene
Phenanthrene	S4UL	220	5	0.3	37.0	10.4	0	Mean value below guideline	n	0			not normal	not normal	n	40.2	Phenanthrene
Phenols	S4UL	550	5	0.3	0.3	0.3	0	Mean value below guideline	y	0			not normal	not normal	n	0.3	Phenols
Pyrene	S4UL	1200	5	0.6	51.0	16.9	0	Mean value below guideline	y	0			not normal	not normal	n	58.7	Pyrene

Notes

S4UL	Suitable for Use Level as published by LQM/CIEH
C4SL	Category 4 Screening Level
SGV	Soil Guideline Value as published by the Environment Agency 2009
SSV	Soil Screening Value as derived by Soiltechnics
ATK	Soil Screening Value derived by Atkins
*	Assuming a SOM of 2.5%

Title
Analysis of test data in relation to concentrations of organic chemical contaminants.

Table number
4

soiltechnics
environmental and geotechnical consultants

Analysis of test data in relation to concentrations of inorganic chemical contaminants

Adopted Model: Industrial/Commercial and BPG5
Receptor: Vegetation

Test procedure			Summary of test data					Initial comparison	Outlier test				Normality test			UCL	
Contaminant	Guideline source	Guideline value mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth	Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Arsenic	S4UL	640	5	13.0	30.0	22.6	0	Mean value below guideline	y	0				normal	normal	n	35.6	Arsenic
Beryllium	S4UL	12	5	1.0	2.2	1.5	0	Mean value below guideline	y	0				not normal	not normal	n	2.8	Beryllium
Boron	S4UL	240000	5	0.4	1.1	0.7	0	Mean value below guideline	y	0				normal	normal	n	1.3	Boron
Cadmium	S4UL	190	5	0.1	2.4	0.7	0	Mean value below guideline	n	0				not normal	not normal	n	2.6	Cadmium
Chromium (III)	S4UL	8600	5	5.1	46.0	26.6	0	Mean value below guideline	y	0				normal	normal	n	57.2	Chromium (III)
Copper	BPG5	130	5	4.7	430.0	107.3	1	Mean value below guideline	n	0				not normal	not normal	n	461.8	Copper
Cyanide (total)	ATK	34	5	0.5	0.5	0.5	0	Mean value below guideline	y	0				not normal	not normal	n	0.5	Cyanide (total)
Lead	C4SL (l)	1100	5	22.0	430.0	181.4	0	Mean value below guideline	y	0				normal	not normal	n	545.1	Lead
Mercury#	S4UL	58	5	0.1	2.1	0.6	0	Mean value below guideline	n	0				not normal	not normal	n	2.3	Mercury#
Nickel	S4UL	980	5	3.7	42.0	24.9	0	Mean value below guideline	y	0				normal	normal	n	52.4	Nickel
Selenium	S4UL	12000	5	0.2	0.2	0.2	0	Mean value below guideline	n	0				not normal	not normal	n	0.2	Selenium
Vanadium	S4UL	9000	5	9.3	48.0	33.9	0	Mean value below guideline	y	0				normal	normal	n	63.3	Vanadium
Zinc	BPG5	300	5	26.0	500.0	162.2	1	Mean value below guideline	n	0				not normal	normal	n	539.7	Zinc

S4UL Suitable for Use Level as published by LQM/CIEH
C4SL Category 4 Screening Level
C4SL (lower) (upper) Category 4 Screening Level for Lead at lower or upper bound of range
ATK Soil Screening Value derived by Atkins
BPG5 Guideline from BPG Note 5 as published by Forest Research

Assumed to be elemental mercury as initial screening value

Title: Analysis of test data in relation to concentrations of inorganic chemical contaminants.
Table number: 5

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Analysis of test data in relation to concentrations of organic chemical contaminants

Adopted model: Industrial/Commercial and BPG5
Receptor: Vegetation

Test procedure			Summary of test data					Initial Screening	Outlier test				Normality test			UCL	
Contaminant	Guideline source	Guideline value* mg/kg	No. of tests	Min. mg/kg	Max. mg/kg	Mean mg/kg	No. of tests above guideline value	Initial screening	Pass outlier test?	Number of outliers	Location of outlier	Depth / Concentration mg/kg	Shapiro-Wilk Normality test	Probability plot test	Data normally distributed?	95% UCL of mean mg/kg	Contaminant
Acenaphthene	S4UL	97000	5	0.1	1.5	0.4	0	Mean value below guideline	n	0			not normal	not normal	n	1.6	Acenaphthene
Acenaphthylene	S4UL	97000	5	0.1	1.6	0.6	0	Mean value below guideline	y	0			normal	normal	n	1.8	Acenaphthylene
Anthracene	S4UL	540000	5	0.1	12.0	3.1	0	Mean value below guideline	n	0			not normal	not normal	n	12.9	Anthracene
Benzo(a)anthracene	S4UL	170	5	0.3	26.0	9.7	0	Mean value below guideline	y	0			normal	not normal	n	31.9	Benzo(a)anthracene
Benzo(a)pyrene	S4UL	35	5	0.3	30.0	11.6	0	Mean value below guideline	y	0			normal	normal	n	38.1	Benzo(a)pyrene
Benzo(b)fluoranthene	S4UL	44	5	0.3	29.0	11.5	0	Mean value below guideline	y	0			normal	normal	n	37.2	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	S4UL	4000	5	0.2	15.0	6.0	0	Mean value below guideline	y	0			normal	normal	n	19.6	Benzo(g,h,i)perylene
Benzo(k)fluoranthene	S4UL	1200	5	0.1	12.0	4.7	0	Mean value below guideline	y	0			normal	normal	n	15.4	Benzo(k)fluoranthene
Chrysene	S4UL	350	5	0.2	23.0	8.5	0	Mean value below guideline	y	0			normal	normal	n	28.2	Chrysene
Dibenzo(a,h)anthracene	S4UL	3.6	5	0.1	2.9	1.1	0	Mean value below guideline	y	0			normal	normal	n	3.7	Dibenzo(a,h)anthracene
Fluoranthene	S4UL	23000	5	0.6	59.0	19.9	0	Mean value below guideline	y	0			normal	normal	n	68.0	Fluoranthene
Fluorene	S4UL	68000	5	0.1	1.7	0.5	0	Mean value below guideline	n	0			not normal	not normal	n	1.8	Fluorene
Indeno(1,2,3-cd)pyrene	S4UL	510	5	0.2	19.0	7.9	0	Mean value below guideline	y	0			normal	normal	n	25.4	Indeno(1,2,3-cd)pyrene
Naphthalene	S4UL	460	5	0.1	0.9	0.5	0	Mean value below guideline	y	0			normal	normal	n	1.2	Naphthalene
Phenanthrene	S4UL	22000	5	0.3	37.0	10.4	0	Mean value below guideline	n	0			not normal	not normal	n	40.2	Phenanthrene
Phenols	S4UL	1500	5	0.3	0.3	0.3	0	Mean value below guideline	y	0			not normal	not normal	n	0.3	Phenols
Pyrene	S4UL	54000	5	0.6	51.0	16.9	0	Mean value below guideline	y	0			not normal	not normal	n	58.7	Pyrene

Notes

S4UL	Suitable for Use Level as published by LQM/CIEH
C4SL	Category 4 Screening Level
SGV	Soil Guideline Value as published by the Environment Agency 2009
SSV	Soil Screening Value as derived by Soiltechnics
ATK	Soil Screening Value derived by Atkins
*	Assuming a SOM of 2.5%

Title: Analysis of test data in relation to concentrations of organic chemical contaminants.
Table number: 6

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environmental and geotechnical consultants

Summary of leachate test results

Receptor	Groundwater	
Water type	Freshwater	
Fish type	0	
Water hardness	>250	mg/l

Contaminant	Guideline value (µg/l)	Guideline source	Location	DTS01	DTS02	DTS03	DTS04	DTS06	DTS07
			Depth (m)	0.20	0.20	0.30	0.20	0.30	0.30
Inorganics (µg/l)									
Arsenic	50	EQS (f)		4	1				< 1.0
Boron	2000	EQS (f)		< 20	< 20				39
Cadmium	5	EQS (f)		< 0.080	< 0.080				< 0.080
Chromium	250	EQS (f)		< 1.0	< 1.0				< 1.0
Copper	28	EQS (f)		3	2				5
Lead	250	EQS (f)		2	< 1.0				< 1.0
Mercury	1	EQS (f)		< 0.50	< 0.50				< 0.50
Nickel	200	EQS (f)		< 1.0	< 1.0				< 1.0
Selenium[1]	10	UKDWS		< 1.0	< 1.0				< 1.0
Vanadium[2]	60	EQS (f)		2	< 1.0				< 1.0
Zinc	500	EQS (f)		2	< 1.0				2
Free Cyanide[1]	50	UKDWS		<50	<50	0	0	0	<50
Nitrate as N	50000	UKDWS		700	950	<500	<500	<500	<500
Sulphate as SO4	400000	EQS(f)		<50	<50	0	0	0	<50
PAH (µg/l)									
Benzo(a)pyrene[1,4]	0.01	UKDWS		2.70	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene[2]	10	EQS (f)		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Sum of 4 PAH[1]	0.1	UKDWS		7.2	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*
TPH (µg/l)									
Hydrocarbons[1]	10	UKDWS				67	<2	<2	
Benzene	30	EQS (f)				< 1.0	< 1.0	< 1.0	
Toluene[2]	50	EQS (f)				< 1.0	< 1.0	< 1.0	
Ethyl benzene[3]	300	WHO				< 1.0	< 1.0	< 1.0	
Xylene[2]	30	EQS (f)				< 1.0	< 1.0	< 1.0	

Notes

1 EQS values not available
2 UKDWS not available
3 Lower detectable limit above UKDWS. Concentrations below detectable limits are not considered further.
* Taken as lower detection limit
# Taken as lower detection limit of a single compound
$ Hardness data presented by the Environment Agency

UKDWS UK Drinking Water Standard Guideline taken from "The Water Supply (Water Quality) Regulations 2000"
EQS (f) Environmental Quality Standard for freshwater published by the Environment Agency
EQS (s) Environmental Quality Standard for saltwater published by the Environment Agency

Title	Table number
Comparison of measured concentrations with guideline values	7

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Summary of petroleum hydrocarbon test results

Model: Residential

BTEX (Red highlights indicate exceedance of guideline value)

Indicator	unit	S4UL (mg/kg)	Concentration DTS03 0.30	DTS04 0.20	DTS06 0.30	DTS06 0.50	DTS07 0.30
Benzene	mg/kg	0.17	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	mg/kg	290	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	mg/kg	110	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
o-Xylene	mg/kg	140	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
m,p-Xylene	mg/kg	130	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Hydrocarbon banding (Red highlights indicate exceedance of GAC value)

Fraction	unit	S4UL (mg/kg)	Concentration DTS03 0.30	DTS04 0.20	DTS06 0.30	DTS06 0.50	DTS07 0.30
Aliphatic							
EC 5 - 6	mg/kg	78	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
EC >6 - 8	mg/kg	230	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
EC >8 - 10	mg/kg	65	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
EC >10 - 12	mg/kg	330	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
EC >12 - 16	mg/kg	2400	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
EC >16 - 35	mg/kg	92000	< 0.10	< 0.10	94.7	< 0.10	11
EC >35 - 44	mg/kg	92000	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic							
EC 5 - 7 (benzene)	mg/kg	140	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
EC >7 - 8 (toluene)	mg/kg	290	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
EC >8 - 10	mg/kg	83	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
EC >10 - 12	mg/kg	180	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
EC >12 - 16	mg/kg	330	< 0.10	1.1	< 0.10	< 0.10	< 0.10
EC >16 - 21	mg/kg	540	38	32	1.7	< 0.10	28
EC >21 - 35	mg/kg	1500	150	110	16	< 0.10	500
EC >35 - 44	mg/kg	1500	18	11	< 0.10	< 0.10	10

Title	Table number
Comparison of measured concentrations of petroleum hydrocarbons with guideline values	8

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Initial Conceptual Model (following source-pathway-receptor assessment)

Source	Pathway										Receptor		Risk assessment to CIRIA C552	
	Humans						Vegetation	Water					Consequence of risk occurring via most likely pathway	Risk
	Ingestion of air-borne dusts	Ingestion of soil	Ingestion of vegetables and soil attached to vegetables	Inhalation of air-borne dusts	Inhalation of vapours	Dermal contact with soil and dust	Root uptake, deposition to shoots and foliage contact	Percolation of water through contaminated soils	Near-surface water run-off through contaminated	Saturation of contaminated soils by flood waters				
Soils														
Past site use-residential properties	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Medium	Moderate
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
Past site use-formed garage	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Mild	Low/moderate
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Medium	Moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Medium	Moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Medium	Moderate
Underground storage tanks	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Mild	Low/moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Medium	Moderate
Current use of the site	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Mild	Low/moderate
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Mild	Low/moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Mild	Low/moderate
Made Ground soils	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Medium	Moderate
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Medium	Moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Mild	Low/moderate
Hydrocarbon impacted soils	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Medium	Moderate
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Medium	Moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Medium	Moderate

Title	Table number
Initial Conceptual Site Model	1

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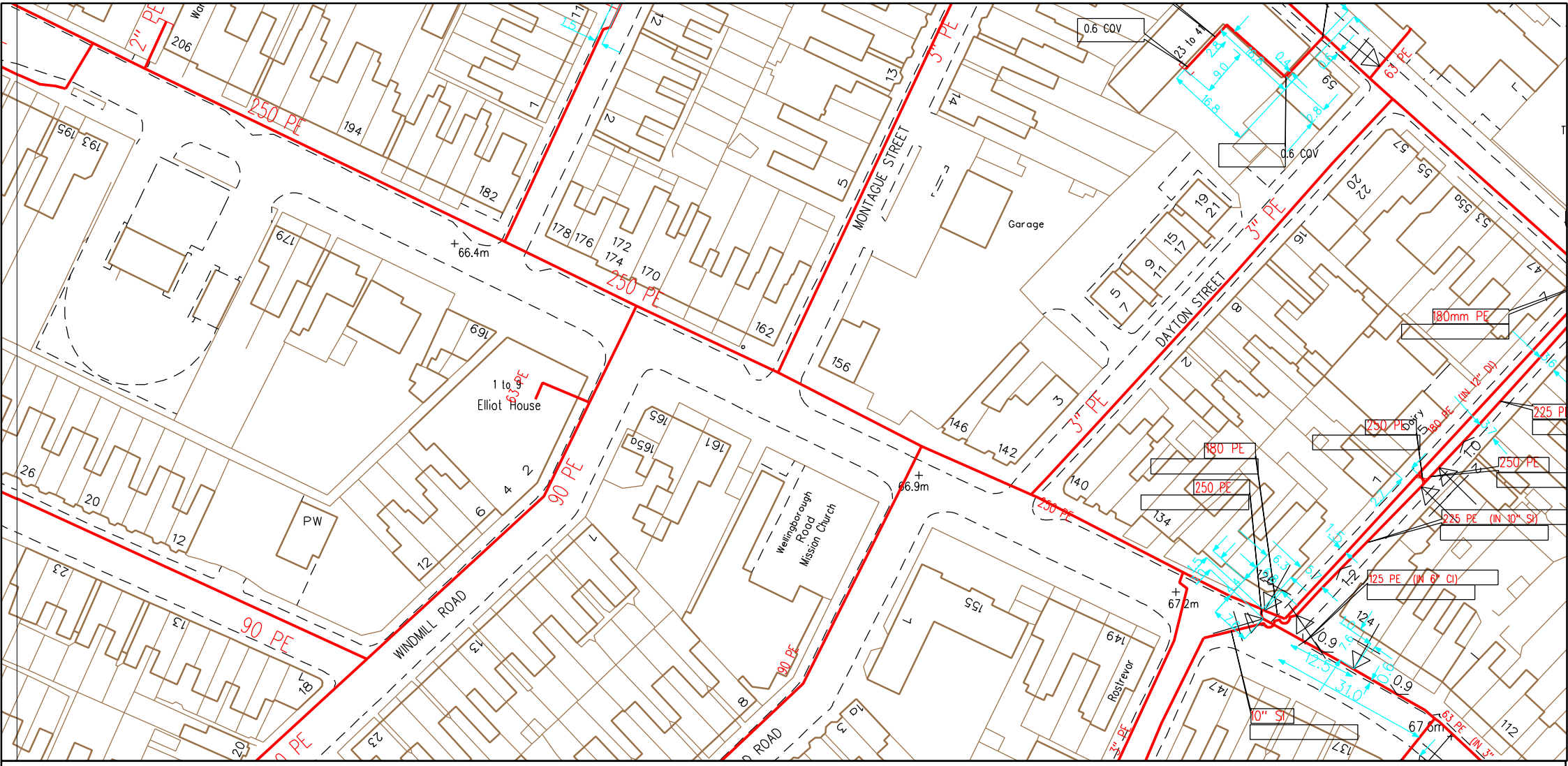
Updated Conceptual Model (following laboratory testing)

Source	Pathway										Receptor		Risk assessment to CIRIA C552	
	Humans						Vegetation	Water					Consequence of risk occurring via most likely pathway	Risk
	Ingestion of air-borne dusts	Ingestion of soil	Ingestion of vegetables and soil attached to vegetables	Inhalation of air-borne dusts	Inhalation of vapours	Dermal contact with soil and dust	Root uptake, deposition to shoots and foliage contact	Percolation of water through contaminated soils	Near-surface water run-off through contaminated	Saturation of contaminated soils by flood waters				
Soils														
Past site use-residential properties	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Minor	Low
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Minor	Low
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Minor	Low
Past site use-formed garage	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Mild	Low/moderate
Underground storage tanks	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Mild	Low/moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Mild	Low/moderate
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Minor	Low
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Mild	Low/moderate
Current use of the site	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Mild	Low/moderate
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Minor	Low
Made Ground soils	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Minor	Low
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Minor	Low
Hydrocarbon impacted soils	Likely	Low likelihood	Unlikely	Likely	Likely	Likely	-	-	-	-	Current site users	Adult	Minor	Low
	Likely	Likely	Likely	Likely	Likely	Likely	-	-	-	-	Proposed site users	Child	Medium	Moderate
	Likely	Likely	Unlikely	Likely	Likely	Likely	-	-	-	-	Construction operatives	Adult	Minor	Low
	-	-	-	-	-	-	Likely	-	-	-	Vegetation (proposed)	-	Minor	Low
	-	-	-	-	-	-	-	Likely	Low likelihood	Unlikely	Water (current and proposed)	-	Minor	Low

Title	Table number
Updated Conceptual Site Model	2



SCALE: Not to scale	LP MAINS
USER ID: RachelB	MP MAINS
DATE: 08/03/2016	IP MAINS
EXTRACT DATE: 11/12/2015	LHP MAINS
MAP REF: SP9566	NHP MAINS
CENTRE: 495147, 266912	

Some examples of Plant Items:

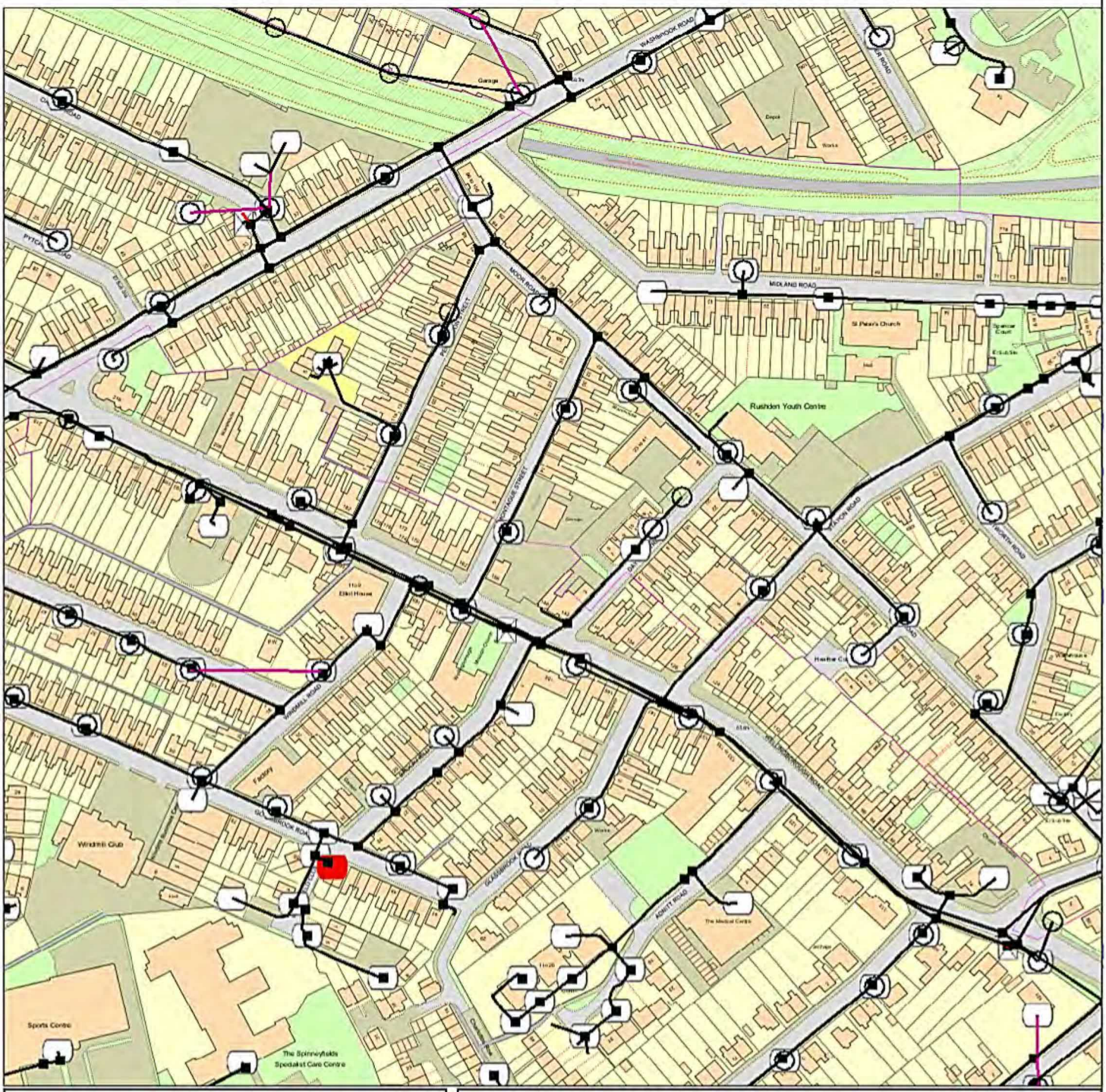
Valve | Depth of Cover | Syphon | Diameter Change | Material Change

This plan shows those pipes owned by National Grid Gas plc in their role as a Licensed Gas Transporter (GT). Gas pipes owned by other GTs, or otherwise privately owned, may be present in this area. Information with regard to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections, etc. are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by National Grid Gas plc or their agents, servants or contractors for any error or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue. Further information on all DR4s can be determined by calling the DR4 hotline on 01455 892426 (9am-5pm) A DR4 is where a potential error has been identified within the asset record and a process is currently underway to investigate and resolve the error as appropriate.

MAPS Viewer Version 5.6.7.0

Local Machine

Maps by email Plant Information Reply



IMPORTANT WARNING

Information regarding the location of BT apparatus is given for your assistance and is intended for general guidance only. No guarantee is given of its accuracy. It should not be relied upon in the event of excavations or other works being made near to BT apparatus which may exist at various depths and may deviate from the marked route.

DIAL BEFORE YOU DIG

FOR PROFESSIONAL ON SITE ASSISTANCE PRIOR TO COMMENCEMENT OF EXCAVATION WORKS

ADVANCE NOTICE REQUIRED
(Office hours: Monday-Friday 08.00 to 17.00)

Tel: 0800 9173993
E-mail: dbyd@openreach.co.uk
Website: www.dialbeforeyoudig.com

KEY TO BT SYMBOLS

UNDERGROUND PLANT	POLE
A/C, D/W or W OVERHEAD PLANT	CABINET
JOINT BOX	BURIED JOINT
456 OR 456 DISTRIBUTION POINT	J JOINTING POST
MANHOLE OR 72	PROPOSED U/G
DP BOUNDARY	A/C, D/W or W PROPOSED O/H
OR OTHER BT BOUNDARY	PROPOSED BOX

Other proposed plant is shown using dashed lines. BT symbols not listed above may be disregarded. Existing BT plant may not be recorded. Information valid at the time of preparation.

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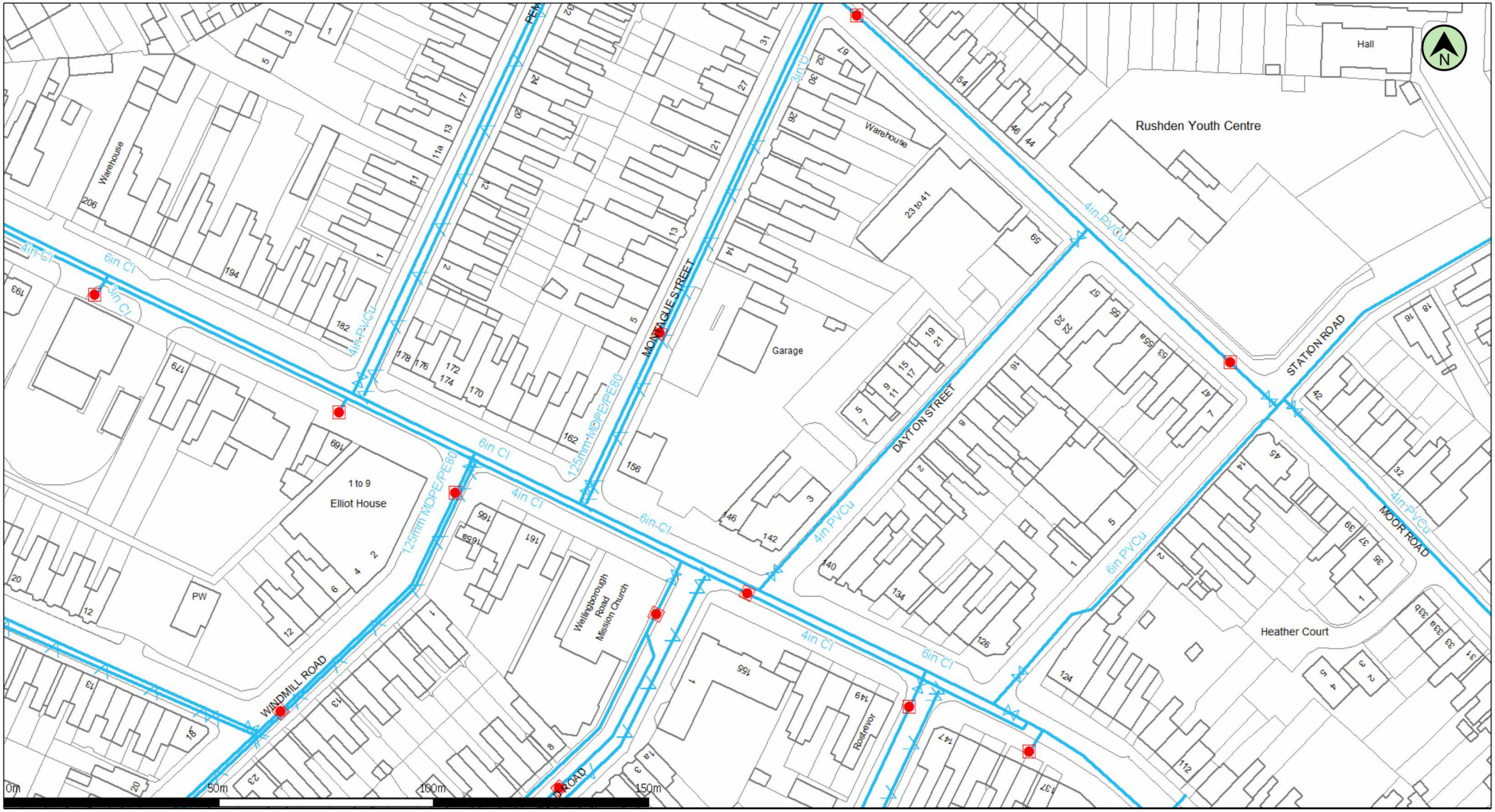
BT Ref : ZPJ03086Z
Map Reference : (centre) SP9518466930
Easting/Northing : (centre) 495184,266930
Issued : 08/03/2016 15:08:54

FOOTNOTE: WARNING IT IS ESSENTIAL THAT YOU CONTACT NATIONAL NETWORK HANDLING CENTRE BY EMAIL nnhc@openreach.co.uk BEFORE PROCEEDING WITH ANY WORK IN THE HATCHED AREA



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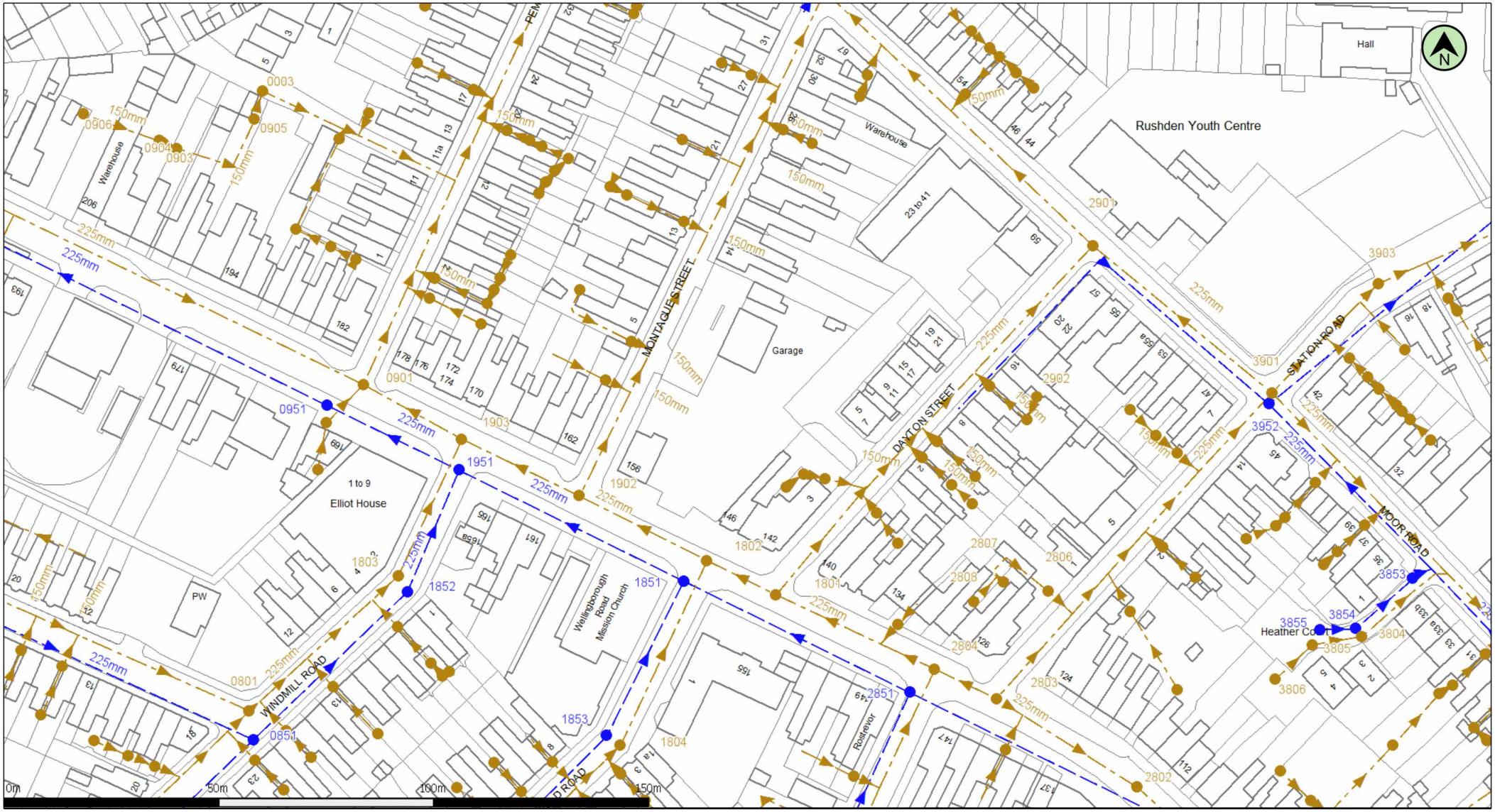
This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2016 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Potable Water
Raw Water
Decommissioned Water
Fitting
Hydrant

rachel.brown@soiltechnics.net

Montague Street

love every drop anglianwater



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- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main (Colour denotes effluent type)
- Private Sewer (Colour denotes effluent type)
- Decommissioned Sewer (Colour denotes effluent type)
- Outfall (Colour denotes effluent type)
- Inlet (Colour denotes effluent type)
- Manhole (Colour denotes effluent type)
- Sewage Treatment Works
- Pumping Station

rachel.brown@soiltechnics.net

Montague Street

love every drop anglianwater

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Our Ref: 8173841 Your Ref: STN3556B

Tuesday, 08 March 2016

R Brown
Cedar Barn White Lodge
Walgrave
Northamptonshire
nn6 9PY

Western Power Distribution,
Mapping Centre
Toll End Road
Tipton
West Midlands
United Kingdom
DY4 0HH
www.westernpower.co.uk

Map Response
T 0121 623 9780
F 0121 623 9223
WPDMapResponse
@westernpower.co.uk

LinesearchbeforeUdig
Help Desk 0845 437 7365

Dear R Brown

Thank you for your enquiry dated Tuesday, 08 March 2016

I now enclose a copy of our plan showing existing Western Power Distribution (WPD) Electricity / WPD Surf Telecom apparatus in the vicinity of your proposed works. This information is given as a general guide only and its accuracy cannot be guaranteed. Please note that all WPD equipment on site should be assumed to be LIVE until WPD prove otherwise and provide you with confirmation to this effect in writing. Recent additions to our network, or service connections between the main cable and a building or street lamp may not be shown.

Damage to underground cables and contact with overhead lines can cause severe injury or may prove fatal. If you are excavating on site in the vicinity of either WPD Electrical apparatus or WPD Surf Telecom apparatus you must comply with the requirements of the following:-

Health & Safety Executive guidance HS(G)47, Avoiding Danger from underground services.

Work taking place in the vicinity of our plant is also regulated under the:-

Electricity at Work Regulations 1989, Health and Safety Act 1974, CDM Regulations 2015.

Safe working procedures should be defined and practiced

Please ensure that the use of mechanical excavators in the vicinity of our plant is kept to a minimum. WPD Surf Telecom ducts contain fibre cables, which are expensive to repair. Therefore, extreme care must be taken whilst working in the vicinity of these ducts, hand digging methods being used to determine their precise position.

If there are overhead lines crossing your site and your proposal involves building works which may infringe the clearance to our overhead system then you should call the relevant general enquiries number (see page 2 of this letter) for advice. Where overhead lines cross your site you must comply with the requirements of Health & Safety Executive guidance as laid down in GS6, Avoidance of Danger from Overhead Electric Lines.

Where diversions to WPD apparatus are needed to allow change to occur on site, the cost of these alterations may be charged to the persons responsible for the works.

If you require advice in connection with your proposals please contact the relevant general enquiries number (see page 2 of this letter)

Following consultation the local Western Power Distribution team will where necessary prepare detailed proposals and provide a quotation for any necessary alterations and/or development of our equipment on the site.

Yours sincerely
WPD Map Response Team

Western Power Distribution PLC
South West - 02366894
South Wales - 02366985
East Midlands - 02366923
West Midlands - 03600574

Registered in
England and Wales

Registered Office:
Avonbank
Feeder Road
Bristol
BS2 0TB

Contact Us

You can contact us 24 hours a day, 7 days a week, 365 days a year with any power supply issues on **0800 6783 105**

Mapping Enquiries
If you have an enquiry relating to this letter or the attached map plan, please contact us using the following information:

Telephone	0121 623 9780
Fax	0121 623 9223
Email	WPDMapResponse@westernpower.co.uk

General Enquiries
If you have a general enquiry, please call us on the following telephone number:

All areas	0800 096 3080

LinesearchbeforeUdig
If you have an enquiry relating to the use of the LinesearchbeforeUdig website please contact LinesearchbeforeUdig using the following information:

Telephone	0845 437 7365
Email	enquiries@linesearchbeforeudig.co.uk
Website	www.linesearchbeforeudig.co.uk

Steps to help keep you safe

- **If you are working within 10 metres of our 33kV, 66kV, 132kV underground electricity cables or within 10 metres of an overhead electricity line you should call the relevant General Enquiries for free safety advice.**

  Safety Documents – please download our informative safety documents to help ensure that you, your staff and the public are kept safe whilst working in the vicinity of electricity.
  http://www.westernpower.co.uk/Health-and-Safety/Public-Safety

- **Make sure you have up to date plans** - remember that recent additions to our network or service connections between the main cable and a building or street lamp may not be shown.

- **Look for signs of service cables -** an electricity meter box or nearby streetlamp may give you an indication that service cables are present in your area of work.

- **Non WPD Network -** electricity cables, lines and equipment owned by others may also be present in addition to WPD network. They are unlikely to be shown on our plans.

- **Use a cable locator** - trace electricity cables and mark the position of them using paint or other waterproof marking on the ground.

- **Hand dig trial holes** - to confirm the position of cables in close proximity to your area of your work and use spades and shovels rather than picks, pins or forks.

- **Have an emergency plan** - so that everyone working on site understands what to do in the event of an underground electricity cable being damaged or contact being made with an overhead electricity line.

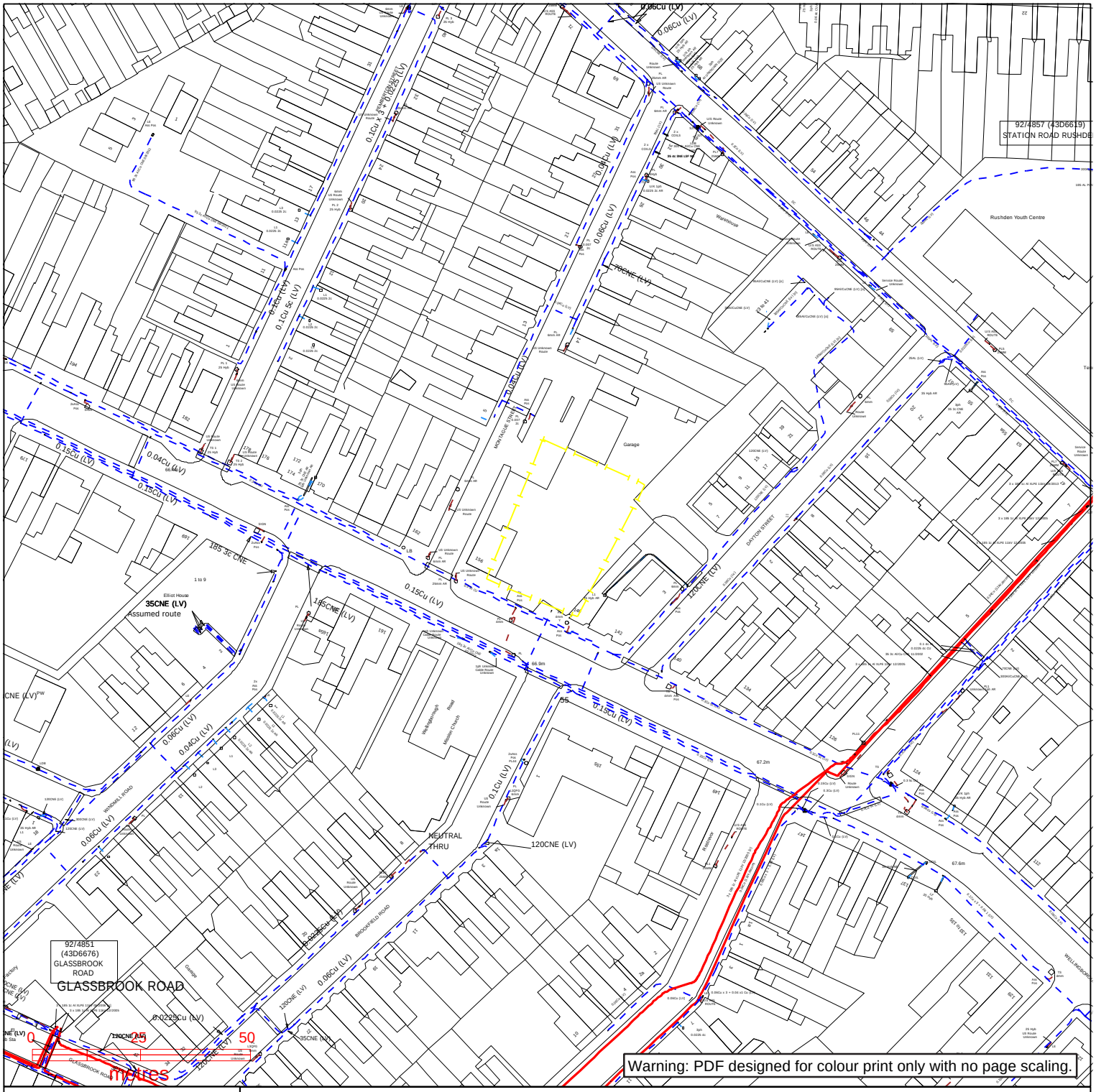
- **If you are working within 10 metres** of an overhead electricity line then it may be necessary for you to erect warning signs and markers, or height restriction goal posts. Ensure that you comply with the requirements of Health & Safety Executive guidance laid down in GS6, Avoidance of Danger from Overhead Electric Lines.

- **If you are erecting a structure** that could allow anyone standing on it, or its access device (ladder, scaffold, MEWP), to come within 3m of any overhead electric line then **you must inform us**. This is your duty and a legal requirement under the Electricity Safety, Quality & Continuity Regulations 2002.

- **If you cannot work safely** around the underground electricity cable or overhead electricity line, then you may need to get it moved to allow your works to go ahead. Call the general enquiry numbers above for guidance.

- **It is possible that cables or pipes may be embedded in concrete** - electricity cables embedded in concrete MUST be made 'dead' by Western Power Distribution or the cable owner before the concrete is broken out. Alternatively, another safe way of working should be agreed.

Cables are sometimes covered by tiles or a marker tape - these can be concrete, polythene or earthenware and are a useful early warning of the presence of cables; you should avoid disturbing any tiles or tape to expose the cable. Not all cables have these warning indicators.



Warning: PDF designed for colour print only with no page scaling.

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Contact U

Mapping Enquiries:
All areas 0121 623 9780
General Enquiries:
All areas 0800 096 3080

Date Requested: 08/03/2016
Job Reference: 8173841
Site Location: 495176 266923
Requested by:
Mrs R Brown
Your Scheme/Reference:
STN3556B

Exact Scales:
1:1250 Area or Circle dig site
1:500 Line dig site

Link Box

Site Location
Line/Area

Overhead Line
PL
Service
LV
HV (11kV)
HV (33kV)
HV (66kV)
HV (132kV)

Underground Cable

SURF Telecoms

PME Earth

Underground Earth

Pilot Cables

Pole Mounted Transformer

Ground Mounted Transformer

* Advice should be sought from the Western Power Distribution General Enquiries team for any work that is to take place in proximity to 132kV underground cables and 132kV overhead lines

IMPORTANT NOTICES

This information is given as a guide only and its accuracy cannot be guaranteed. Services or recent additions to the network may not be shown.

Cables, overhead lines & substations owned by other electricity network owners or private companies may be present but will not be shown.

You should always verify exact locations of cables using a cable locator and by careful use of hand tools in accordance with HSE guidance note HSG47.

When working within 10m of any overhead electric line you should follow the requirements of HSE Guidance Note GS6.

For further advice on working near our electricity cables or lines, call our General Enquiries number.

Report damage immediately – KEEP EVERYONE AWAY FROM THE AREA
0800 6783 105