Roxhill Developments Limited

M1 Junction 15 West, Northampton

Preliminary Ground Investigation Interpretive Report

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RSK GENERAL NOTES

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1 INTRODUCTION

1.1 Introduction

RSK Environment Limited (RSK) has been commissioned by Roxhill Developments Limited (the Client) to carry out a Preliminary Ground Investigation Interpretive Report for the site of the proposed commercial development at M1 Junction 15 west.

This report is subject to the RSK service constraints given in Appendix A.

RSK has produced a Preliminary Sources Study Report (reference 312598 - 01 (00), October 2014) and a Factual Ground Investigation Report (reference 312598 - 02 (00), October 2014) pertaining to the site, both of which support and should be read in conjunction with this report.

1.2 Terms of reference

This report comprises a preliminary ground investigation report in general accordance with the requirements of:

- BS5930:1999+A2:2010 'Code of practice for site investigations':
- Environment Agency CLR 11 2004a 'Model Procedures for the Management of Land Contamination' (Contaminated Land Risk Assessment):
- Highways Agency HD22/08, 'Managing Geotechnical Risk' (Ground Investigation): and
- BS EN 1997-2:2007. Eurocode 7 — Geotechnical design — Part 2: Ground investigation and testing.

1.3 Proposed development

It is understood that the site is being considered for commercial development. The development area located within the north eastern area of the site includes two large distribution warehouses with associated loading bays, hard standing and access routes, as well as a two story office building. Site drainage including five drainage ponds located at either end of the distribution warehouses, a highway network joining to the A508 and soft landscaping with a bund around the north, east and west of the proposed development.

In order to undertake the commercial development a cut and fill exercise will be undertaken at the site.

1.4 Objective

The subject of this report is the development area including the proposed Main Development Plateau for the construction of distribution warehouses, office block and associated hardstanding. In accordance with the Client's specific objectives,

requirements and brief; the objective for the works was developed with the aim of providing a preliminary ground investigation report which includes:

- provide sufficient data to confirm the ground model
- obtain data to provide a chemical and geotechnical characterisation of each strata
- assist with master planning design
- provide data to support planning applications

In line with Eurocode 7, BS5930, BS10175 and CLR 11 further phases of targeted investigation (post Planning Approval) may be required to provide specific data and information for detailed design of individual elements of the scheme as the design evolves.

1.5 Scope

The project has been carried out to an agreed brief as set out in RSK's proposal (ref. M1 Junction 15 West, Northampton; Geotechnical and Geo-environmental Services; Master Planning and EIA Support, dated 10th July 2014).

The intrusive investigation elements have been restricted to the proposed development area of the site.

No investigation was possible within the south western corner and south eastern corners of the site as these areas were still cropped at the time of the investigation and permission was denied by the land owner. Access to the gun club area was not permitted at any point during the investigation, although the gun club does not fall within the areas of proposed development. In addition, ecological constraints and considerations had to be taken account of in the planning and locating of intrusive investigation exploratory holes.

1.6 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

2 SITE DETAILS

2.1 Site location

The site covers approximately 172 hectares, the centre of which is defined by the following National Grid co-ordinates: 474940, 254715. The site is bound by the M1 motorway which runs roughly north west to south east along the north eastern boundary of the site and the A508 running north east to south west along the south eastern boundary of the site. A brook with fields beyond denotes the southern boundary of the site, and hedgerows with fields beyond define the western boundary. Collingtree Lane marks the northern boundary of the site.

The village of Blisworth is situated approximately 1km to the west of the site. The village of Milton Malsor is located approximately 0.5km north west of the site and the village of Collingtree is located some 100m east beyond the M1 Motorway.

2.2 Local topography, geography and geomorphology

The site sits within a formerly glaciated area. The land is gently undulating with a general rise from the southern extent to the north eastern corner

The site generally slopes down from west to east, with the peak of the hill on which the site sits being located near to the centre of the western boundary of the site. The top of the hill forms a ridge which extends along the majority of the western boundary of the site. At its highest, the site elevation is approximately 102m AOD, located near to the centre of the western boundary, down to its lowest elevation of approximately 80m AOD along the sites eastern boundary, within a shallow valley associated with the unnamed brook flowing north east, along the sites south eastern boundary.

The M1 motorway is located in a shallow cutting along the eastern site boundary.

The geological sequence of the area is understood to be one of fossiliferrous mudstone and siltstone, laminated and bituminous in part, with thin siltstone or silty mudstone beds and rare fine-grained calcareous sandstone beds deposited within sea conditions and eroded by periods of glaciations and later deposition of Oadby Member and Glaciofluvial Deposits.

2.3 Site description

The site is predominately utilised for arable farming and comprises fields with hedgerow field boundaries including a variety of immature to mature sized trees of various species. Two areas of mixed woodland are also located within the site. The woodlands are located near to the centre of the site, adjacent to the main access track trough the site. The majority of fields comprised stubble from recent harvesting, however the fields in the extreme south of the site comprised bean crops. The general elevation of the surrounding land undulates up and down, with the site elevations generally sloping down from northwest to south and south east.

The main access to the site is via a rough compacted gravel track leading north from the south western quarter of the site off of the A508, towards the sites centre. In the centre of the site, just off the track is a spoil head of rubble consisting of brick tarmac and stone (presumed to be used for improving farm tracks).

There are two buildings located on the site. To the south west of the centre of the site is a gun club with shooting range and clay pigeon shooting. Derelict farm buildings including two derelict outhouses are also located in the east of the site. The derelict farm buildings are either of stone construction, which is in particularly poor condition, or corrugated sheet metal sheds.

An overhead 1.1kv power supply enters the north west of the site, travelling south east and south towards the derelict farm buildings on low level wooden poles. The derelict farm buildings are generally empty but appear to be utilised as a store for stone as well as containing two former fuel tanks, now appearing to be partially filled with water.

The site also contains two telecom masts , one is located in the south eastern corner of the site accessed via concrete track running from the A508, while the second mast is located in the north east close to the boundary and footbridge to Collingtree beyond the M1.

At the south of the site is a brook which flows north east towards Northampton.

It was also noted from ecological plans supplied to RSK that the site has two badger sets which are located in the east of the site. One is located on the north east corner in coniferous woodland and the second is within a boundary hedge. The ecological plans supplied to RSK also indicate that there is a pond within the grounds of the gun club which may have contained great crested newts, as well as common lizard habitats and bat roosts. RSK was prohibited from entering the property associated with the gun club on health and safety grounds and as such these features were not observed during the walkover.

Supplied plans also indicated existing underground gas and water district mains in the east corner of the site though no markers were observed.

3 SUMMARY OF AVAILABLE INFORMATION

3.1 Published geology and expected ground conditions

The British geological Survey (BGS) plans and maps obtained have been reviewed to determine the anticipated geology beneath the site.

It is envisaged that the local geology beneath the site will be in line with the summary below detailed within Table 1.

Table 1: Expected geology

Geology	Comment
Surfacing and Buried Structures: (source: Envirocheck History Maps, Site Observation)	Hard standing was identified along tracks to existing farm buildings in the east of the site as well as to a telecoms mast in the east of the site. Hard standing was also associated with the derelict farm buildings in the east of the site.
Made Ground / Topsoil: (source: BGS Maps, Available Borehole Logs, Envirocheck Geology & History Maps, memoirs)	The entire Site is anticipated to be underlain by a cultivated plough layer resulting in a sub soil or growing medium rather than topsoil which meets the BS for topsoil. Given its extensive use for arable crops it is anticipated that this layer could extend between 0.2 and 0.6m depth and is anticipated to be derived from the underlying Glacial Deposits beneath so would be expected to comprise sandy gravelly clay.
Drift Deposits: (source: BGS Maps, Available Borehole Logs, Envirocheck Geology & History Maps, memoirs)	The majority of the site appears to be underlain by a mantle of **Oadby Member** (Diamicton Till / Glacial Till) which is anticipated to be primarily sandy gravelly clay. It may also contain sandy gravel strings, lenses and pockets which may bare perched or trapped groundwater. In the north and east fingers of **Glaciofluvial Deposits** are anticipated to be present and are likely to take the form of sands and gravels.
Bedrock (source: BGS Maps, Available Borehole Logs, Envirocheck Geology & History Maps, memoirs)	The entirety of the Site is indicated to be underlain by **Whitby Mudstone Formation** likely to be weathered beneath the overlying superficial deposits to firm to stiff brown and blue grey clays tending to mudstones with subordinate siltstone, limestone bands. Calcareous shell, fossil fragments and naturally occurring sulphate crystals are common throughout these deposits.
Mining (source: Coal Authority web viewer, BGS Maps, Available Borehole Logs, Envirocheck records, Geology & History Maps)	None Identified.
Faults (source: BGS Maps, Available Borehole Logs, Envirocheck Geology Maps, memoirs)	None Identified.
Opencast Quarrying (source: Coal Authority web viewer, BGS	Some sand and gravel quarries noted within 400m of the site, although none expected on site. A site at Milton Malsor located immediately beyond the northern boundary of

Geology	Comment
Maps, Envirocheck History Maps)	the site has allocated permissions for the extraction of up to 1.2M tonnes of glacial sands and gravels.
Soil Chemistry (source: Envirocheck / BGS)	Available soil chemistry data suggests that the natural soils anticipated to be present across the site are unlikely to contain any significantly elevated concentrations of contaminants that would be considered to represent a risk to Human Health for a commercial development.

4 GROUND INVESTIGATION

The investigation undertaken at the site comprised the following:

- Setting out and service Clearance (RSK SafeGround).
- Excavation of twenty seven trial pits using an operated tracked excavator to depths of between 1.80m and 4.80m bgl.
- Carry out three soakaway tests in selected trial pits in general accordance with BRE 365.
- Sinking of sixteen window sample boreholes to depths of between 3m and 6m bgl using a windowless sampler drilling rig.
- Sinking of sixteen boreholes to depths of between 7.50m and 20.45m bgl using a standard cable percussive drilling rig.
- Installation of twenty four combined groundwater/gas monitoring wells and piezometers to varying depths including provision of flush lockable covers and 1.5m high wooden marker stakes (in fields).
- Four initial return visits to monitor groundwater levels/ground gas concentrations
- One groundwater sampling visit.
- Surveying in of as built exploratory hole positions using GPS surveying equipment.
- Removal of instrumentation covers and capping of instrumentation.
- Associated sampling and insitu testing.
- Soil sample geotechnical laboratory testing.
- Soil sample chemical and contamination laboratory testing.
- Groundwater sample chemical and contamination laboratory testing.

Full records and details covering the methodology of the investigation, the location rationale for exploratory holes, exploratory hole logs, completed laboratory testing results and exploratory hole location drawings are presented separately within the Factual Ground Investigation Report (312598 – 02 (00)).

The ground investigation was developed to supplement the findings of the desk study research which is presented separately within the Preliminary Sources Study Report (312598 – 01 (00)). The investigation was designed to confirm the anticipated ground conditions and to obtain strata geotechnical and chemical properties to allow design assessments to be refined. Specific issues targeted by the ground investigation are identified in Table 2 below:

Table 2: Issues targeted within the ground investigation

	Area	Issue	Exploratory Holes	Testing	Comments
Geo-environmental	Whole Site	General chemical characteristics of the Topsoil, near surface sub soils and groundwater as the site is Greenfield	All	Chemical analysis	To confirm contamination risk potential. To confirm in ground aggressivity for concrete mix designs
Geotechnical	Whole Site	General geotechnical characteristics	All	Soils testing	To confirm distribution, classification, uniformity in plan and depth
	Cuttings and earthworks properties	Strata depths, properties and groundwater levels	CP1-3/5/12 WS4-11 TP1/2/6/(s) 11/12/13/(s) 20/21-23/ 25/26	SPT, PI, QUTxl, Hand Shear Vane, Consols, Compaction, MCV/MCC, Recompact CBR	To confirm strata strength characteristics and uniformity. To confirm distribution, classification and reusability in earthworks filling operations
	Embankment Foundations	Strata depths and properties and groundwater levels	WS1—8/ 13-16 TP1/2/4/5/6/ 11/12/27/28	Classification and Compaction testing	To confirm strata strength characteristics and uniformity
	Buildings Plateau Foundations	Strata depths and properties and groundwater levels	CP1 -16 WS9-12 TP6-10/13/14/16 /17/19	PI, QUTxl, Consols	To confirm bearing and settlement characteristics and uniformity of strata
	Hard standing and highways and earthworks	Strata depths and properties and groundwater levels	TP4-9/13/22-26	Classification, Compaction testing and recompacted CBR.	To confirm distribution, classification, uniformity in plan and depth
	Flood Attenuation Ponds	Soil Infiltration	TP(s)5/15 /20	Soakaways, permeability tests and classification tests	To define permeability's and effectiveness of soakaways or need for lining of ponds

Due to ecological constraints (a barn owl roost) the derelict farm buildings which fall within the proposed development area, east of the centre of the site, could not be investigated. These derelict buildings contain tanks which should be investigated once access is available or during enabling works. Similarly, the gun club area could not be investigated due to access not being granted, however, this area, while on site, is outside of the proposed development area.

5 GROUND CONDITIONS IDENTIFIED

The results of the Preliminary Ground Investigation and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented separately in the Factual Ground Investigation Report (312598–02(00)).

5.1 Ground conditions

The exploratory holes revealed that the site is underlain by a variable thickness of agricultural topsoil and subsoil over drift deposits including, the Oadby Member (Glacial Till) over Glaciofluvial deposits. Both the drift deposits encountered contained bands of cohesive and granular strata.

Underlying these drift deposits the strata of the Whitby Mudstone Formation was primarily clay with weathered siltstone and mudstone bands. This appears to confirm the stratigraphical succession described within the initial conceptual model and this is represented pictorially within the sections presented as Figures 8 – 10 within this report.

For the purpose of discussion, the ground conditions are summarised in Table 3 and the strata discussed in subsequent subsections.

Table 3: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to Bottom of stratum m bgl	Thickness (m)
Agricultural Topsoil (Plough Layer)	CP1-16, WS1-16, TP1-28	0.10 – 0.50	0.10-0.50
Subsoil	CP1/2/4/5/8, WS1/5/8/10/12/13/15/16, TP3/4/13/16/17/19/20(s)/22/24-28	0.40 – 1.30	0.10 – 0.90
Oadby Member (locally absent)	CP1-3/5-15, WS1/3-16, TP1-2/4/6-22/ 24-25/27-28	1.20 – 11.70	0.55 – 10.90
Glaciofluvial Deposits (locally absent)	CP1 -5/15-16, WS2-4/7/8/10/11/16, TP3-10/13/15/20/22/23/26/27	3.20 - >20.45	0.5 - >8.75
Whitby Mudstone Formation (clay)	CP3-16, WS11/13-16, TP14/22/26	Proven to greater than 15.45m in CP4 & 5	>8.85
Note: **Thickness' are proven thickness in exploratory holes and not full thickness of strata. Strata are likely to be thicker.**			

5.1.1 Agricultural topsoil

The topsoil (ploughed surface materials) across the site generally comprised slightly brown sandy slightly gravelly clay, or slightly gravely clayey sand. The gravel comprised angular to rounded fine to coarse sandstone, quartzite, flint, chalk and rare brick. The Agricultural Topsoil ranged in thickness between 0.10 to 0.50m thick but was generally 0.3 to 0.40m thick across most of the site.

The recorded laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Seven soil samples of these deposits were sent for contamination screening testing.

No obvious visual or olfactory evidence of contamination was identified within any of these deposits encountered during the ground investigation.

5.1.2 Subsoil

The subsoil (ploughed surface materials) across the site generally comprised orange brown slightly sandy slightly gravelly clay, or clayey sand. The gravel comprised angular to rounded fine to coarse quartzite, flint and chalk. The Subsoil was encountered below the Agricultural Topsoil and ranged in thickness between 0.10 to 0.90m thick where identified to be present. The variations in thickness may in part be attributed to historic ridge and furrow farming techniques which may have been employed in the area in the past.

The recorded laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Three soil samples of these deposits were sent for contamination screening testing.

No obvious visual or olfactory evidence of contamination was identified within any of these deposits encountered during the ground investigation.

5.1.3 Oadby Member

This stratum was encountered immediately beneath the topsoil/subsoil across the majority of the site and mainly comprised of firm to stiff brown or dark grey slightly sandy slight gravelly silty CLAY. The gravel fraction comprised mixed lithologies including chalk, quartz, flint, coal and ironstone. Locally these deposits included zones of very clayey silts, very silty clays and pockets of sands and gravely sands.

Available exploratory holes indicate that these stratums can vary in thickness between 0.55 – 10.90m, with the majority of holes where full thickness was defined suggesting thickness of around 4 to 5m.

These deposits were recorded to be generally stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 4 below and are included within the Appendix J.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 4: Summary of in-situ and laboratory test results for the cohesive Oadby Member

Soil parameters	Range	No Tests
Moisture content (%)	10 – 30 (av 23.5)	38
Liquid limit (%)	28 – 73 (av 52)	28
Plasticity limit (%)	13 – 24 (av 19.5)	
Plasticity index (%)	11 – 51 (av 33)	
Plasticity term	CL - CH	
Shrinkage Potential	Low to High	NHBC
Clay (%)	25 – 72 (av 54)	14
Silt (%)	25 – 71 (av 38)	
Sand (%)	0 – 27 (av 5)	
Gravel (%)	0 – 10 (av 2)	
Earthworks Class	Class 2A Wet Cohesive	HA MCDHW Series 600
Maximum Dry Density – 4.5kg Rammer (Mg/m^3)	1.50 – 1.83 (av1.71)	13
Optimum Moisture Content - 4.5kg Rammer (%)	15 – 28 (av 20)	
Natural Moisture Contents of samples tested (%)	19 – 29 (av 26)	
Lowest Acceptable Moisture Content Range that should allow 95% compaction and 5% or less air voids to be achieved (interpolated from test graphs)	14.5 – 26.5 (av 19.4)	
Highest Acceptable Moisture Content Range that should allow 95% compaction and 5% or less air voids to be achieved (interpolated from test graphs)	20 – 30.5 (av 24.5)	
Re-compacted CBR – 4.5kg Rammer (%)	0.7 – 13.0 (20 - 29% mc)	10
Moisture Condition Value (MCV)	10.7 – 12.6 (24 - 29% Nat mc)	5
Moisture Condition Calibration (MCC) MCV 8 = MCV 13 =	 29.00 – 31.90%mc 22.80 – 24.00%mc	3
SPT 'N' values (depth plots presented separately)	5 - >50	97
Undrained shear strength inferred from SPT 'N' values (kN/m^2)	23 - >300	
Stiffness term	Soft to Very Stiff	
Undrained shear strength measured by triaxial testing (kN/m^2) – varies with depth	14 – 140 (av 78)	11
Bulk Density (Mg/m^3)	1.87 – 2.28 (av 2.03)	
Natural Moisture Content at test	13 – 30 (av 23)	
Stiffness term	Very Soft to Stiff	
Undrained shear strength measured by	50 – 296 (av157)	7

Soil parameters	Range	No Tests
Laboratory Hand Shear Vane testing (kN/m^2) - varies with depth		
Stiffness term	Firm to Very Stiff	
Coefficient of Consolidation C_v (m^2/Yr) *Taken from testing at or close to overburden pressures*	0.83 – 44.00*# (av 18.85)	12
Coefficient of compressibility M_v (m^2/MN) *Taken from testing at or close to overburden pressures*	0.057 – 0.45*# (av 0.20)	
Settlement Term	Low to High Compressibility	
Notes: * dependant on depths and loadings, # samples noted to swell at low pressures,		

The SPT data is plotted against depth and level is presented graphically in Appendix J.

Given the topography, individual borehole plan positions and inherent heterogeneity of the strata in terms of its thickness and material structure there is considerable variation with depth and level. However, as expected in most instances the data indicates a progressive increase in SPT and corresponding strength of the strata with depth with most materials initially being firm closer to surface becoming stiff with depth, locally however softer materials have been identified particularly in the southern end of the site and closer to the surface presumably where weathering has occurred.

The compaction tests undertaken indicate an optimum moisture content range of 15 - 28%.

Acceptable Moisture Content Ranges obtained by interpolation of the available test results graphs on the assumption that a minimum 95% compaction and 5% or less air voids will be required suggest that it will be possible to achieve compaction if the moisture contents of the soils fall between 14.5 and 30.5%.

MCV tests are often used to control the suitability of materials for compaction during earthworks and directly relate to moisture content. In most instances an MCV range of between 8 and 13 are set as the acceptability criteria to control the earthworks as this range tends to ensure that only suitable moisture content materials are incorporated within the works which can therefore be compacted. Moisture content calibration testing carried out on a limited number of samples does however suggest that moisture contents would need to fall between 22 and 32% to allow compaction to be achieved.

MCV single point testing carried out on a small number of samples at natural moisture content seems to suggest that the 5 samples tested at as dug moisture contents fall within a suitable envelope for MCV and moisture content and should therefore be compactable.

Natural moisture contents are shown to vary significantly ranging between 10 and 30%, however the vast majority of moisture contents recorded for these deposits within the various laboratory tests and samples detailed above appear to fall within the desired range of between 20 and 30%. This suggests that these materials could be suitable for reuse with no treatment. However, suitability for reuse within earthworks is often governed by the prevailing weather conditions during the works and the methods of working. It should be appreciated that these Glacial Deposits are formerly over

consolidated soils and when exposed by removal of overburden are likely to be subject to stress relief and swell taking in moisture and reducing in strength as several of the consolidation tests carried out demonstrate. It is anticipated that some form of lime or and cement modification might be required to allow these materials to be reused within structural fill, however this would need to be carried out with caution due to the potential for sulphate heave reactions resulting from the natural presence of high sulphates within these deposits.

In addition it should be appreciated that in several exploratory holes Silts or very silty clays were identified and a number of particle size distribution tests indicate extremely high silt contents in some of these deposits. Plasticity testing however seems to suggest that the clays are dominant with no results falling beneath the A-Line. It should however be appreciated that silts and soils with high silt contents can be very difficult to use within engineered and compacted fills as the vibration of rollers tends to liquefy high silt content soils, particularly where high moisture contents or precipitation takes place during the works.

It should however be recognised that the testing carried out to date is indicative only, it is considered that there is currently a small statistical number of tests and that further investigation and testing will be required to confirm this for earthworks specification and designs. Due to the variation in material properties, the size of the site and the volume of cut materials it is recommended that at the detailed design and specification stage that an intensive sampling and testing investigation is undertaken to confirm the properties of the materials from the proposed cut areas.

The effect of moisture content is also further demonstrated in the results of the re-compacted CBR tests. CBR tests carried out on re-compacted samples with moisture contents closer to optimum achieved higher CBR values than samples tested with a higher moisture content. This demonstrates the affect and susceptibility of these strata to moisture content when reused.

Thirteen samples of this stratum were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of up to 1,610 mg/l and a minimum pH of 7.8.

Eight soil samples of these deposits were sent for contamination screening testing.

No obvious visual or olfactory evidence of contamination was identified within any of these deposits encountered during the ground investigation.

5.1.4 Glaciofluvial deposits

This stratum was encountered locally within select exploratory holes beneath the topsoil/subsoil and Oadby Member and is indicated to be present to depths of between 3.2 and >20.45m below ground level with recorded thickness' varying between 0.5 and >8.75m.These deposits appeared to generally comprise orange brown occasionally slightly clayey gravelly sand or sand and gravel with the sand being predominant and mostly medium sized. The gravel content was generally sub rounded fine to coarse flint and quartzite with occasional chalk, coal and other lithologies.

These deposits were recorded to be unstable during excavation and collapses are noted on the exploratory logs presented in the Factual Ground Investigation Report presented separately.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 5 below and are included within the Appendix J.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 5: Summary of in-situ and laboratory test results for the cohesive Glaciofluvial Deposits

Soil parameters	Range	No Tests
Moisture content (%)	8.7 – 19	3
Liquid limit (%)	NP – 30	2
Plasticity limit (%)	NP – 14	
Plasticity index (%)	NP – 16	
Plasticity term	NP - Low	
Shrinkage Potential	Low	NHBC
Clay (%)	0 – 13 (av 4)	8
Silt (%)	0 – 18 (av 6)	
Sand (%)	28 – 90 (av70)	
Gravel (%)	0 – 47 (av 19)	
Earthworks Class	Class 1A – 1B	HA MCDHW Series 600
Maximum Dry Density – 4.5kg Rammer (Mg/m^3)	1.82 – 2.06 (av1.96)	3
Optimum Moisture Content - 4.5kg Rammer (%)	9.8 – 13 (av 11)	
Natural Moisture Contents of samples tested (%)	7 – 16 (av10.7)	
Lowest Acceptable Moisture Content Range that should allow 95% compaction and 5% or less air voids to be achieved (interpolated from test graphs)	10 – 15	
Highest Acceptable Moisture Content Range that should allow 95% compaction and 5% or less air voids to be achieved (interpolated from test graphs)	15 - 19	
Re-compacted CBR – 4.5kg Rammer (%)	1.2 – 23 (7.4 -16% mc)	3
SPT ‘N’ values (depth plots presented separately)	5 - >50	49
Density term	Loose to Dense	
Notes: * dependant on depths and loadings, # samples noted to swell at low pressures,		

The SPT data is plotted against depth and level is presented graphically in Appendix J.

Given the topography, individual borehole plan positions and inherent variation of the strata in terms of its thickness and material structure there is considerable variation with depth and level. However, as expected in most instances the data indicates a progressive increase in SPT and corresponding strength of the strata with depth with most materials initially being initially loose to medium dense increasing in density with depth to dense. It should be appreciated that drilling disturbance may have resulted in the lower test results.

The compaction tests undertaken indicate an optimum moisture content range of 9.8 - 13%.

Acceptable Moisture Content Ranges obtained by interpolation of the available test results graphs on the assumption that a minimum 95% compaction and 5% or less air voids will be required suggest that it will be possible to achieve compaction if the moisture contents of the soils fall between 10 and 19%.

Natural moisture contents are shown to vary significantly ranging between 8.7 and 19%, thus it is anticipated that these materials if excavated as part of the earthworks would be suitable for reuse with no treatment. However, suitability for reuse within earthworks is often governed by the prevailing weather conditions during the works and the methods of working.

It should however be recognised that the testing carried out to date is indicative only, it is considered that there is currently a small statistical number of tests and that further investigation and testing will be required to confirm these findings for earthworks specification and designs. Due to the variation in material properties, the size of the site and the volume of cut materials it is recommended that at the detailed design and specification stage that an intensive sampling and testing investigation is undertaken to confirm the properties of the materials from the proposed cut areas.

The effect of moisture content is also further demonstrated in the results of the re-compacted CBR tests. CBR tests carried out on re-compacted samples with moisture contents closer to optimum achieved higher CBR values than samples tested with a higher moisture content. This demonstrates the affect and susceptibility of these strata to moisture content when reused.

Five samples of this stratum were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of up to 41 mg/l and a minimum pH of 7.78.

No obvious visual or olfactory evidence of contamination was identified within any of these deposits encountered during the ground investigation.

5.1.5 Whitby Mudstone Formation

The Whitby Mudstone Formation stratum includes:

- Weathered mudstone comprising clay or silt;
- Mudstone bands; and
- Siltstone bands.

These deposits have been identified to be present beneath the Oadby Member and Glaciofluvial deposits and are indicated to be present to depths of greater than 15.45m bgl below ground levels and are anticipated to extend to significant depths of as deep as 120m bgl. Available investigation confirms thicknesses of greater than 8.85.These deposits appeared to generally comprise dark grey occasionally slightly sandy occasionally very silty clay and rarely silt, with bands of mudstone and siltstone.

These deposits were recorded to be stable during excavation where encountered.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 6 below and are included within the Appendix J.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 6: Summary of in-situ and laboratory test results for Whitby Mudstone Formation

Soil parameters	Range	No tests
Moisture content (%)	19 - 23	2
Liquid limit (%)	38 - 50	2
Plasticity limit (%)	18 - 28	2
Plasticity index (%)	20 - 28	2
Plasticity term	Intermediate	
Shrinkage Potential	Medium	NHBC
SPT 'N' values (depth plots presented separately)	23 - >50	47
Undrained shear strength inferred from SPT 'N' values (kN/m^2)	100 - >300	
Stiffness term	Stiff to Very Stiff	
Undrained shear strength measured by triaxial testing (kN/m^2)	109 - 224	3
Bulk Density (Mg/m^3)	2.10 – 2.12	3
Natural Moisture Content at test	19	
Stiffness term	Stiff to Very Stiff	
Undrained shear strength measured by shear vane testing (kN/m^2)	158 - 302	4
Natural Moisture Content at test	18 - 22	
Stiffness term	Very Stiff	
Coefficient of Consolidation C_v (m^2/Yr) *Taken from testing at or close to overburden pressures*	0.76 – 6.30*#	3
Coefficient of compressibility M_v (m^2/MN) *Taken from testing at or close to overburden pressures*	0.081 – 0.13*#	

Soil parameters	Range	No tests
Settlement Term	Low to Medium Compressibility	
Notes: * dependant on depths and loadings, # samples noted to swell at low pressures,		

The SPT data is plotted against depth and level and presented graphically in Appendix J. As expected in most instances this indicates a progressive increase in SPT and corresponding strength of the strata with depth as the strata graduates from residual weathered soils to weak rock. Initially the weathered strata are noted to be firm to stiff where close to the surface and highly weathered.

Natural moisture contents are shown to be fairly consistently around 20% with the materials being generally stiff in nature. It would appear unlikely that these deposits will be encountered in earthworks re-profiling excavations however they maybe encountered if deep foundation or service excavations are undertaken. It should be appreciated that these deposits are over consolidated and when exposed by removal of overburden are likely to be subject to stress relief and swell taking in moisture and reducing in strength as several of the consolidation tests carried out demonstrate. Therefore this may make them difficult to reuse within structural fill operations. It is anticipated that some form of lime or and cement modification might be required to allow these materials to be reused within structural fill, however this would need to be carried out with caution due to the potential for sulphate heave reactions resulting from the natural presence of high sulphates within these deposits.

Three samples of these strata were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of up to 578mg/l and a minimum pH of 7.55.

No obvious visual or olfactory evidence of contamination was identified within any of these deposits encountered during the ground investigation.

5.1.6 Results of soakaway testing

Three soakaway tests were attempted close to locations where it is thought that storm water attenuation ponds or drainage swales might be located to check to see if any infiltration might occur and to confirm if the ground conditions might be suitable for the adoption of soakaway sustainable urban drainage systems.

The results of soakaway testing are summarised in Table 7.

Table 7: Soakaway test results

Trial pit	Geological unit	Test result (m/s)
TPS5	Glaciofluvial Deposits (granular over cohesive)	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS15	Oadby Member (cohesive over granular)	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS20	Oadby Member (cohesive over granular)	Insufficient drop in water level. Unable to calculate infiltration rate.

Trial pit	Geological unit	Test result (m/s)
Notes: Strata predominantly cohesive in nature and therefore not conducive to soakaway.		

5.2 Groundwater

Groundwater was encountered during the investigation as detailed in Table 8.

Table 8: Groundwater results during investigation

BH/TP	Stratum	Strike (m bgl)	Level (mAOD)	Rise (m bgl)	Level (mAOD)
CP2	OM (cohesive)	2.30	93.59	2.10	93.79
CP2	GFD (granular)	15.00	80.89	13.20	82.69
CP4	GFD (granular)	3.40	81.54	-	-
CP6	WMF (clay)	7.90	76.41	7.10	77.21
CP6	WMF (clay)	11.40	72.91	12.10	72.21
CP8	WMF (mudstone)	6.80	74.90	3.90	77.80
CP11	WMF (siltstone)	8.80	74.58	5.10	78.28
CP14	OM (cohesive)	1.20	78.72	-	-
CP15	GFD (granular)	3.50	77.39	1.60	79.29
CP16	GFD (granular	5.00	76.34	3.00	78.34
WS1	OM (cohesive)	4.00	76.70	-	-
WS8	GFD (granular)	2.90	91.38	-	-
WS12	OM (cohesive)	4.00	83.30	-	-
WS14	WMF (clay)	4.00	92.32	-	-
WS16	OM / GFD (granular)	3.70	93.94	-	-
TP7	GFD (granular)	3.70	79.31	-	-
TP7	GFD (granular)	4.20	78.81	-	-
TP8	GFD (granular)	1.80	78.74	-	-
TP9	GFD (granular)	2.10	79.21	-	-
TP15(s)	GFD (granular)	1.70	79.61	-	-
TP20(s)	GFD (granular)	2.20	85.34	-	-
TP22	GFD (granular)	3.70	85.13	-	-
TP25	OM (cohesive)	0.70	86.21	-	-
TP26	GFD (granular)	1.70	87.81	-	-
TP26	GFD (granular)	2.15	87.36	-	-
TP27	GFD (granular)	2.10	93.89	-	-

BH/TP	Stratum	Strike (m bgl)	Level (mAOD)	Rise (m bgl)	Level (mAOD)
TP28	OM (cohesive)	1.80	96.13	-	-
Notes: OM – Oadby Member, GFD – Glaciofluvial Deposits, WMF – Whitby Mudstone Formation					

Where not listed, exploratory holes did not encounter groundwater strikes during formation. It should be noted that the speed of drilling and casing of holes can often mask minor seepages and water strikes. Indeed the addition of water within cable percussion boreholes to allow drilling to progress through granular deposits may obscure water strikes, however major water strikes would be evident.

It should be noted that groundwater levels might fluctuate for a number of reasons including in the short term the prevailing weather conditions immediately before and during investigation and monitoring works and longer term seasonal variations should be expected.

The results of the subsequent groundwater monitoring and well surveying exercise are summarised in Table 9. The data is produced within a groundwater elevation statistics report included within Appendix J.

Table 9: Groundwater monitoring data (04/09/2014 to 24/09/2014)

Monitoring well	Response Zone (m bgl)	Strata	Ground Level elevation (m AOD)	Monitored Groundwater Depth Range (mb GL)	Monitored Groundwater Elevation (m AOD)
CP1	8.00-15.00	GFD	90.77	11.43-11.46	79.34-79.31
CP2	14.00-20.00	GFD	95.89	16.52*	79.37
CP3	8.00-12.00	WMF	84.07	5.33-5.65	78.74-78.42
CP4	1.00-8.00	GFD	84.94	4.47-4.56	80.47-80.48
CP5	4.00-8.00	OMc/ GFD /WMF	88.22	5.11-5.16	83.11-83.06
CP6	6.00-8.00	OMc & WMF	84.31	3.33-3.40	80.98-80.91
CP7	1.00-6.00	OMc/g & WMF	80.72	0.83-0.85	79.89-79.87
CP8	2.00-5.00	OMc/g	81.70	1.47-1.50	80.23-80.20
CP9	6.00-11.00	WMF	82.09	4.70-4.95	77.39-77.14
CP10	2.00-5.00	OMc	83.56	4.31-Dry	79.25-78.56
CP11	7.00-10.00	WMF	83.38	4.36-4.41	79.02-78.97
CP12	1.00-5.00	OMc/g	85.83	1.48-1.53	84.35-84.30
CP13	8.00-13.00	OMc/g & WMF	83.99	2.34-2.76	81.65-81.23
CP14	1.00-5.00	OMc & WMF	79.92	0.54-0.55	79.38-79.37
CP15	6.00-9.00	WMF	80.89	*1.10-1.13*^	*79.79-79.76*^
CP16	2.00-5.00	GFD	81.34	1.19-1.27	80.15-80.07

Monitoring well	Response Zone (m bgl)	Strata	Ground Level elevation (m AOD)	Monitored Groundwater Depth Range (mb GL)	Monitored Groundwater Elevation (m AOD)
WS2	1.00-3.00	GFD	82.99	Dry	n/a
WS3	3.00-6.00	GFD	84.55	4.47-4.52	80.08-80.03
WS4	2.00-5.00	GFD	85.10	Dry	n/a
WS6	3.00-6.00	OMc	90.76	0.51-0.58	90.25-90.18
WS8	2.00-4.00	GFD	94.28	1.33-1.42	92.95-92.86
WS9	2.50-5.50	OMc	91.05	4.30- (dry)	86.75-85.55
WS11	2.00-4.00	OMc/GFD/WMF	87.13	2.78-2.85	84.35-84.28
WS15	3.00-6.00	WMF	98.55	1.48-1.50	97.07-97.05
Notes: GFD – Glaciofluvial Deposits, OMc/g – Oadby Member cohesive/granular, WMF – Whitby Mudstone Formation. CP2 was found to be blocked at a depth of 5.00m during the first three monitoring visits but was cleared during the fourth. As such only one water level was obtained. ^ Possible leaking seal between GFD and WFD on instrument. As water was encountered in WFD during boring.					

The detailed records and plots of groundwater with time are provided within Appendix J and are also included within the factual Ground Investigation Report 312598 – 02(00) presented separately.

The findings appear to confirm the site has localised perched water tables within discrete pockets of sands and gravels within the Oadby Member (Glacial Till) at varying levels. In addition localised seepages from the cohesive Oadby Member have also accumulated within the base of standpipes instrumented within these cohesive deposits. The variable nature of the granular and cohesive strata present throughout the Oadby Member deposits results in pockets of water bearing granular strata which are not thought to be linked or consistent across the site.

Deeper instruments placed within or across the granular Glaciofluvial deposits at depth seem to suggest a continuous water table is present within these strata at depths of around 79 to 80m AOD.

Water strikes and levels have also been recorded at the top or base of some mudstone and siltstone bands within the Whitby Mudstone Formation, suggesting that despite the generally unproductive nature of these deposits and its low permeability, groundwater is present, confined between the bands of very low permeability mudstone and siltstone.

The exploratory holes record multiple granular and cohesive layers within the glacial deposits as well as siltstone and mudstone bands between low permeability clays within the solid geology.

Subsequent monitoring of groundwater levels suggests that the general groundwater flow direction is towards the east/south east.

It's should also be appreciated that some of the instrumentation installed cover large response zones including some more permeable strata trapped between less permeable strata. If the more permeable strata yield water these standpipes fill up to the draining layer trapped in the less permeable mudstone surrounding them below and therefore maintain what appears to be a long term water table which may not reflect reality and possibly only represent perched water confined by cohesive strata above and below.

Ten water samples were obtained from monitoring instrumentation installed using bailer sampling techniques and were sent for contamination screening testing. No obvious visual or olfactory contamination was identified when taking these samples.

5.3 Ground gas regime

The results of the ground gas monitoring and testing carried out are given in Appendix H. The maximum results are recorded in Table 10.

Table 10: Summary of ground gas monitoring results

Borehole	Response zone/strata	Probable source(s) of ground gas	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%) (minimum)	Flow rate (l/hr)	Water level (m b TOC)
CP1	GFD	None identified	4	0.1	2.1	17.8	1.1*	11.46
CP2	GFD	None identified	4	0.0	2.2	16.0	0.7	16.52
CP3	WMF	None identified	4	0.1	0.7	19.8	0.0	5.65
CP4	GFD	None identified	4	0.1	1.4	17.7	0.0	4.56
CP5	OMc/ GFD /WMF	None identified	4	0.0	0.9	18.7	0.0	5.16
CP6	OMc & WMF	None identified	4	0.0	1.4	14.5	0.2	3.40
CP7	OMc/g & WMF	None identified	4	0.0	0.1	20.4	0.0	0.85
CP8	OMc/g	None identified	4	0.0	2.2	17.4	0.0	1.5
CP9	WMF	None identified	4	0.0	0.5	19.6	0.1	4.95
CP10	OMc	None identified	4	0.0	0.4	14.8	0.0	4.9
CP11	WMF	None identified	4	0.0	0.2	20.2	0.0	4.14
CP12	OMc/g	None identified	3	0.0	0.3	19.1	0.2	1.53
CP13	OMc/g & WMF	None identified	4	0.0	0.8	19.3	0.0	2.76
CP14	OMc & WMF	None identified	4	0.0	0.1	20.4	0.0	0.55
CP15	WMF	None identified	4	0.0	0.1	20.2	0.0	1.13
CP16	GFD	None identified	4	0.0	0.7	19.5	0.1	1.27
WS2	GFD	None identified	4	0.0	1.8	18.9	0.1	DRY

Borehole	Response zone/strata	Probable source(s) of ground gas	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%) (minimum)	Flow rate (l/hr)	Water level (m b TOC)
WS3	GFD	None identified	4	0.0	2.4	18.1	0.3	4.52
WS4	GFD	None identified	4	0.0	1.4	19.1	0.0	DRY
WS6	OMc	None identified	4	0.0	0.1	20.2	0.0	0.58
WS8	GFD	None identified	4	0.1	1.0	19.3	0.0	1.42
WS9	OMc	None identified	4	0.1	2.3	16.8	0.0	5.56
WS11	OMc/GFD/WMF	None identified	4	0.0	2.4	18.1	0.1	2.85
WS15	WMF	None identified	4	0.0	0.8	19.1	0.0	1.5
Notes	*only recorded on one occasion.							

No obvious sources of gas were identified during the investigation and the results detailed above are believed to represent the natural soil gas conditions. Gas monitoring visits were undertaken during periods of rising, constant and falling pressures of between 1003 and 1013mbar.

5.4 Visual/olfactory evidence of soil and groundwater contamination

No visual or olfactory evidence of soil or groundwater contamination was encountered or identified during the investigations.

5.5 Ground model

The ground model for the site has been interpolated using the available intrusive ground investigation data and this is represented pictorially within Figures 8-10 which provides the best interpretation of the ground beneath the development area.

In short the ground conditions beneath the site appear to comprise variable thicknesses of cohesive Oadby Member (Glacial Till) and this appears to be present across the majority of the site immediately below the surface.

Glaciofluvial deposits appear to be present beneath the Oadby Member (Glacial Till) in the north to significant depths and come close to surface the in the eastern part of the site where the Oadby Member is absent.

In the southern most part of the site the Glacial deposits are inter mixed and it appears that the cohesive Oadby Member (Glacial Till) is interleaved with the granular Glaciofluvial Deposits. It is important to note that some very silty clays and very clayey silt deposits were identified within the southern part of the site. This mixed geology suggests the southern part of the site has been affected by multiple complex glacial

processes some of which might have included periods where Glaciolacustrine deposits may have been deposited which may explain the silts laid down within this area.

The rise in topography at the site seems to coincide with the rise in levels of the top of the deep underlying solid Whitby Mudstone Formation. Available exploratory holes tend to suggest that the Whitby Mudstone Formation rises to the north and west and dips to the east and south beneath the overlying drift deposits. The Whitby Mudstone Formation comprises predominantly stiff clay tending to mudstone with depth and includes subordinate interbedded siltstone bands.

The findings appear to confirm the site has localised perched water tables trapped within discrete pockets of sands and gravels within the cohesive Oadby Member (Glacial Till) at varying levels. A more continuous water table appears to be present at depth within the granular Glaciofluvial deposits at depths of around 79 to 80m AOD being perched above the less permeable Whitby Mudstone below.

It is important to note that water strikes have also been recorded in the Whitby Mudstone below too, appearing to be confined within the siltstone bands.

It should be noted that the ground conditions beneath the derelict farm buildings and within the area associated with the shooting club have not been proven due to access constraints. Ground Investigations to date have been primarily focused upon the development area only.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2004a), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

6.1 Linkages for assessment

Section 5.5 outlines the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in Table 11.

Table 11: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact with impacted soil by future end users	Direct comparison of laboratory results of soil samples compared to human health GAC in Appendix B for a proposed **commercial and industrial end use.**
2. Inhalation exposure of future end users to contaminants in the vapour phase	Human health GAC outlined in Appendix B for soil and groundwater based on indoor inhalation exposure to vapour-phase volatile organic compounds (VOC).
3. Inhalation exposure of future end users to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
3. Uptake of contaminants by vegetation potentially impacting plant growth	Comparison of soil data to GAC in Appendix C
4. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix E for plastic water supply pipes using UKWIR (2010) guidance.
5. Leaching of soil contaminants and dissolved phase migration to Secondary A aquifer and unnamed watercourses	Since no leachate data is available the potential for leaching has been considered qualitatively using soil and groundwater results. Comparison of groundwater data to GAC in Table 1 of Appendix F
6. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: depressions and excavations that could affect workers	Gas screening values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the revised Wilson and Card classification presented within CIRIA report C665

Potentially relevant pollutant linkage	Assessment method
enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	(Wilson et al., 2007) owing to the development comprising buildings with a ground floor slab.
Notes:	

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

6.2.1 Direct contact with impacted soil by future end users

End users of the site are defined as those who are exposed to sources of contamination on a regular and predictable basis. In the case of developments for a commercial end use, the critical receptor is defined within SR3 as a 16 to 65 year old female.

The chemical test results have been compared directly to the appropriate GAC for each contaminant, based upon a conservative Soil Organic Matter (SOM) of 1%. The direct comparison table, which presents the chemical laboratory data set compared against the appropriate GAC, is included within Appendix C.

All samples are below the GAC and the results of the assessment indicate the strata encountered are suitable for use.

Based on the above assessment, no potentially significant risks associated with the soil contamination have been identified and it is considered that the site may be regarded as suitable for the proposed end use. It should however be noted that no investigation was undertaken in the within the area of the derelict barns which lies within the footprint of the development area.

6.2.2 Inhalation exposure of future residents to asbestos fibres

No made ground was encountered during the site investigation and visual inspection of samples while on site did not identify any materials suspected of potentially containing asbestos. The only suspected asbestos containing material identified at the site was sections of roofing on the derelict farm buildings to the east of the centre of the site.

6.2.3 Uptake of contaminants by vegetation potentially inhibiting plant growth

The results have been compared with the GAC presented in Appendix D for this linkage. The results indicate that a relevant pollutant is unlikely to exist associated with phytotoxic effects.

6.2.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in Appendix E for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

The results indicate that a relevant linkage is unlikely to exist associated with organic contaminants and therefore polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

6.2.5 Migration of dissolved phase contaminants to wider secondary aquifer body

Soil samples were not analysed for leachable contaminants as no sources were defined to be present at the site. However, concentrations at the site are generally typical of those recorded in natural strata and topsoil.

The results of the comparison of the groundwater results to the freshwater GACs are provided within Appendix G and summarised below in Table 12.

Table 12: Summary of groundwater exceedances

Determinant	GAC (µg/l)	Exceedances
Ammonia (NH3 as N)	0.025 (mg/l)	CP3, 5, 6, 7, 11, 13, 14 and WS6 maximum at CP13 - 0.59mg/l
Copper	28	CP14 - 30µg/l
Chromium (III + VI)	4.7	CP3, 6, 9, 11, 13, 14 and WS6 maximum at CP13 and CP14 - 12µg/l
Lead	7.2	CP3 - 8µg/l, CP9 - 9µg/l, CP13 - 10µg/l and CP14 - 116µg/l
Selenium	10	CP7 - 23µg/l, CP11 - 16µg/l
Nickel	20	CP7 - 21µg/l

The identified copper and nickel exceedances are considered to be marginal and as such are unlikely to represent a risk to freshwater receptors.

Ammonia exceedances have been identified within groundwater across the site and are likely to be associated with fertiliser application at the site and the surrounding area over many years as no other source has been identified. When compared to the Surface Water Ecosystem Classifications the total ammonia identified within groundwater would be classified as Grade B (good), for which the threshold is 0.60mg/l. In addition, once

the site has been redeveloped and is no longer used as arable farmland, concentrations of ammonia are likely to reduce within the groundwater. Therefore it is considered that surface water receptors are unlikely to be at risk from the ammonia identified in groundwater beneath the site.

Chromium (III and VI) concentrations have been identified within groundwater above the freshwater GAC across the site. An analysis of the soil data (see Appendix C) indicates that the maximum concentration of chromium identified at the site was 35mg/kg, when compared against the typical background concentrations within the area (60-90mg/kg) as noted within the Landmark Envirocheck report contained within the Preliminary Sources Study Report (reference 312598 - 01 (00) the concentrations encountered are below typical background concentrations. It is therefore considered that the concentrations identified in groundwater are either not related to the site or are attributable to natural soils and as such the risks posed by chromium (III & VI) are considered acceptable.

Lead concentrations above the GAC have been identified across the site, and while the majority of these exceedances are marginal and are unlikely to pose a significant risk to freshwater receptors, a single elevated concentration of 116µg/l was identified in groundwater obtained from CP14. CP14 is located in the eastern corner of the site, and as such it unlikely to be related to potential lead contamination associated with the shooting club located approximately 800m away. This is supported by groundwater obtained from between the shooting club and CP14 which show no or marginally elevated concentrations of lead only. It is possible that the elevated lead concentrations within groundwater at CP14 may be associated with embankment fill materials placed adjacent to the development area in the past to form the elevated embankments to for the grade separated Junction 15 over the M1. Alternatively the slightly elevated concentrations of lead maybe related to historic pollution from exhaust particulates that may have entered the ground water via the M1 drainage or systems. Therefore, it is considered that the slightly elevated concentrations of lead are localised to the eastern corner of the site, and, with the most likely potential source located off site, risks to freshwater receptors posed by the site are considered acceptable.

The identified nickel and selenium exceedances from CP7 and CP11 respectively are considered to be marginal and as such are unlikely to be a risk to groundwater or surface water receptors.

In addition the Secondary A Aquifer associated with the Glaciofluvial Deposits appears to be located hydraulically up-gradient, and there are no abstractions within the vicinity of the site. In addition, no source of nickel or selenium has been identified at the site.

6.2.6 Ground gas

The results have been assessed in accordance with the guidance provided in *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (Wilson et al., 2007). In the assessment of risks and selection of appropriate mitigation measures, the report identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV thresholds are guideline values and not absolute. The GSV thresholds may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to adopt a higher risk classification than the GSV threshold indicates.

Situation A relates to all development types except low-rise housing and, by combining the qualitative assessment of risk with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flows for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

The site is to be redeveloped with high bay distribution warehousing and offices and therefore falls under Situation A.

The GSV calculations for each borehole are included in Appendix H.

The gas monitoring data has identified a maximum methane concentration of 0.1% and a maximum concentration of carbon dioxide of 2.4%. A maximum gas flow rate of 1.1l/hr has been recorded. The calculated worst possible case GSV for methane is 0.00l/hr and the GSV for carbon dioxide is 0.03l/hr. Based on the GSVs the site has been characterised as ***CS1 Very Low Risk.***

For a characteristic Situation 1 (CS1 Very Low Risk) site, no special precautions are required for gas protection.

It is considered that the gas monitoring programme carried out to-date is likely to have established the 'worst-case' scenario and has characterised the ground gas regime sufficient to enable the confident assessment of risk and subsequent design of an appropriate gas protection scheme(s) for the proposed development.

6.3 Summary of quantitative risk assessment

The site is currently in use as arable farm land.

Intrusive ground investigations carried out across the site have confirmed that the site is directly underlain by natural soils the exception being some very shallow areas of reworked natural soils in areas close to access tracks. No contaminated strata were identified during the field works.

The comparison of laboratory testing results of the soils collected from the ground investigation indicate that pollutant linkages are unlikely to exist for risk to human health, phytotoxic effects, water supply pipes or risks to the underlying secondary aquifer and nearby water courses. Exceedances of some metals and ammonia were identified within groundwater, however, due to the generally minor nature of the exceedances and lack of

on site sources, and the nearest sensitive aquifer being hydraulically up-gradient of the exceedances, they are not considered to pose a risk.

Ground gas monitoring has indicated that the design of gas protection should be adopted in line with characteristic situation 1 for which no special precautions are required.

It should be noted that two areas (the derelict farm buildings and the shooting club) were inaccessible during the site investigation and therefore could not be assessed. The derelict farm buildings located east of the centre of the site are located within the development footprint of proposed commercial development and as such this area should be investigated once accessible and vigilance should be maintained during enabling works and demolition works within the area.

While the shooting club and associated area have not been investigated during this site investigation, there are no proposals for a change of use as the shooting club falls outside of the development area.

7 ASSESSMENT OF POTENTIAL LAND CONTAMINATION

7.1 Potential sources of contamination

Likely ground contamination resulting from the current and former land uses has been determined from the desk study research and reference to; the Environment Agency Publication CLR 8 'Potential Contaminants for the Assessment of Land' and the relevant Department of the Environment Industry Profiles.

The initial Assessment of Potential Land Contamination based upon site walkover and available data collated is included within the Preliminary Sources Study Report for the site ref: 312598 – 01 (00) presented separately.

This report updates the initial assessment by taking account of:

- the ground model proven by recent ground investigations and outlined within Figures 8 - 10 and discussed in section 5 of this report; and
- the Quantitative Risk Assessment of the chemical analysis of soil and groundwater samples taken from the recent ground investigations and assessment of gas monitoring results also undertaken as part of the recent ground investigations.

In summary there do not appear to be any primary significant contaminative sources, materials or processes that have historically or are presently taking place on or across the site or within the immediate surrounding area of any significance.

Furthermore, visual evidence gathered during the site walkover and examination of soil samples during the ground investigations suggests that no significant contamination is present, indeed little or no Made Ground is present.

Table 13 below updates the primary issues of concern previously identified:

Table 13: Identified risks of potential contamination sources

	Contaminants of concern	Notes
On-site		
Fuel store within derelict barn areas	Possibility of hydrocarbon fuel leakage or spillage within the vicinity of the derelict barns.	No groundwater contamination was identified at the site however no investigation was undertaken within the area of the derelict barns. Potential remains for localised contamination located below the existing buildings and further investigation should be undertaken during enabling works.
Farming related activities across the site	Potential for pesticides, herbicides and ammonia used on site as part of general farm activities, also the potential for minor hydrocarbon spillages/leaks.	No pesticide/herbicide or hydrocarbon contamination identified anywhere at the site. Elevated ammonia was encountered in groundwater across the site which will likely reduce following development.

	Contaminants of concern	Notes
Shooting club located in the centre of the site	Potential for lead contamination as a result of lead shot.	No elevated soil or groundwater concentrations of lead were identified within the vicinity of the shooting club however, no investigation was undertaken within the specific area of the shooting club. It is noted that the shooting club does not fall within the development area of the site.
Groundwater beneath the site.	Potential for various contaminants	Exceedances of some metals and ammonia were identified within groundwater, however, due to the generally minor nature of the exceedances and lack of on-site sources, and the nearest sensitive aquifer being hydraulically up-gradient of the exceedances, they are not considered to pose a risk.
Off-site		
Landfill to the north east of the site	Ground gas.	No made ground identified and granular bands within glacial deposits are not thought to be continuous as such pathway for migration would be limited. In addition, no significantly elevated ground gas or groundwater contamination concentrations identified during monitoring.
Other Issues; • Asbestos cement board cladding • Embankment Fill or drainage associated with motorway junction	To be investigated by others Lead.	 Possibly the source of elevated lead within groundwater at CP14.

In summary the ground investigation has not identified any significant areas of Made Ground or potential contamination confirming as expected that the vast majority of the site is undisturbed Greenfield land underlain by clean natural geological strata, however, neither the shooting club nor the area occupied by derelict farm buildings were investigated during the site works.

Chemical analyses of both soil samples and groundwater samples from across the site indicate that no contaminants exceed the relevant SGV / SSV's for the proposed end use (In this case commercial) and therefore these materials are not considered to be contaminated with respect to Human Health for the proposed end use. Section 6 of this report discusses the significance of the chemical testing analyses for soil and groundwater in more detail and the results are presented in Appendices C and G, in tabular form. Exceedances of some metals and ammonia were identified within groundwater, however, due to the generally minor nature of the exceedances and lack of on-site sources, and the nearest sensitive aquifer being hydraulically up-gradient of the exceedances, they are not considered to pose a risk.

Gas monitoring of instrumentation installed within exploratory holes indicated a low risk in line with a Characteristic Situation 1 for which no special gas protection measures required, as discussed within Section 6.2.7.

The information detailed above has been used to update the Contaminated Land Risk Assessment (Conceptual Site Model) Matrix included in Appendix I.

The main identified risks are discussed below in more detail however reference should be made to the risk matrix to understand all of the risks assessed

7.2 Preliminary contaminated land risk assessment

7.2.1 Risk to human health during construction

Considering that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to human health during construction is considered to be Negligible. Residual risks to human health could remain within the area of derelict farm buildings, which should be investigated during enabling works, and at the shooting club, however this is not part of the development area at the site.

7.2.2 Risk to human health post construction

Given the nature of the proposed scheme is for a large scale commercial development human exposure to soils and groundwater will be extremely low. Also when considering that no significant Made Ground or contamination has been observed, is shown to have been present upon historical plans, within environmental data or is shown to be present within recent ground investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to human health upon completion to workers and site users is considered to be Negligible. Residual risks to human health could remain within the area of derelict farm buildings, which should be investigated during enabling works, and at the shooting club, however this is not part of the development area at the site.

7.2.3 Risk to local ecology and landscape planting

Given that the crops and flora are thriving upon the site and that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to the local ecology from contamination is considered to be Negligible.

7.2.4 Risk to surface water

Exceedances of some metals and ammonia were identified within groundwater, however, due to no significant made ground being observed, the generally minor nature of the exceedances within groundwater and a lack of on-site sources, and that the scheme will be built using clean site won materials or / and suitable imported material the risk to surface water from contamination is considered to be Negligible.

The greatest risks to surface waters are from potential uncontrolled release of silt, created during construction activities and subsequent effects on aquatic flora and fauna. This will be controlled by a suitable site specific construction environmental management plan and code of practice.

7.2.5 Risk to groundwater

Exceedances of some metals and ammonia were identified within groundwater, however, due to no significant made ground being observed, the generally minor nature of the exceedances, the lack of on-site sources, and the nearest sensitive aquifer being hydraulically up-gradient of the exceedances, and that the scheme will be built using clean site won materials or / and suitable imported material the risk to groundwater from contamination is considered to be Negligible.

7.2.6 Risk due to ground gas

The Envirocheck data suggests that there are no landfills present within the vicinity of the site. The anticipated geology is not indicative of the widespread presence of strata likely to naturally degrade and produce harmful soil gases. Therefore it is concluded that no significant source of ground gas is likely to be present at the site.

Monitoring of ground gas on the site has yielded no concentrations of methane gas, very low concentrations of carbon dioxide and no to very low flow conditions and as such indicates that the landfill identified 114m north west of the site is unlikely to pose a risk to the site.

As the proposed scheme design for the site is an Industrial Development the exposure to ground gases posing a risk to human health post-construction is considered to be negligible if basic gas protection measures in line with a Characteristic Situation 1 as recommended within CIRIA C665 are adopted within the design and construction of the buildings.

In regards to ground gases posing a risk to workers during the construction there is considered to be a low risk to personnel from asphyxiation where they have to enter below ground excavations or in ground inspection chambers. Provided suitable atmosphere testing is carried out and confined spaces protocols are observed and these risks to construction and maintenance workers are considered to be low. These risks are managed through health and safety procedures including CDM regulations therefore the resultant risks are expected to be Negligible.

7.2.7 Risk to buried structures and services

The evidence available at the time of this report suggests that no Made Ground or contamination is likely to be present. However information to date suggests that naturally occurring elevated sulphates in the form of sulphate crystals (gypsum) are likely to be present within cohesive soils present beneath the site both in the Oadby Member (Glacial Till) and the underlying Whitby Mudstone from which it is derived. Testing has been undertaken and provided in ground concrete mixes are designed in accordance with the findings of the testing and BRE SD1:2005 the risk of damage to concrete exposed to naturally aggressive substances is considered to be Negligible.

This has been confirmed by recent investigations with testing suggesting that DS-5 AC-5 class concrete will be required to be adopted. However due to the design class of concrete being DS-3 or less based on water soluble sulphate only, the concrete class required could be limited to **DS-4 AC-4**, as sulphate classification based on total potential sulphate is generally highly conservative as not all the pyrite in soil will be oxidised and only a part will be taken into solution by groundwater. It is recommended that further testing is undertaking at detailed design stage to confirm this over a broader selection of sample depths.

7.3 Requirement for further assessment

At enabling works stage it is recommended that a watching brief is undertaken by a geo-environmental engineer to examine and test the ground in the area of the derelict barns when demolished with particular attention paid to the areas where possible fuel tanks are located.

8 GEOTECHNICAL SITE ASSESSMENT

8.1 Preliminary geohazard and geotechnical assessment

Using all of the available information and taking into account the ground model for the site outlined upon Figures 4 to 10 the Preliminary Geotechnical Risk Register presented within the Preliminary Sources Study Report (312598 – 01(00)) has been revised and updated and is presented in Appendix K and this highlights several potential risks associated with the site. The main identified risks are discussed below in more detail however reference should be made to the risk matrix to understand all of the risks assessed.

8.1.1 Mining and natural cavities

The site is not within an area affected by coal mining or brine extraction. The geology is not conducive to the formation of large natural cavities. This has been confirmed by the ground investigation which has confirmed the ground model.

8.1.2 Man made voids or obstructions

There is the possibility that a small void is present within the derelict farm buildings, east of the centre of the site. Examination of this area should be undertaken when access is available to confirm the extent to which the tanks are below ground.

No voids have been identified during the ground investigation.

8.1.3 Earthworks

Significant cut to fill earthworks are required to be undertaken to achieve the proposed redevelopment of the site and to form the main development plateau for the distribution warehouses. It is understood that at this time the development plateau finished floor level is set at 85.5m AOD.

In order to reduce the risk of excessive cost for offsite disposal and on site importation it is assumed that;

- site won materials will be utilised
- a cut to fill volume balance will be achieved.

The ground investigation has determined that clean natural soils are present within the areas of cut and that these materials should be suitable for reuse provided they are carefully selected and managed in accordance with a suitable earthworks specification.

In particular careful control of moisture content is required as the majority of the sites won soils are likely to be cohesive clays. The prevailing weather conditions will have a substantial effect on suitability; however the methodology of works will also have a significant impact upon suitability. These over consolidated cohesive soils will also be subject to stress relief upon unloading and as a result tend to take in moisture and soften. Therefore double handling and stockpiling should be avoided if at all possible.

In order for these cohesive soils to be acceptable for successful reuse within structural fill earthworks the moisture content will be critical. Therefore it is anticipated that subject to testing lime modification or stabilisation techniques maybe required to allow marginal materials to be reused successfully within structural fill, however all materials are likely to be acceptable for use within landscape features.

Further ground investigation aimed specifically at the reuse of cut material is recommended to confirm strata classification and suitability at detailed design stage.

It should be appreciated that these materials do have high naturally occurring sulphates distributed within them. Such sulphates can react with lime used in stabilisation and cause heave. Therefore any use of lime stabilisation must be considered very carefully and the mix designed to reduce this risk. Further investigation and stabilisation laboratory trials should be undertaken if this is proposed to further assess this risk.

8.1.4 Existing cut slopes

There are no existing cut slopes located within the site.

8.1.5 Existing embankment slopes

There are no existing embankment slopes on the site. The M1 Junction 15 is on a low embankment close to the eastern boundary of the development site; however this is maintained by the Highways Agency and does not appear to be showing any signs of instability.

8.1.6 Proposed cut slope design

Significant cut slopes are required in the north of the site in order to form the main development plateau for the distribution warehouses. In some areas embankments may be created above the cut slopes to further screen the distribution warehouses.

It is anticipated that significant cost will be incurred in the formation of the cut slopes required to achieve the scheme plateau. Deep cuttings will be necessary and are anticipated to encounter mainly the cohesive Oadby Member deposits although lesser volumes of granular Glaciofluvial deposits may also be encountered in west.

Therefore, cut slope stability will need to be carefully assessed and a suitably robust engineering design provided which includes drainage of the strata anticipated to be encountered, particularly as localised water bearing granular pockets maybe encountered. Slope assessments should also take account of the fact that upon unloading these over consolidated clays tend to take in water, reduce in strength and even swell over time with strengths tending to residual strength levels. This will of course affect the stability of cut slopes. The addition of any embankment loading upon the cut slopes will also need to be taken account of within any assessments. Therefore it is recommended that conservative slack slope angles are used within master planning designs.

It is recommended that at detail design stage further investigation and detailed slope stability analysis should be undertaken to value engineer and refine the cut slope design angles.

8.1.7 Proposed embankment design

Large embankments are proposed for the site, although these are believed to be non structural landscape embankments around the periphery of the site along the east, north and western boundaries.

It is anticipated that significant cost will be incurred in the formation of the embankments due to the volumes of materials required to be placed. It is assumed that clean site won materials will be suitable for reuse within the embankment construction as part of a cut fill balance design to avoid excessive costs for importation of materials to form the embankment.

The design of the embankment will need to take account of the classification of the materials being utilised for its construction. Options for increasing side slopes and reducing footprint and volume may be explored and these may include reinforced embankments (geogrids) or soil stabilisation (lime and cement) or even retaining walls if required.

Investigations have confirmed that no unstable geology considered susceptible to significant settlement or instability is likely to be present along the footprint of the Embankment. Therefore there is considered that there is a negligible risk that failure and settlement of any proposed embankment and embankment side slopes will occur as a result of the foundation soils beneath.

The risk of failure of embankments is increased where fine grained soils are used to construct them particularly if insufficient compaction and drainage is designed and the works proceed too quickly. Therefore it is recommended that staged construction is undertaken and that granular basal and interim granular layers are installed and linked to the wider drainage network to avoid the build-up of pore water pressures in fine soils beneath and within the embankment as works progress. This will aid and speed up consolidation and increase stability. Alternatively or additionally the use of soil stabilisation or reinforced earth might be considered partially in transition zones and around abutments or for the entire embankment.

Embankment slopes must be designed appropriate to the stability of the soils being used to construct the embankment and take account of the strength of the underlying foundation soils and any predicted loads (resulting from maintenance vehicles) along the crest.

Drainage will need to be carefully designed to cope with surface water runoff and to avoid runneling and softening of the slope faces and softening in the foundation soils, in particular at the toe of the slopes.

Embankment settlement and slope stability analysis may be required at detailed design stage. Further investigation may also be required to be undertaken in areas of the embankment formation and into cut material to assess the classification and suitability of cut materials for reuse to allow the embankment designs to be refined.

It is recommended that a detailed Earthworks Specification and set of Works Design drawings are prepared at detailed design stage and embankment stability checks are undertaken.

8.1.8 Cut to fill transition zones

It is anticipated that there will be a cut to fill transition line running broadly north east to south west across the centre of the proposed location of the main distribution warehouse in the north of the site.

This change from cut to filled areas can cause differential settlement to building foundations and floor slabs. It is understood that the current scheme layout places the main proposed building across the cut to fill transition and as such design of foundations and floor slabs will require careful consideration within this area particularly as softer clay soils appear to be present within the southern area of the site, beneath the proposed fill and heave is possible within the unloaded clay soils within the areas of cutting at the northern part of the site.

8.1.9 Earthworks – Materials Reuse

At this time it is expected that the southern part of the development plateau will be formed by placement of around 4m of structural fill to achieve the finished floor levels of 85.5m AOD. In addition fill will be required to form the landscape screening bunds around the eastern, northern and western boundaries to the site.

It is presumed that from the fill will be site-won arisings from the major cutting works to be undertaken at the northern and western parts of the development area to achieve the finished floor levels of 85.5m AOD.

It is expected that the majority of the cut materials will be cohesive Oadby Member (Glacial Till) with some granular Glaciofluvial Deposits.

The cohesive Oadby Member (Glacial Till) would be a Class 2A wet cohesive material. Whilst the granular Glaciofluvial deposits would be Class 1A and in some instances 1B general granular fill.

Available testing of samples obtained during the ground investigation tends to suggest that these materials could be suitable for reuse with no treatment. However, suitability for reuse within earthworks is often governed by the prevailing weather conditions during the works and the methods of working. It should be appreciated that these cohesive Glacial Deposits are formerly over consolidated soils and when exposed by removal of overburden are likely to be subject to stress relief and swell taking in moisture and reducing in strength as several of the consolidation tests carried out demonstrate. It is anticipated that some form of lime or and cement modification might be required to allow these materials to be reused within structural fill, however this would need to be carried out with caution due to the potential for sulphate heave reactions resulting from the natural presence of high sulphates within these deposits.

In addition it should be appreciated that in several exploratory holes silts or very silty clays were identified and a number of particle size distribution tests indicate extremely high silt contents in some of these deposits. Plasticity testing however seems to suggest that the clays are dominant with no results falling beneath the A-Line. It should however be appreciated that silts and soils with high silt contents can be very difficult to use within engineered and compacted fills as the vibration of rollers tends to liquefy high

silt content soils, particularly where high moisture contents or precipitation takes place during the works.

It should be recognised that the testing carried out to date is indicative only; it is considered that there is currently a small statistical number of tests and that further investigation and testing will be required to confirm this for earthworks specification and designs. Due to the variation in material properties, the size of the site and the volume of cut materials it is recommended that at the detailed design and specification stage that an intensive sampling and testing investigation is undertaken to confirm the properties of the materials from the proposed cut areas.

According to the CL: AIRE guidance "The Definition of Waste: Development Industry Code of Practice" (version 2, March 2011), any material that may be otherwise considered by the Environment Agency as waste (such as made ground), if dealt with in accordance with the Code of Practice under a Materials Management Plan (MMP) will not be considered as waste if used for the purposes of land development. Any Clean and Naturally occurring material may be reused on the site of origin without the need to be included within an MMP which appear to be the case at this site and therefore it is not anticipated that a Materials Management Plan will need to be developed to allow the cut to fill earthworks to be undertaken.

It is recommended that at detail design stage further investigation should be undertaken to more comprehensively classify and test the compacted properties of the cut strata such that a suitable earthworks specification maybe formulated.

8.1.10 Earthworks Classification

An initial classification, based on the Highways Agency Specification for Highway's Works (SHW 2004), of the materials likely to be encountered on the site is presented in Table below:

Table 14: Earthworks classification

Material	SHW Classification	Recommended use below	Notes on use
Agricultural Topsoil and Subsoil	5	Landscaped areas and cover to embankment and cutting side slopes	Careful control on storage and avoidance of using saturated materials, particularly on slopes.
Cohesive Oadby Member (Glacial Till)	2A	General Fill	Should be possible to reuse in structural fill. Moisture content will need to be carefully controlled.
Granular Glaciofluvial Deposits	1A & 1B	General Fill	Present in the north and west of the site at depth, in areas of deepest proposed cutting.

In summary it is expected that the majority of the site won deposits will be suitable for reuse with the majority of the near surface weathered cohesive materials being within the suitable moisture content range to allow the materials to be compacted to 95% maximum dry density or greater and less than 5% air voids, although some materials

were noted to be slightly wetter than optimal. Therefore, wetter materials may require drying or modification/ stabilisation to make them acceptable for reuse within structural fill. Much will depend upon the prevailing weather conditions at the time the earthworks are undertaken and the care with which the selection of materials and works are undertaken.

If significant volumes of material are deemed unsuitable for reuse by means of moisture contents alone it is recommended that soil modification or stabilisation is considered to render these materials suitable for use within engineering fill. Stabilisation works will need to be mindful of the risks of sulphates being present within the soils which could react with lime to cause heave. Investigation and test results undertaken at this preliminary stage at the site do indicate that significant sulphates concentrations are present. If stabilisation techniques are considered further it is suggested that it will be necessary to undertake further more comprehensive investigation and testing to confirm the suitability of these techniques, a suitable economic design mix and achievable properties of the modified or stabilised materials.

It is recommended that at detailed design stage a suitably robust Earthworks Specification is developed and that all materials are placed and compacted in accordance with this specification.

8.1.11 Foundations and Floor Slabs

Cut areas

It is anticipated that the main distribution warehouses will cross the cut fill transition line, as such, areas located north of the cut/fill transition line with up to around 8m of cut necessary at the very northern end. Formation soils are therefore anticipated to expose firm to stiff Oadby Member (Glacial Till) or perhaps in places medium dense to dense Glaciofluvial sands. Therefore it is anticipated that traditional shallow spread foundations and ground bearing floor slabs will be possible, founded directly upon competent solid strata. However some considerations of the potential risk of heave in the unloaded strata across the large building footprints maybe necessary if the structures have tight tolerances as swelling of unloaded soils was noted during consolidation testing and stress relief softening could occur.

Filled areas

The majority of proposed development at the site is located in the south east of the site south of the cut/fill transition line where up to 4m of fill will need to be placed.

It should be noted that investigations in some of the southern area at current ground levels indicated softer ground conditions at shallow depths.

Therefore foundations within filled areas will need to be designed according to the prevailing conditions and in accordance with the standards of engineering fill provided.

Where fill is relatively shallow and the depth to competent bearing strata in the natural undisturbed soils below is relatively shallow then foundations could be formed as over deepened pad or trench fill foundations extended through the full depths of fill and softer natural strata into the competent underlying natural strata. Where deeper fill is placed piled foundations may need to be considered.

Holistic Design

However, in order to achieve an economic design solution which allows the use traditional shallow spread foundations and ground bearing floor slabs but which takes account of the loading and differential settlement tolerances required and variable ground conditions, it is suggested that a holistic approach is required. It is therefore considered that some form of ground improvement treatment might be necessary. Given the volumes and nature of the earthworks reprofilling it is suggested that the most likely economic solution would be to adopt a performance based soil stabilisation earthworks technique. This could be applied to ensure the placed fill was engineered to deliver a suitably stiff and homogenous fill to allow both floor slabs and foundations to be formed within it. It could also be carried out across the full footprint of the building and loading bay yards and even extended to the highways in cut areas too as this would improve the exposed cohesive soils and reduce the risks of potential heave and softening from weather degradation and unloading sealing these strata. However this would need to be carried out with caution due to the potential for sulphate heave reactions resulting from the natural presence of high sulphates within these deposits.

It should also be recognised that the testing carried out to date is indicative only; it is considered that there is currently a small statistical number of tests and that further investigation and testing is anticipated to be required to confirm soil properties for earthworks specification and designs. Due to the variation in material properties, the size of the site and the volume of cut materials it is recommended that at the detailed design and specification stage that an intensive sampling and testing investigation is undertaken to confirm the properties of the materials from the proposed cut areas.

The cut and fill earthworks, ground improvement treatment and drainage specifications and designs will need to be checked to ensure that foundation bearing, settlement, differential settlement and slope stability criteria required for the development are met.

8.1.12 Highway & Service Yard construction

As the site requires significant cut to fill earthworks to achieve the required development levels, it is anticipated that engineering earthworks design specification will be provided to cover these elements.

This is considered likely to include a performance specification for the formation levels beneath highways in both cut and filled embankment areas.

Based upon available re-compacted CBR testing and available Plasticity Index testing it is recommended that a preliminary design CBR of <2% should be adopted for design purposes for re-compacted cohesive soils.. This could of course be increased if modification or stabilisation techniques were used or more granular materials were placed and compacted at final formation levels.

8.1.13 Groundwater levels & Drainage

Groundwater levels suggest a very slight hydraulic gradient toward the east/south east however flows are likely to be slow due to the confining low permeability clays of the Oadby Member.

The site is generally underlain by unproductive strata however it does appear to contain a continuous water table within the deep Glaciofluvial deposits beneath the mantle of Oadby Member (Glacial Till). Monitoring done during the investigation (limited to late summer) suggests that this continuous water table is below the proposed earthworks platform levels and should therefore not affect the scheme design. However, long term monitoring would be beneficial in confirming this hypothesis particularly as groundwater levels are susceptible to variation with prevailing weather conditions and seasonal variation.

Localised perched groundwater is likely to be encountered within granular pockets throughout the Oadby Member Till. It is anticipated that these granular pockets are not continuous across the site and groundwater is likely to be confined within these localised pockets. Excavations and cuttings into these deposits to achieve the required development platform levels are anticipated to encounter these. Therefore locally instability may occur and drainage and dewatering might be required, particularly within final cut slopes. Designs should accommodate suitable drainage systems to cut off and intersect such strata and to filter them away from the development. Temporary works drainage will also need to be carefully considered and will need to be designed to avoid causing localised fines migration and subsequent inundation collapse settlement as these soils are mixed granular and cohesive soils containing high silt contents.

It is also anticipated that the majority of the shallow strata present across the site will not be conducive to infiltration drainage techniques. However areas of sand maybe exposed beneath the cut areas in the north of the site (at depth) and may be more suitable for such techniques, however testing to date proved unsuccessful at the site in shallow strata in the southern area of the site where the proposed surface water attenuation ponds are planned.

8.1.14 Excavations Stability

Conventional plant should be suitable for general excavations at the Site.

Excavations with vertical sides in granular strata are likely to be unstable and will therefore require battering back or appropriate trench support to be provided. Excavations with vertical sides into cohesive deposits are likely to retain some limited stability in the short term but if man entry is required then slopes should be battered to a suitable safe and stable angle or appropriate trench supports will need to be provided.

Groundwater may be expected to be present where granular horizons are intersected and are likely to induce instability, boiling and running sand conditions when penetrated. Dewatering will need careful consideration, design and implementation to avoid causing loss of fines and later inundation collapse settlement in local ground.

Man entry into any excavations should not be undertaken without provision of suitable shoring and support and dewatering or suitable regrading and battering of side slopes to

safe angles. Confined spaces protocols for the Health and Safety of personnel should always be used where man entry into excavations is to be undertaken as low oxygen conditions may be present.

8.1.15 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development because concentrations of chemicals of potential concern (COPC) within natural soils and groundwater were not identified.

8.1.16 Chemical attack on buried concrete

The soils beneath the site are known to include naturally occurring sulphates and as such in ground concrete will need to be designed to accommodate the risks represented by contact with such sulphates.

As such careful consideration should be given to the design chemical and sulphate class of concrete used within the development particularly when in contact with the ground.

In addition consideration will need to be given to the potential for sulphate induced heave especially where the materials noted above are used within a cut and fill program where soils would be significantly disturbed allowing a greater oxidation potential.

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a Greenfield that has not been subject to previous industrial development and the geology (Whitby Mudstone Formation) is referenced within BRE;SD1 as potentially containing between 3% and 5% pyrite. A suite of chemical analyses appropriate to this site classification was carried out on soil samples from the near surface strata determined to be likely to be in contact with in ground concrete either insitu or as part of the proposed earthworks reprofilling.

For the Oadby Member, following guidelines within BRE; SD1, a characteristic water-soluble sulphate content of 843mg/l has been taken, a total potential sulphate of 2.48%. As this value is below the limiting value of 3.0g/l consideration magnesium analysis is not required. Design Sulphate Class of DS-5, may be adopted for the site.

Based on the findings of the groundwater monitoring it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value of 7.8, an aggressive chemical environment for concrete classification of AC-5 may be assumed for design purposes.

For the Whitby Mudstone Formation, following guidelines within BRE; SD1, a characteristic water-soluble sulphate content of 628mg/l has been taken, a total potential sulphate of 3.12%. As this value is below the limiting value of 3.0g/l consideration magnesium analysis is not required. Design Sulphate Class of DS-5, may be adopted for the site.

Based on the findings of the groundwater monitoring it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value of

7.6, an aggressive chemical environment for concrete classification of AC-5 may be assumed for design purposes.

This suggests that DS-5 AC-5 class concrete will be required to be adopted. However due to the design class of concrete being DS-3 or less based on water soluble sulphate only, the concrete class required could be limited to **DS-4 AC-4**, as sulphate classification based on total potential sulphate is generally highly conservative as not all the pyrite in soil will be oxidised and only a part will be taken into solution by groundwater. It is recommended that further testing is undertaking at detailed design stage to confirm this over a broader selection of sample depths.

9 REUSE OF MATERIALS

9.1 Reuse of suitable materials

It is understood that no soil wastes are anticipated to be generated from the site with a complete cut to fill balance being achieved in modelling.

As the site has not been previously developed all excavation works are expected to generate only clean and naturally occurring soils.

Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin. Therefore it should not be necessary to either obtain a licence or prepare a Materials Management Plan in accordance with the CL; AIRE Code of Practice.

9.2 Wastes for landfill disposal

Whilst it is not anticipated that any soils will be removed to landfill an initial assessment of waste classification has been undertaken using the soil contamination data. This is presented within Appendix L. The results suggest that the soils tested would be classified as Non Hazardous for disposal. Given that arisings are anticipated to be natural strata it is possible that they could be classified as inert waste, however full Waste Acceptance Criteria analysis would be required to confirm this.

9.3 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

Currently (since October 2014), landfill tax is £80 per tonne. Further, the Treasury has confirmed that for five years thereafter the tax will not fall below £80.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

10 CONCLUSIONS

10.1 Conclusions

The site is primarily considered to be Greenfield in nature and there is little evidence to suggest there are any significant potential sources of contamination likely to be present that would detrimentally impact upon the proposed scheme design within areas of the site that were investigated. Potentially unknown localised risks may remain within the area of the derelict farm buildings, beneath the building footprints, particularly those which contain tanks, however given the nature of the geology and the site use it is not anticipated that any significant contamination risk exists in this small part of the development area.

Minor exceedances of the GAC's for some metals and ammonia were identified within groundwater, however, due to the generally negligible nature of the exceedances and lack of on-site sources, and the nearest sensitive aquifer being hydraulically up-gradient of the exceedances, they are not considered to pose a risk.

Ground gas monitoring has indicated that the design of gas protection should be adopted in line with characteristic situation 1 for which no special protection measures are required.

The geology of the site comprises mixed cohesive and granular glacial deposits overlying Whitby Mudstone Formation and this could impact upon the geotechnical elements of the detailed design, however these conditions are not anticipated to represent significant risks and would be anticipated to be resolved by normal engineering design and construction methods.

There are also no identified particular natural geohazards that would significantly impact the scheme.

At enabling works stage it is recommended that a watching brief is put in place during the demolition and removal of hard standings relating to the derelict farm buildings where tanks are located, although again the risk of contamination is considered low.

11 RECOMMENDATIONS

11.1 General recommendations

Some of the key recommendations are summarised below. Many of the technical or advice recommendations have not been included below. The whole of the report should be read to identify all recommendations and advice.

- It is recommended that the findings of the Contaminated Land Risk Assessment are discussed and confirmed with the local regulatory authorities.
- It is recommended that at detailed design stage a site wide Earthworks Specification is prepared which should include testing frequency requirements and performance criteria for the various elements of the scheme design.
- At detailed design stage it is recommended that cutting slope designs should be refined, value engineered and checked for stability and should also include design of drainage.
- At detailed design stage it is recommended that embankment design geometries should be checked for slope stability and settlement. However it should be understood that the stability of an embankment will be a function of its geometry, the materials with which it is built, the degree of compaction applied, speed of construction and the foundation strata and underlying groundwater table on to which it is formed. This information will be required to feed into the earthworks specification.
- Drainage will need to be designed with care due to the poor drainage infiltration of the underlying shallow soils.
- In ground concrete should be designed to resist elevated sulphates with a minimum mix design of **DS-4 AC-4** to allow for the potential for naturally occurring sulphates within the Oadby Member and Whitby Mudstone Formation.
- At enabling works stage it is also recommended that a watching brief is put in place during the demolition and removal of hard standings relating to the derelict farm buildings where tanks were identified, although again the risk of contamination is considered low.

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FIGURES

Indicative site boundary

Rev	Date	Description	Drn	Chk	App
00	11.08.14	312598	RG	SP	DB

Junction 15 M1 West

RSK

Figure 1

Site Location Plan

0 300
metres
Scale = 1:10,000 @ A3

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Indicative site boundary

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 2

Proposed Development Plan

0 240

metres

Scale = 1:8,000 @ A3

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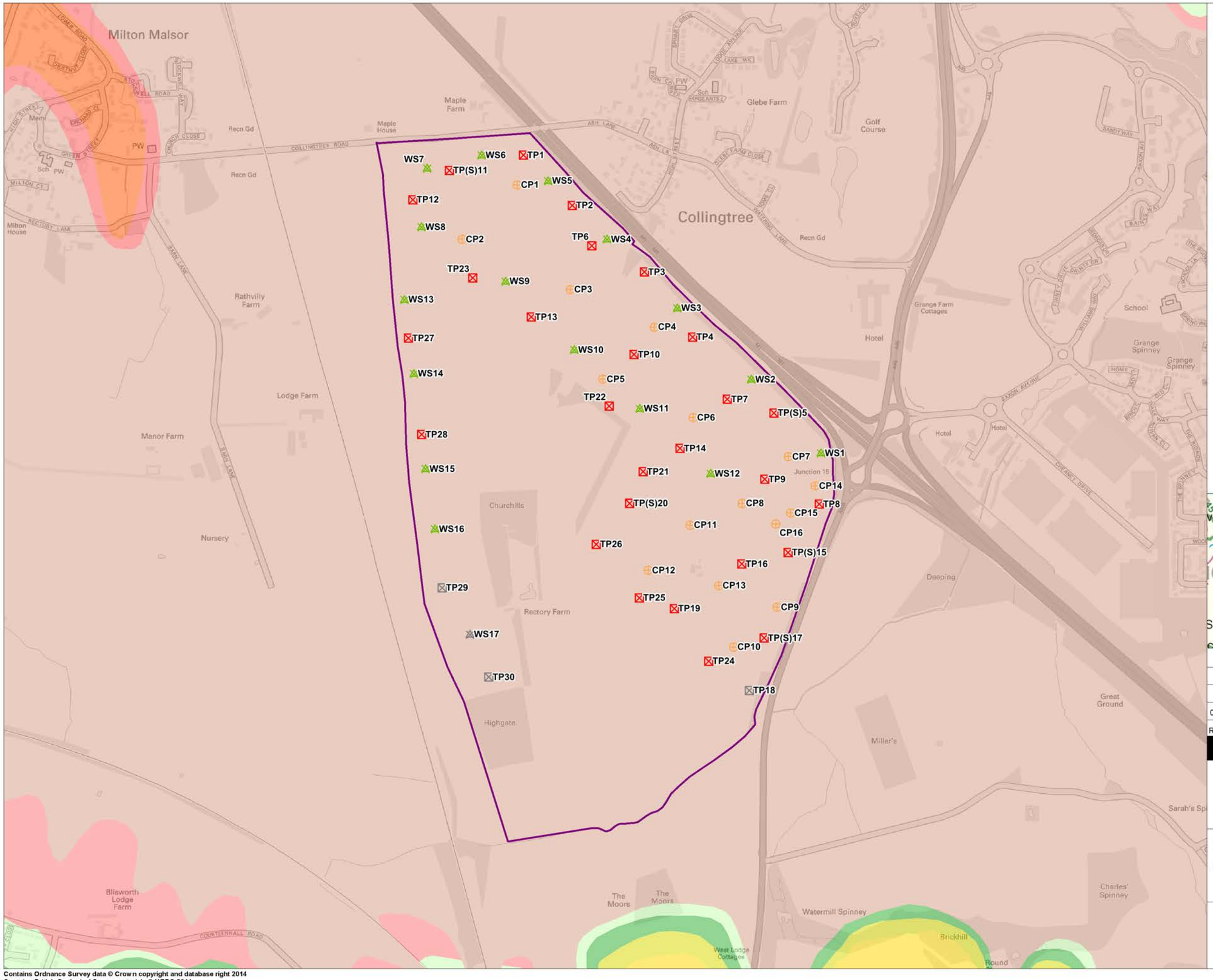

Indicative site boundary

Exploratory Holes

- Trial pit
- Window sample
- Cable percussion borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Solid Geology:

- Blisworth Limestone Formation - Limestone
- Dyrham Formation - Siltstone and Mudstone, Interbedded
- Marlstone Rock Formation - Limestone, Ferruginous
- Northampton Sand Formation - Ironstone, Ooidal
- Rutland Formation - Mudstone
- Stamford Member - Sandstone and Siltstone, Interbedded
- Wellingborough Limestone Member - Limestone
- Whitby Mudstone Formation - Mudstone

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 3

Solid Geology Plan

0 300

metres

Scale = 1:10,000 @ A3

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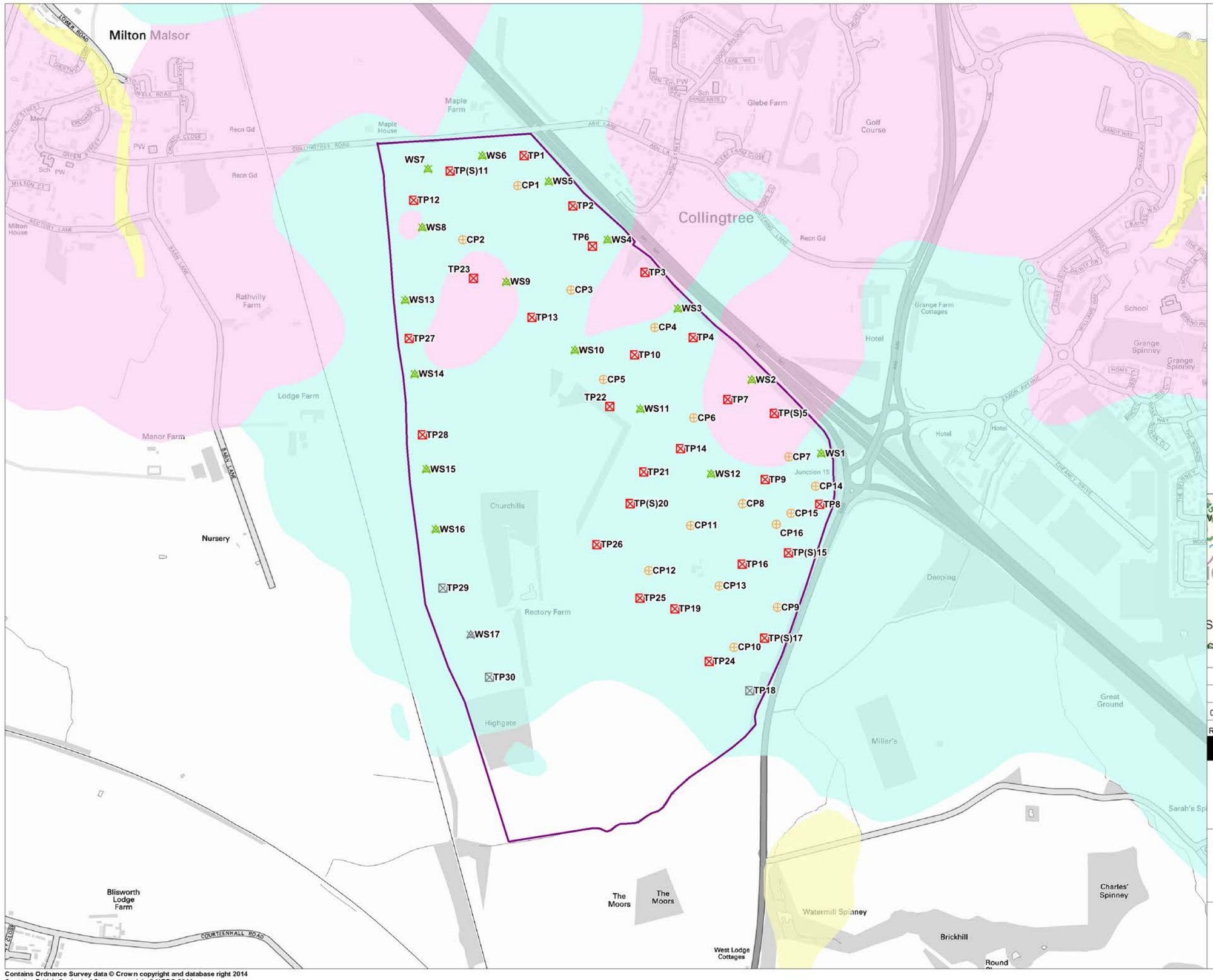

Indicative site boundary

Exploratory Holes

- Trial pit
- Window sample
- Cable percussion borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Drift Geology:

- Alluvium - Clay, Silt, Sand & Gravel
- Glaciofluvial Deposits, Mid Pleistocene - Sand & Gravel
- Oadby Member - Diamicton
- Tufa - Tufa, Calcareous

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 4

Drift Geology Plan

0 300

metres

Scale = 1:10,000 @ A3

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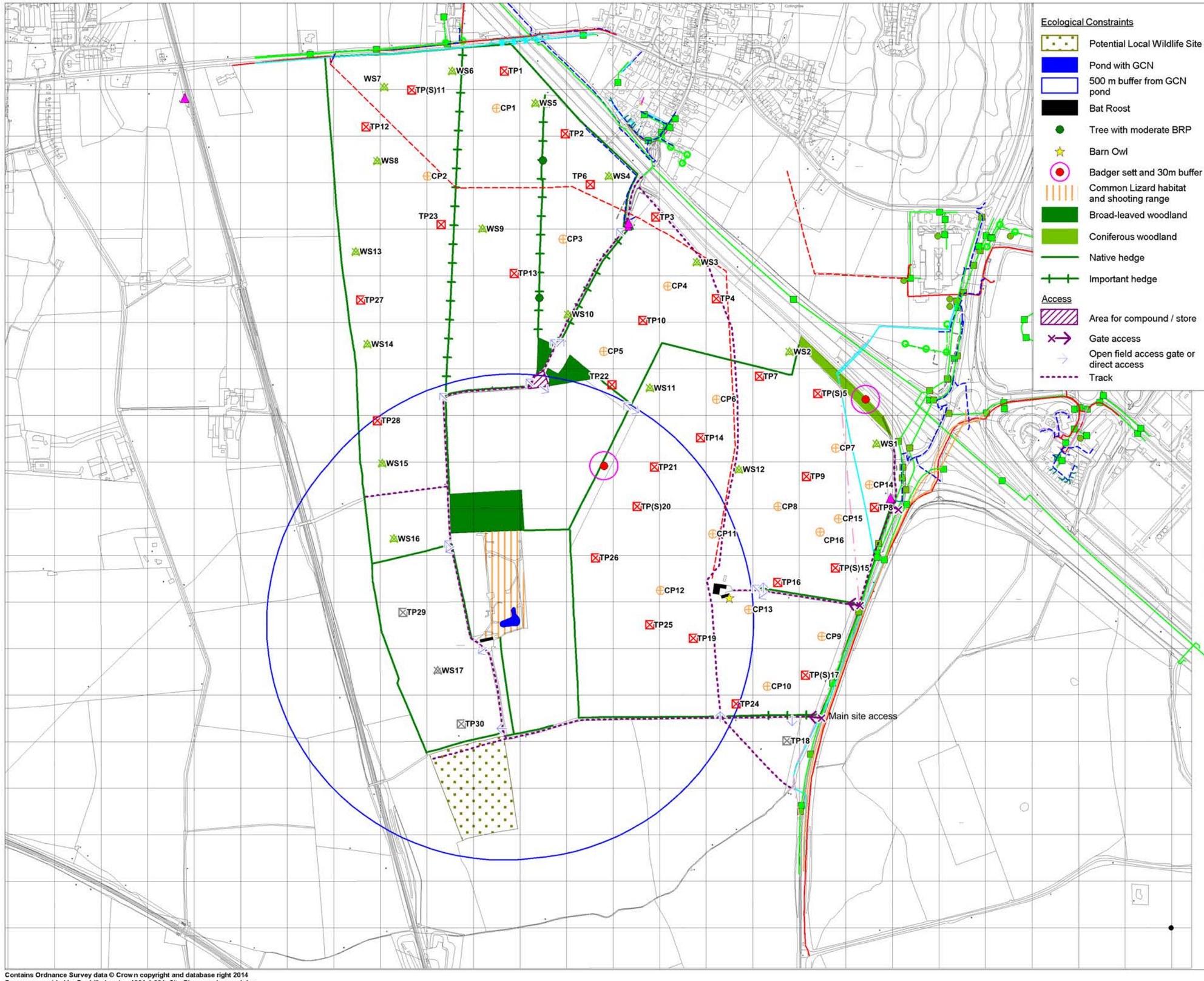

Ecological Constraints

- Potential Local Wildlife Site
- Pond with GCN
- 500 m buffer from GCN pond
- Bat Roost
- Tree with moderate BRP
- Barn Owl
- Badger sett and 30m buffer
- Common Lizard habitat and shooting range
- Broad-leaved woodland
- Coniferous woodland
- Native hedge
- Important hedge

Access

- Area for compound / store
- Gate access
- Open field access gate or direct access
- Track

Services:

WPD - Electirc

- Existing underground 11kV cable
- Existing underground LV mains cable
- Existing underground LV service cable
- Decommissioned LV cable
- 1.1kV overhead line

Anglian Water

- Existing underground district main
- Abandoned main
- Foul sewer

BT

- Underground plant
- Overhead plant and poles
- Joint box
- Manhole
- Distribution point

Cell Site

- Cell site

National Grid Gas

- Existing underground LP mains
- Existing underground MP mains

Virgin Media

- Underground duct route

Contaminated Land Constraints

- Shooting range
- Farm buildings including tanks

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 5

Hazards Plan

0 240

metres

Scale = 1:8,000 @ A3

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Indicative site boundary

Exploratory Holes

- Trial pit
- Window sample
- Cable percussion borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Rev	Date	Description	Drn	Chk	App
00	06.11.14	312598	RG	SP	DB

Junction 15 M1 West

RSK

Figure 6

Exploratory Hole Location Plan - Existing Topography

0 240

metres

Scale = 1:8,000 @ A3

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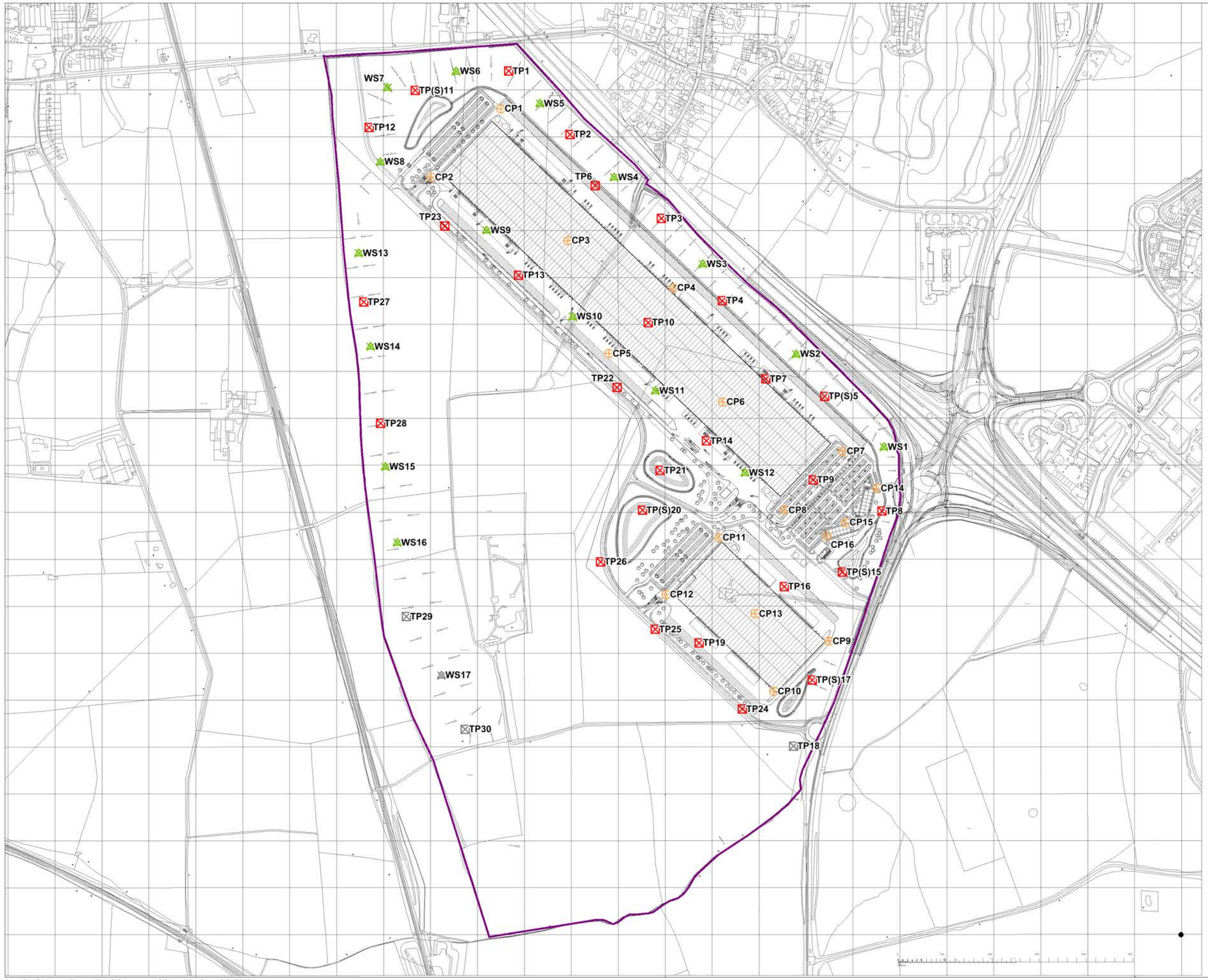

Indicative site boundary

Exploratory Holes

- Trial pit
- Window sample
- Cable percussion borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 7

Exploratory Hole Location Plan - Proposed Scheme

0 240

metres

Scale = 1:8,000 @ A3

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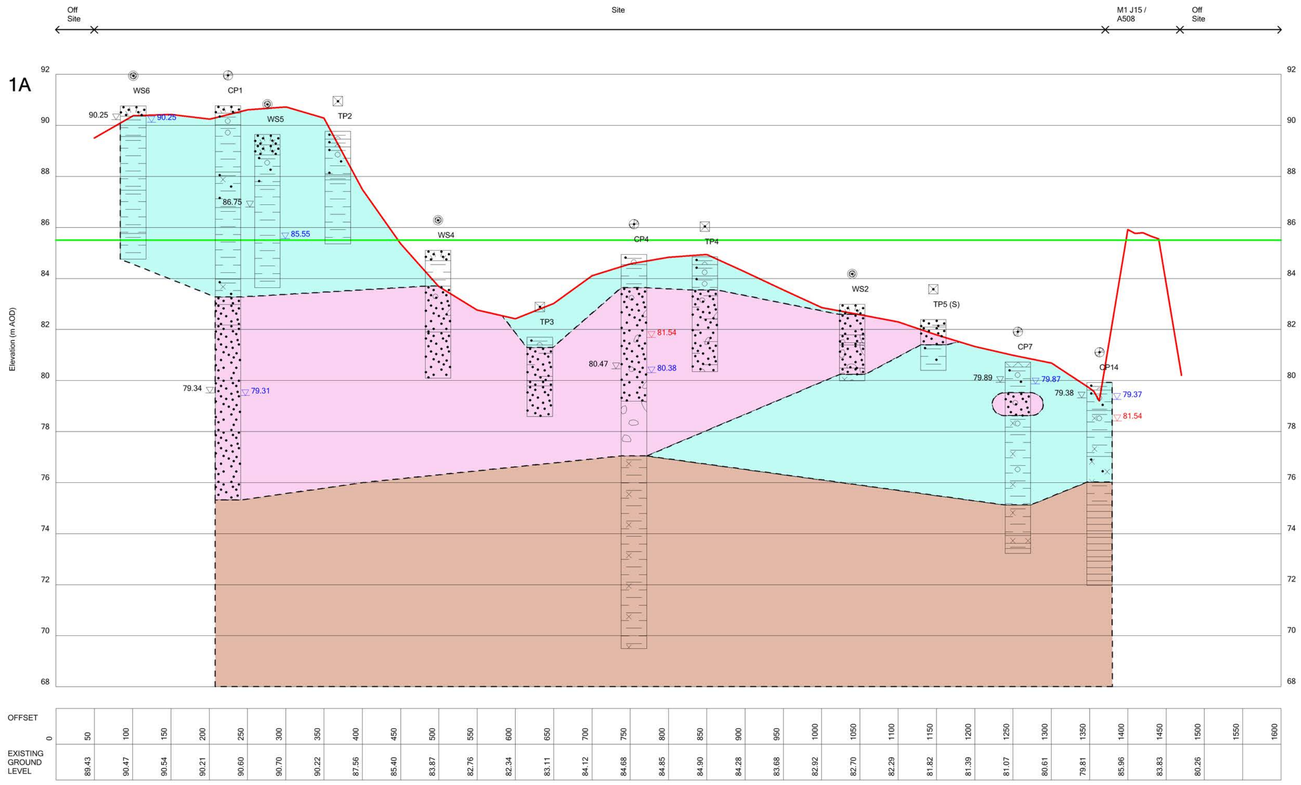
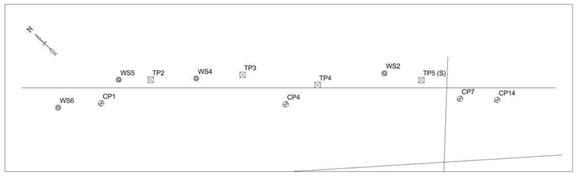


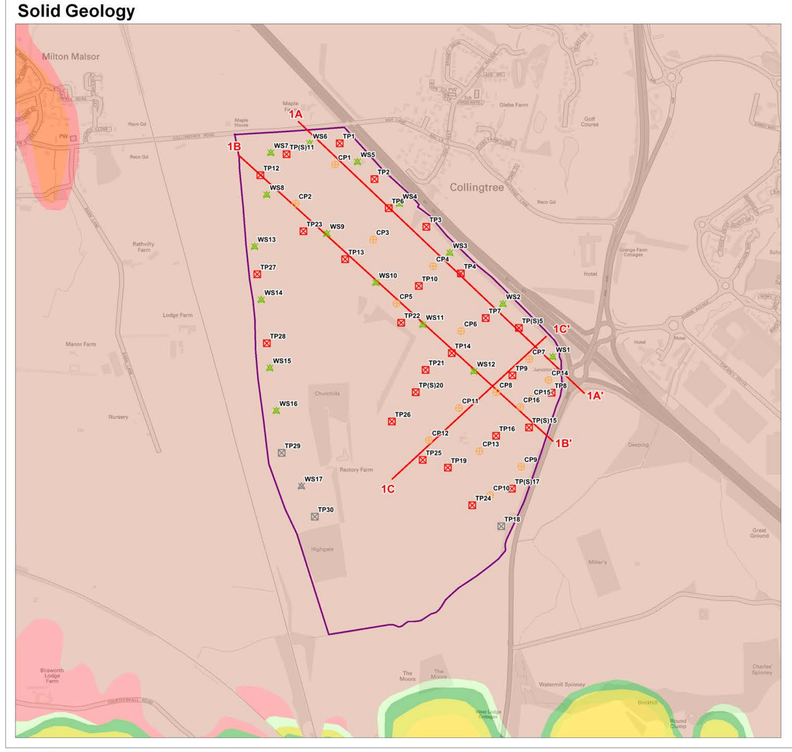
Sitemap and Section Baseline



Materials Legend

- CLAY
- Clayey gravelly SAND
- Gravelly clayey SAND
- Clayey SAND
- GRAVEL
- Gravelly CLAY
- Gravelly silty CLAY
- Gravelly SAND
- Gravelly SILT
- MADE GROUND
- Mudstone
- SAND
- SAND & GRAVEL
- Sandy CLAY
- Sandy silty CLAY
- Gravelly sandy CLAY
- Sandy gravelly CLAY
- Siltstone
- Sandy SILT
- Topsoil

Solid Geology

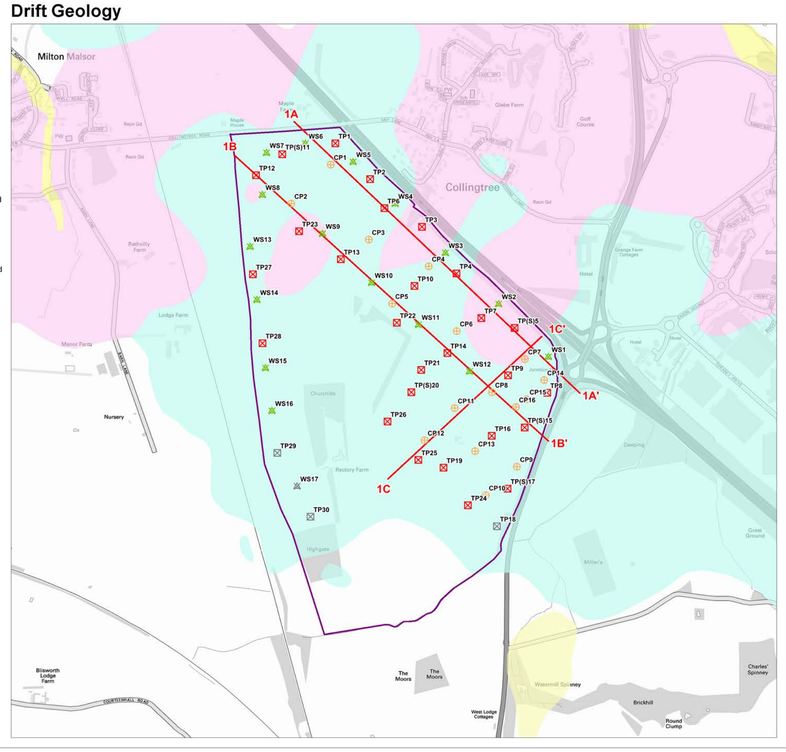


- Indicative site boundary
- Section lines

Exploratory Holes
- Trial Pit
- Window Sample
- Cable Percussion Borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Solid Geology
- Blisworth Limestone Formation - Limestone
- Dyrham Formation - Siltstone and Mudstone, Interbedded
- Marlstone Rock Formation - Limestone, Ferruginous
- Northampton Sand Formation - Ironstone, Ooidal
- Rutland Formation - Mudstone
- Stamford Member - Sandstone and Siltstone, Interbedded
- Wellingborough Limestone Member - Limestone
- Whitby Mudstone Formation - Mudstone

Drift Geology



- Indicative site boundary
- Section lines

Exploratory Holes
- Trial Pit
- Window Sample
- Cable Percussion Borehole
- Trial pit/window sample unable to be undertaken as crops still up in fields

Drift Geology
- Alluvium - Clay, Silt, Sand & Gravel
- Glaciofluvial Deposits, Mid Pleistocene - Sand & Gravel
- Oadby Member - Diamicton
- Tufa - Tufa, Calcareous

- Existing Ground Level
- Proposed Ground Profile (85.5m AOD)
- Indicative Stratum Boundaries
- Cohesive Oadby Member Strata
- Glaciofluvial Deposits
- Whitby Mudstone Formation - Mudstone
- Groundwater strike during investigation (absence indicates hole dry)
- Highest monitored groundwater level Sept 2014
- Lowest monitored groundwater level Sept 2014

The geology shown is indicative only and has been tentatively defined from available exploratory hole data and available BGS mapping.
The strata shown only include major geological units and do not show minor subordinate strata and bands. For full details of strata please refer to the borehole logs and data included in the Factual Ground Investigation Report.

Rev	Date	Description	Drn	Chk	App
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Junction 15 M1 West

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Figure 8

Indicative Ground Model
Section 1A

Not to Scale | REV 00

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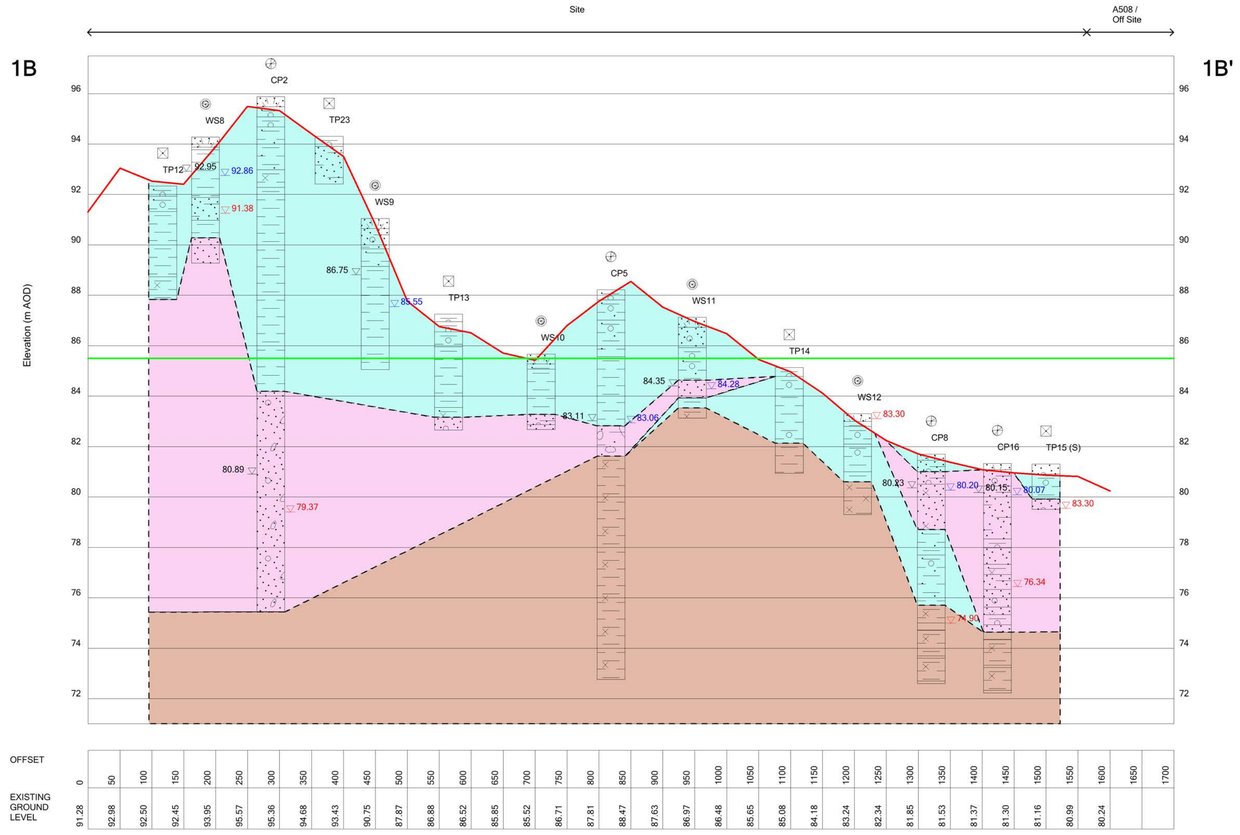
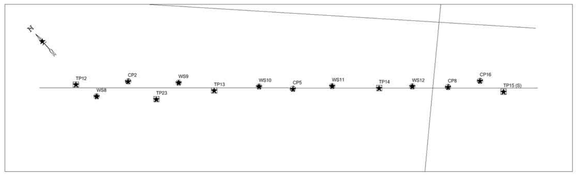


Existing Ground Level
Proposed Ground Profile (85.5m AOD)
Indicative Stratum Boundaries
Cohesive Oadby Member Strata
Glaciofluvial Deposits
Whitby Mudstone Formation - Mudstone
Groundwater strike during investigation (absence indicates hole dry)
Highest monitored groundwater level Sept 2014
Lowest monitored groundwater level Sept 2014

Sitemap and Section Baseline

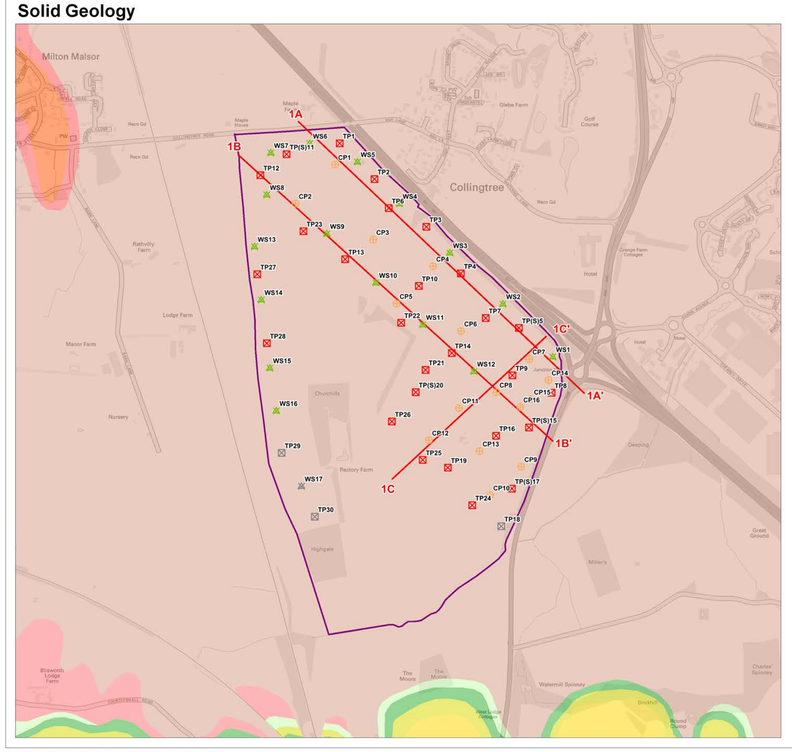


Materials Legend

CLAY
Clayey gravelly SAND
Gravelly clayey SAND
Clayey SAND
Clayey sandy GRAVEL
Gravelly CLAY
Gravelly SAND
Mudstone
SAND
Sandy CLAY
Sandy silty CLAY
Gravelly sandy CLAY
Sandy gravelly CLAY
Siltstone
Topsoil
Clayey SILT
Silty CLAY
Gravelly silty SAND
Silty SAND

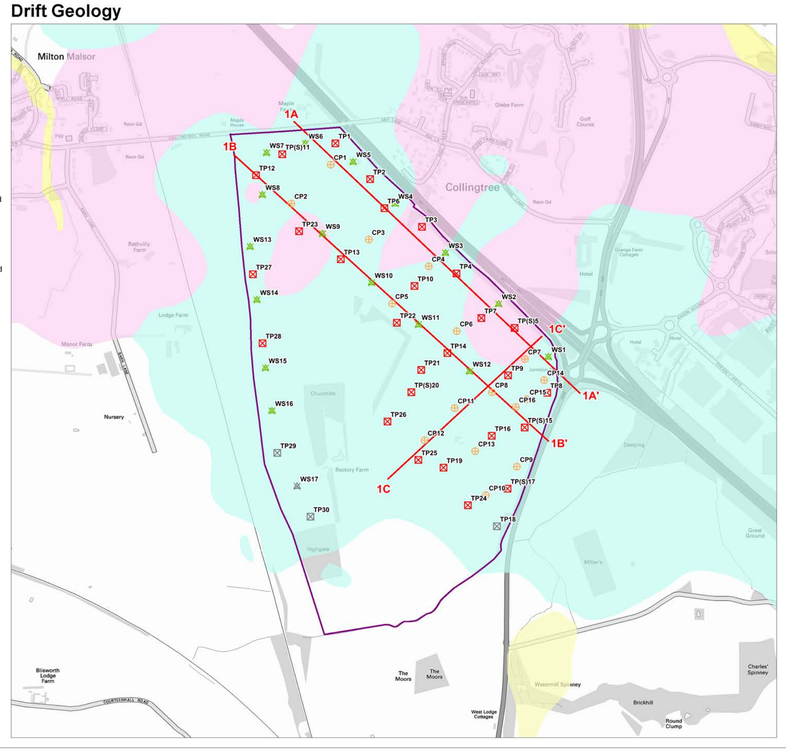
The geology shown is indicative only and has been tentatively defined from available exploratory hole data and available BGS mapping.
The strata shown only include major geological units and do not show minor subordinate strata and bands. For full details of strata please refer to the borehole logs and data included in the Factual Ground Investigation Report.

Solid Geology



Indicative site boundary
Section lines
Exploratory Holes
Trial Pit
Window Sample
Cable Percussion Borehole
Trial pit/window sample unable to be undertaken as crops still up in fields
Solid Geology
Blisworth Limestone Formation - Limestone
Dyrham Formation - Siltstone and Mudstone, Interbedded
Marlstone Rock Formation - Limestone, Ferruginous
Northampton Sand Formation - Ironstone, Ooidal
Rutland Formation - Mudstone
Stamford Member - Sandstone and Siltstone, Interbedded
Wellingborough Limestone Member - Limestone
Whitby Mudstone Formation - Mudstone

Drift Geology



Indicative site boundary
Section lines
Exploratory Holes
Trial Pit
Window Sample
Cable Percussion Borehole
Trial pit/window sample unable to be undertaken as crops still up in fields
Drift Geology
Alluvium - Clay, Silt, Sand & Gravel
Glaciofluvial Deposits, Mid Pleistocene - Sand & Gravel
Oadby Member - Diamicton
Tufa - Tufa, Calcareous

Rev	Date	Description	Drn	Chk	App
00	06.11.14	312598	SP	RG	DB

Junction 15 M1 West

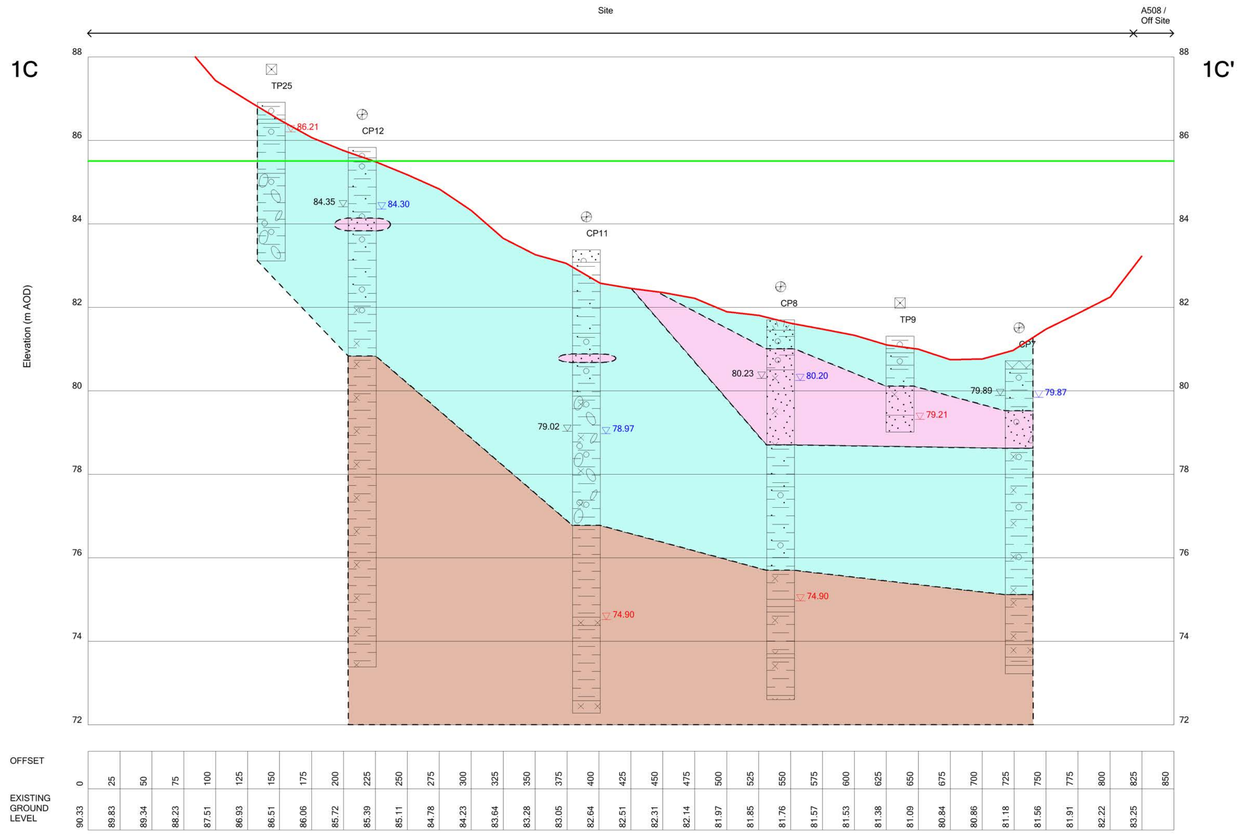
RSK

Figure 9

Indicative Ground Model
Section 1B

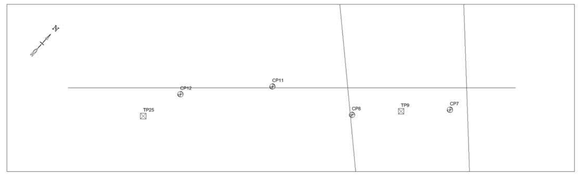
Not to Scale | REV 00

FILE NAME: \\cv-nas1\Asbestos\Geoscience Data\Cov Ground and Environment\Jobs\312000 ONWARDS\312500 - 312599\312598 - Junction 15 M1 West\10 Drawings\GIS\10 - Workspaces\Interp



Existing Ground Level
Proposed Ground Profile (85.5m AOD)
Indicative Stratum Boundaries
Cohesive Oadby Member Strata
Glaciofluvial Deposits
Whitby Mudstone Formation - Mudstone
Groundwater strike during investigation (absence indicates hole dry)
Highest monitored groundwater level Sept 2014
Lowest monitored groundwater level Sept 2014

Sitemap and Section Baseline

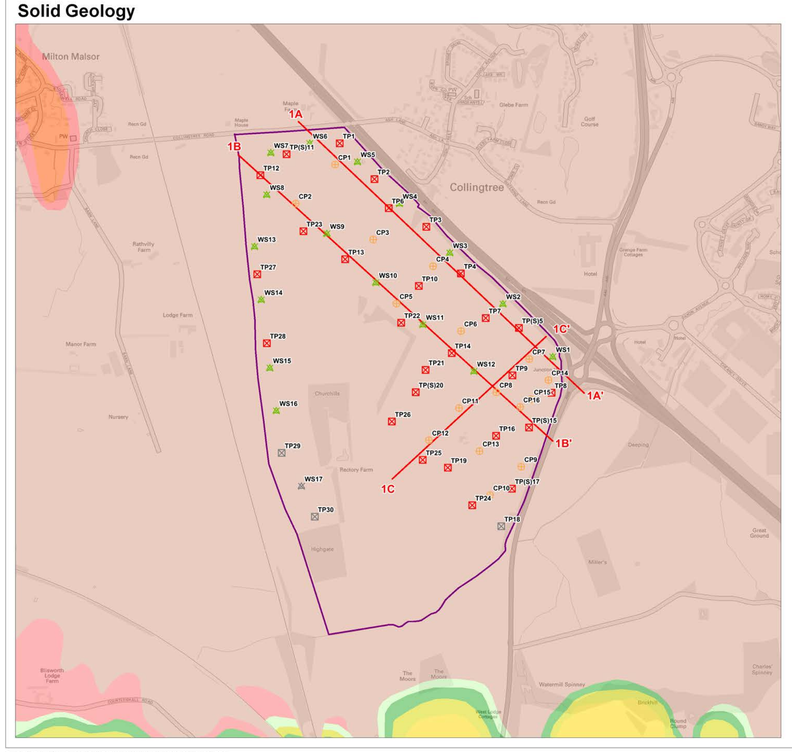


Materials Legend

CLAY
Gravelly clayey SAND
Gravelly CLAY
Gravelly silty CLAY
Gravelly CLAY with COBBLES
Gravelly silty CLAY with COBBLES
Gravelly SAND
MADE GROUND
Mudstone
SAND
Sandy CLAY
Gravelly sandy CLAY
Sandy gravelly CLAY
Siltstone
Topsoil
Silty CLAY
Silty SAND

The geology shown is indicative only and has been tentatively defined from available exploratory hole data and available BGS mapping.
The strata shown only include major geological units and do not show minor subordinate strata and bands. For full details of strata please refer to the borehole logs and data included in the Factual Ground Investigation Report.

Solid Geology



Indicative site boundary
Section lines

Exploratory Holes
Trial Pit
Window Sample
Cable Percussion Borehole
Trial pit/window sample unable to be undertaken as crops still up in fields

Solid Geology
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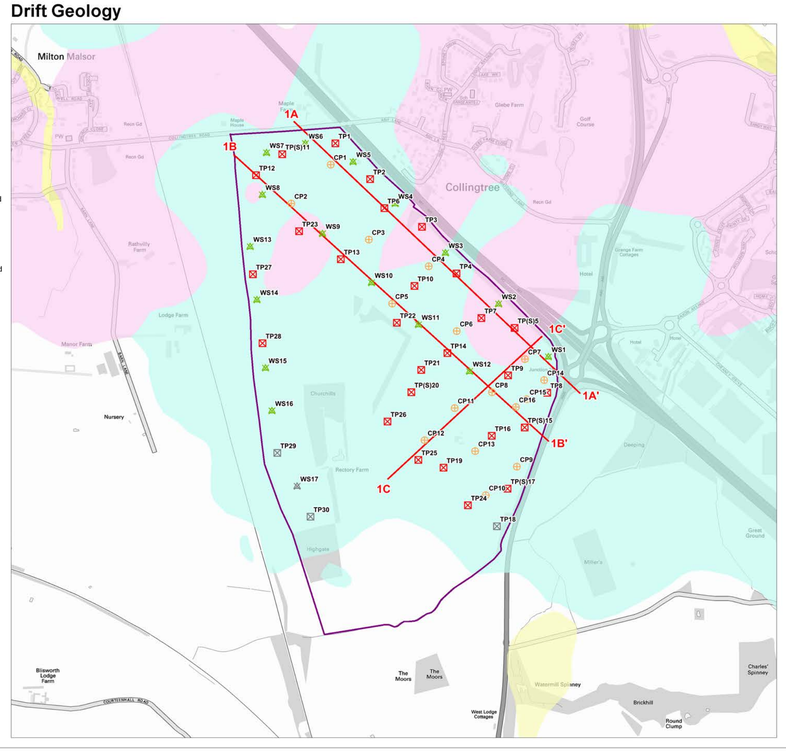
Rutland Formation - Mudstone
Stamford Member - Sandstone and Siltstone, Interbedded
Wellingborough Limestone Member - Limestone
Whitby Mudstone Formation - Mudstone

Drift Geology



Indicative site boundary
Section lines

Exploratory Holes
Trial Pit
Window Sample
Cable Percussion Borehole
Trial pit/window sample unable to be undertaken as crops still up in fields

Drift Geology
Alluvium - Clay, Silt, Sand & Gravel
Glaciofluvial Deposits, Mid Pleistocene - Sand & Gravel
Oadby Member - Diamicton
Tufa - Tufa, Calcareous

Rev	Date	Description	Drn	Chk	App
00	06.11.14	312598	SP	RG	DB

Junction 15 M1 West

Figure 10

Indicative Ground Model
Section 1C

Not to Scale | REV 00

FILE NAME: \\cv-nas1\Asbestos\Geoscience Data\Cov Ground and Environment\Jobs\312000 ONWARDS\312500 - 312599\312598 - Junction 15 M1 West\10 Drawings\GIS\10 - Workspaces\Interp

APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Roxhill Developments Limited in accordance with the terms of a contract between RSK and the "client", dated July 2014. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B
HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: commercial scenario

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Therefore, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value (SGV) reports and associated publications[(1)] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs) in September 2009. It was also produced following publication of GAC by LQM[(6)]. Where available, the published soil guideline values (SGV)[(1)] were used as the GAC. The GAC for lead is discussed separately below owing to it not being derived using the same approach as other compounds.

Lead GAC derivation

The Environment Agency SGV and Tox reports for lead were withdrawn in 2009. In addition, the provisional tolerable weekly intake data published in the Netherlands was also withdrawn in 2010 owing to concerns that it was not suitably protective of human health. The withdrawn SGV was based on a target blood lead concentration 10 μg/dl. In the absence of current guidelines, many consultants have continued to use the withdrawn SGV. However, as this is not considered sufficiently protective of human health RSK has revised its GAC for lead and is currently undertaking a review of recent toxicological developments that will be used to refine this GAC further in the coming months.

Variable	Description of variable	Units	Value in SGV10	Revised value for RSK GAC
T	Health criteria value – reduced owing to concern that 10ug/dl may not be suitably protective of human health	ug/dl	10	5
G	Geometric standard deviation for B typically in range of 1.8 to 2.1	-	2.0	1.8
B	Geometric mean of blood lead concentration in adult women. The value used in SGV10 was based on UK data from 1995 from women in an urban area aged 16–44. Data in the US has shown decreases from between 1.7 and 2.2 to 1ug/dl between the late 1980s/early 1990s and late 1990s/early 2000s for adult females between 17 and 45 years old. Lead concentrations in blood are likely to be decreasing in the UK owing to a ban on lead in internal paint, a ban on lead in fuel and replacement of lead pipes for water supply	ug/dl	2.3	1.0
n	Selected on the basis of the degree of protection needed for a population at risk at the target concentration (T); the default value is 95%	-	1.645	1.645
$AT_{S, D}$	Averaging time assuming exposure over working lifetime. The value has been revised to reflect 49 years in accordance with CLEA commercial scenario outlined in SR3	days	15695	17885
BKSF	Biokinetic slope factor	ug/dl per ug/day	0.4	0.4
IR_S	Soil ingestion rate (including soil-derived indoor dust). This value has been revised to reflect the CLEA commercial scenario outlined in SR3	g/day	0.040	0.050
$AF_{S, D}$	Absorption fraction (same for soil and dust)	-	0.12	0.12
$EF_{S, D}$	Exposure frequency – based on CLEA commercial conceptual model	days/yr	230	230
ED	Exposure duration. This value has been revised to reflect CLEA commercial conceptual model outlined in SR3	years	43	49

The methodology utilised for the adult receptor is the Adult Lead Methodology used in the USA, which is a similar equation to that used in production of the UK SGV outlined in R&D publication SGV10. Parameters within the equation are presented below and have been updated to reflect:

- a revised and more health protective target blood level
- more recent US data pertaining to the geometric blood lead concentration, which indicates decreasing concentrations from 1988 to 2004
- more recent US data regarding the geometric standard deviation (the measure of inter-individual variability in blood lead concentrations within the adult population).

Although the update is based on US data, RSK considers that background blood levels in the UK will also be decreasing owing to lead pipes being replaced, lead no longer being used in fuel and lead paints being banned from internal use. Furthermore, RSK has run the equation with varying inputs to ascertain its sensitivity to certain parameters. Using the parameters outlined above RSK obtains a GAC of **600mg/kg** for an adult in a commercial setting. A similar value is obtained if all input parameters remain equal to those used in production of the former SGV but the soil ingestion rate is increased to reflect 50mg/day reported for the commercial scenario in SR3.

GAC derivation for other metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated for compounds where SGV have not been published using CLEA v1.06 and the supporting UK guidance[1–6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[2–5]. The SAC and GrAC collectively are termed GAC.

Pathway selection

In accordance with EA Science Report SC050221/SR3[3] the commercial scenario considers risks to a female worker who works from the age of 16 to 65 years. It should be noted that this end use is not suitable for a workplace nursery but also may be appropriate for a sport centre or shopping centre where children are present. In accordance with Box 3.5, SR3[3] the pathways considered for production of the SAC in the commercial scenario are:

- direct soil and dust ingestion
- dermal contact with soil both indoor and outdoors
- indoor air inhalation from soil and vapour and outdoor inhalation of soil and vapour.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by workers while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air.

Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous-based or the vapour-based saturation limits. Where model output cells are flagged red the soil or vapour saturation limit has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA handbook[4] this is likely to be impractical in many cases because of the very low solubility/vapour saturation limits and, in any case, is highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets. Therefore, when using the SAC to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility saturation or vapour saturation limit (in brackets), and subsequently incorporate this information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model handbook[4] which explains how to calculate an effective assessment criterion manually.

Input selection

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For SAC for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH), toxicological and specific chemical parameters were obtained from the LQM/CIEH report[6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band have been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the US EPA as in the RBCA model. RBCA

uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- an adult weighing 70kg and breathing 14.8m^3 air per day in accordance with the UK TOX reports[2] and SR3[3]
- the 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not currently available but background exposure is considered important in the overall exposure.

Physical parameters

For the commercial end use, the CLEA default pre-1970s three-storey office building was used. SR3 notes this commercial building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 3.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

GAC

The SAC were produced using the input parameters in Tables 1, 2 and 3 and the GrAC using the input parameters in Table 4. The final selected GAC are presented by pathway in Table 5 with the combined GAC in Table 6.

Figure 1: Conceptual model for CLEA commercial scenario

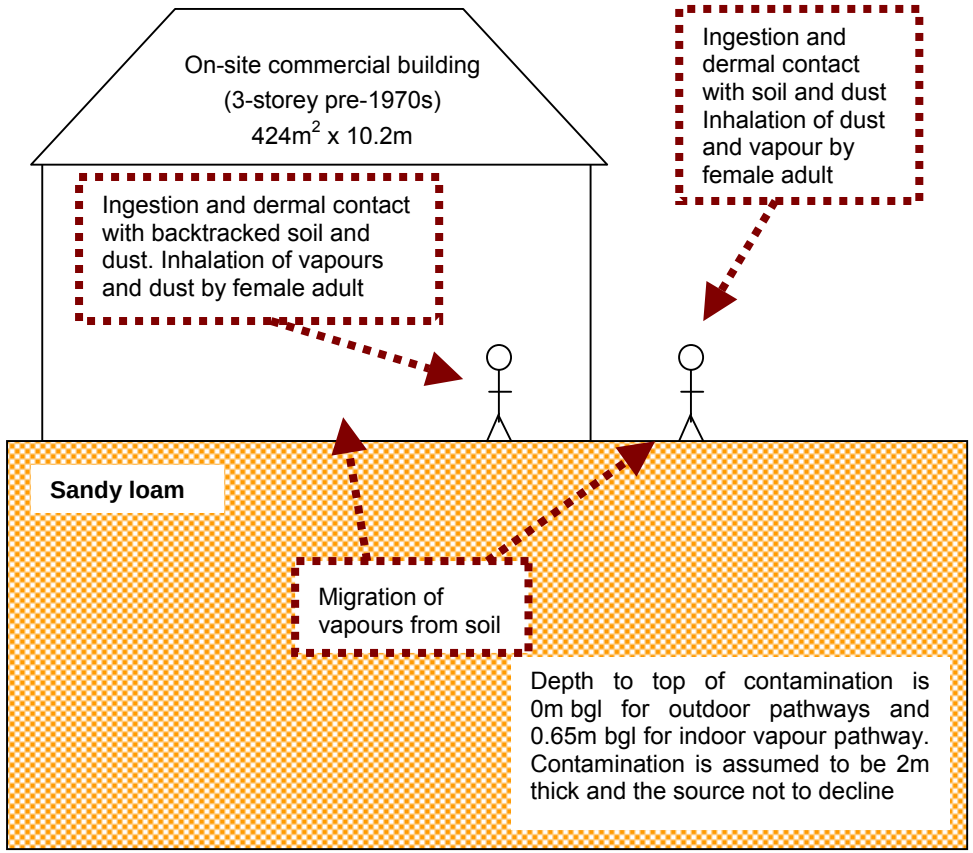


Table 1: Exposure assessment parameters for commercial scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Commercial	Chosen land use
Receptor	Female worker	Taken as female adult exposed over 49 years from age 16 to 65 years, Box 3.5, SR3[3]
Building	Office (pre-1970)	Key generic assumption given in Box 3.5, SR3[3]. Pre-1970s three-storey office building chosen as it is the most conservative in terms of protection from vapour intrusion (Section 3.4.6, SR3[3])
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[3]). Table 4 presents soil-specific inputs
Start age class (AC)	17	AC corresponding to key generic assumption that the critical receptor is a working female adult exposed over a 49-year period from age 16 to 65 years. Assumption given in Box 3.5, SR3[3]. Data specific to AC exposure is presented in Table 2 and receptor specific in Table 3
End AC	17	
SOM (%)	6	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for sites where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Commercial – receptor inputs for CLEA model

Parameter	Unit	Value	Justification
Exposure frequency (EF) (soil and dust ingestion)	day yr^{-1}	230	From Table 3.9, SR3[3]. The working week is assumed 45 hours including a 1-hour lunch break each day. Indoor and outdoor exposure are weighted by the frequency of time spent indoors and outdoors (8.3 hours a day and 0.7 hours a day respectively)
EF (dermal contact with dust. indoor)	day yr^{-1}	230	
EF (dermal contact with soil, outdoor)	day yr^{-1}	170	
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	230	
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	170	
Occupancy period (indoor)	hr day^{-1}	8.3	Box 3.6, SR3[3]. Weighted average based on a nine-hour day including one-hour lunch being spent outside 75% of the year
Occupancy period (outdoor)	hr day^{-1}	0.7	
Soil to skin adherence factor (indoor and outdoor)	mg cm^{-2} day^{-1}	0.14	Table 8.1, SR3[3] for age class 17
Soil and dust ingestion rate	g day^{-1}	0.05	Table 6.2, SR3[3] for age class 17
Body weight	kg	70	Table 4.6, SR3[3] for female AC 17
Body height	m	1.6	Table 4.6, SR3[3] for female AC 17
Inhalation rate	m^3 day^{-1}	14.8	Table 4.14, SR3[3] for female AC 17
Max. exposed skin fraction (indoor and outdoors)	m^2 m^{-2}	0.08	Based on adult female assuming face and hands are exposed. Table 4.7, SR3[3]

Table 3: Commercial – soil, air and building inputs for CLEA model

Parameter	Unit	Value	Justification
Soil properties for sandy loam			
Porosity, total	$cm^3\ cm^{-3}$	0.53	Default soil type is sandy loam, Section 4.3.1, SR3[3]. Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	$cm^3\ cm^{-3}$	0.20	
Porosity, water filled	$cm^3\ cm^{-3}$	0.33	
Residual soil water content	$cm^3\ cm^{-3}$	0.12	
Saturated hydraulic conductivity	$cm\ s^{-1}$	0.00356	
van Genuchten shape parameter (*m*)	-	0.3201	
Bulk density	$g\ cm^{-3}$	1.21	
Threshold value of wind speed at 10m	$m\ s^{-1}$	7.20	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature of UK surface soils. Section 4.3.1, SR3[3]
Air dispersion model			
Mean annual wind speed (10m)	$m\ s^{-1}$	5.0	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 1.6m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	120	From Table 9.1, SR3. Values for a 2ha site, appropriate to a commercial land use in Newcastle (most representative city for UK, section 9.2.1,SR3[3])
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.8	Section 3.4.6 and 9.2.2, SR3[3] for average office such as that used in the commercial scenario
Building properties for office (pre-1970) with ground-bearing floor slab			
Building footprint	m^2	424	From Table 3.10, SR3[3]
Living space air exchange rate	hr^{-1}	1.0	
Living space height (above ground)	m	9.6	
Living space height (below ground)	m	0.0	Assumed no basement.
Pressure difference (soil to enclosed space)	Pa	4.4	From Table 3.10, SR3[3]
Foundation thickness	m	0.15	

Parameter	Unit	Value	Justification
Floor crack area	m^2	0.165	
Dust loading factor	$\mu g\ m^{-3}$	100	Default value for a commercial site taken from Section 9.3, SR3[3]
Vapour model			
Default soil gas ingress rate	$cm^3\ s^{-1}$	150	Section 10.3, report SC050021/SR3[3]
Depth to top of source (beneath building for indoor exposure)	cm	50	Section 3.4.6, SR3[3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (outdoors)	cm	0	Section 10.2, SR3[3] assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[4]
Time average period for surface emissions	years	49	Working lifetime from 16–65 years. Key generic assumption given in Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2: GrAC conceptual model for RBCA commercial scenario

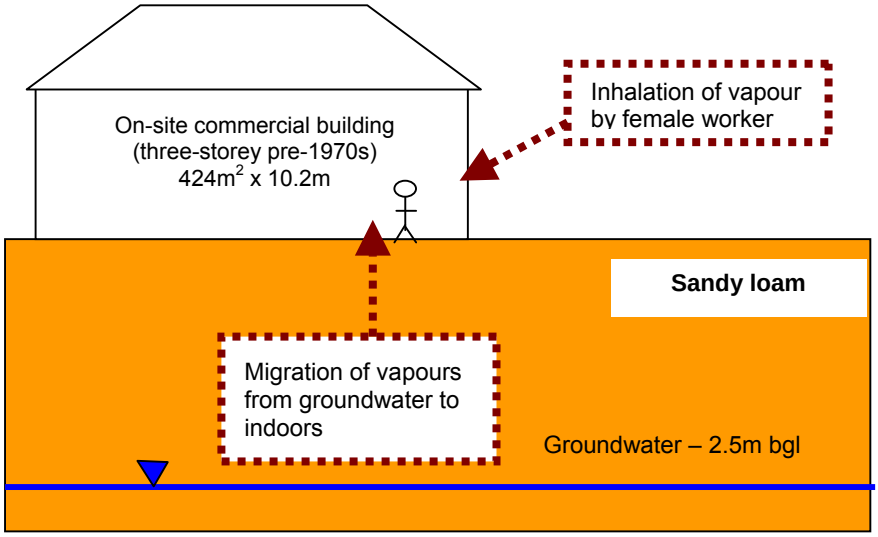


Table 4: Commercial – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	49	From Box 3.5, SR3[3]
Receptor weight	kg	70	Female adult, Table 4.6, SR3[3]
Exposure duration	Years	49	From Box 3.5, SR3[3]
Exposure frequency	Days/yr	86.25	Weighted using occupancy period of 9 hours per day for 230 days of the year ((9hours x 230 days)/24 hours)
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone	m	0.1	Professional judgement

Parameter	Unit	Value	Justification
thickness			
Building			
Building volume/area ratio	m	9.6	Table 3.10, SR3[3]
Foundation area	m^2	424	Table 3.10, SR3[3]
Foundation perimeter	m	82.40	Based on square root of building area being 20.59m
Building air exchange rate	d^{-1}	24	Table 3.10, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	Table 3.10, SR3[3]
Foundation crack fraction	-	3.89E-04	Calculated from floor crack area of 0.165m^2 and building footprint of 424m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	4.4	From Table 3.10, SR3[3]

References

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2. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2*, January (Bristol: Environment Agency).

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6. Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

7. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

8. Changes made to the CLEA framework documents after the three-month evaluation period in 2008, released January 2009 by the Environment Agency.

Table 5

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	GrAC (mg/l)	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(b)(c)	-	6.35E+02	6.95E+02	-	NR	6.35E+02	6.95E+02	-	NR	6.35E+02	6.95E+02	-	NR
Cadmium	(b)	-	3.99E+02	3.87E+02	2.30E+02	NR	3.99E+02	3.87E+02	2.30E+02	NR	3.99E+02	3.87E+02	2.30E+02	NR
Chromium (III) - oxide		-	3.31E+05	3.34E+04	3.04E+04	NR	3.31E+05	3.34E+04	3.04E+04	NR	3.31E+05	3.34E+04	3.04E+04	NR
Chromium (VI) - hexavalent		-	2.01E+03	3.48E+01	3.42E+01	NR	2.01E+03	3.48E+01	3.42E+01	NR	2.01E+03	3.48E+01	3.42E+01	NR
Copper		-	1.78E+05	9.60E+04	7.17E+04	NR	1.78E+05	9.60E+04	7.17E+04	NR	1.78E+05	9.60E+04	7.17E+04	NR
Lead	(a)	-	6.00E+02	-	-	NR	6.00E+02	-	-		6.00E+02	-	-	NR
Elemental mercury (Hg^0)	(b)(d)	5.60E-02	-	1.84E+01	-	4.31E+00	-	4.57E+01	-	1.07E+01	-	1.09E+02	-	2.58E+01
Inorganic mercury (Hg^{2+})	(b)	-	4.41E+03	2.09E+04	3.64E+03	NR	4.41E+03	2.09E+04	3.64E+03		4.41E+03	2.09E+04	3.64E+03	NR
Methyl mercury (Hg^{4+})	(b)	1.00E+02	4.25E+02	2.73E+03	3.68E+02	7.33E+01	4.25E+02	4.97E+03	3.91E+02	1.42E+02	4.25E+02	9.41E+03	4.07E+02	3.04E+02
Nickel	(b)	-	2.22E+04	1.79E+03	-	NR	2.22E+04	1.79E+03	-	NR	2.22E+04	1.79E+03	-	NR
Selenium	(b)(c)	-	1.30E+04	-	-	NR	1.30E+04	-	-	NR	1.30E+04	-	-	NR
Zinc	(c)	-	6.67E+05	2.09E+08	-	NR	6.67E+05	2.09E+08	-	NR	6.67E+05	2.09E+08	-	NR
Cyanide		-	1.69E+04	1.95E+03	1.81E+03	NR	1.69E+04	1.95E+03	1.81E+03	NR	1.69E+04	1.95E+03	1.81E+03	NR
Volatile organic compounds														
Benzene	(b)	1.40E+02	5.53E+02	2.96E+01	2.81E+01	1.22E+03	5.53E+02	5.51E+01	5.01E+01	2.26E+03	5.53E+02	1.14E+02	9.47E+01	4.71E+03
Toluene	(b)	5.90E+02	4.25E+05	6.85E+04	5.90E+04	8.69E+02	4.25E+05	1.51E+05	1.11E+05	1.92E+03	4.25E+05	3.42E+05	1.89E+05	4.36E+03
Ethylbenzene	(b)	1.80E+02	1.91E+05	1.84E+04	1.68E+04	5.18E+02	1.91E+05	4.31E+04	3.51E+04	1.22E+03	1.91E+05	1.00E+05	6.57E+04	2.84E+03
Xylene - m	(b)	2.00E+02	3.43E+05	6.59E+03	6.46E+03	6.25E+02	3.43E+05	1.55E+04	1.48E+04	1.47E+03	3.43E+05	3.61E+04	3.27E+04	3.46E+03
Xylene - o	(b)	1.70E+02	3.43E+05	7.08E+03	6.94E+03	4.78E+02	3.43E+05	1.65E+04	1.58E+04	1.12E+03	3.43E+05	3.84E+04	3.46E+04	2.62E+03
Xylene - p	(b)	2.00E+02	3.43E+05	6.34E+03	6.22E+03	5.76E+02	3.43E+05	1.48E+04	1.42E+04	1.35E+03	3.43E+05	3.45E+04	3.14E+04	3.17E+03
Total xylene	(b)	2.00E+02	3.43E+05	6.59E+03	6.46E+03	6.25E+02	3.43E+05	1.55E+04	1.48E+04	1.47E+03	3.43E+05	3.61E+04	3.27E+04	3.46E+03
Methyl tertiary butyl ether (MTBE)		4.80E+04	9.53E+03	2.09E+04	8.21E+03	1.66E+04	9.53E+03	2.72E+04	8.55E+03	2.16E+04	9.53E+03	4.18E+04	8.93E+03	3.34E+04
Trichloroethene		3.60E+01	9.92E+03	1.19E+01	1.19E+01	1.54E+03	9.92E+03	2.49E+01	2.49E+01	3.22E+03	9.92E+03	5.54E+01	5.50E+01	7.14E+03
Tetrachloroethene		2.30E+02	2.65E+04	1.31E+02	1.31E+02	4.24E+02	2.65E+04	2.94E+02	2.91E+02	9.51E+02	2.65E+04	6.75E+02	6.58E+02	2.18E+03
1,1,1-Trichloroethane		1.30E+03	1.14E+06	7.01E+02	7.00E+02	1.43E+03	1.14E+06	1.43E+03	1.43E+03	2.92E+03	1.14E+06	3.14E+03	3.13E+03	6.39E+03
1,1,1,2 Tetrachloroethane		1.10E+03	1.10E+04	1.16E+02	1.15E+02	2.60E+03	1.10E+04	2.68E+02	2.62E+02	6.02E+03	1.10E+04	6.24E+02	5.91E+02	1.40E+04
1,1,2,2 Tetrachloroethane		1.10E+03	1.10E+04	2.98E+02	2.90E+02	2.67E+03	1.10E+04	6.10E+02	5.78E+02	5.46E+03	1.10E+04	1.34E+03	1.19E+03	1.20E+04
Carbon Tetrachloride (tetrachloromethane)		5.70E+00	2.70E+03	3.04E+00	3.04E+00	1.52E+03	2.70E+03	6.67E+00	6.65E+00	3.32E+03	2.70E+03	1.51E+01	1.50E+01	7.54E+03
1,2-Dichloroethane		6.10E+00	2.29E+02	7.14E-01	7.12E-01	3.41E+03	2.29E+02	1.03E+00	1.03E+00	4.91E+03	2.29E+02	1.77E+00	1.75E+00	8.43E+03
Vinyl Chloride (chloroethene)		4.10E-01	2.67E+01	6.31E-02	6.30E-02	1.36E+03	2.67E+01	8.16E-02	8.14E-02	1.76E+03	2.67E+01	1.25E-01	1.24E-01	2.69E+03
1,2,4-Trimethylbenzene		5.70E+01	-	4.17E+01	-	5.57E+02	-	9.89E+01	-	1.36E+03	-	2.19E+02	-	3.25E+03
1,3,5-Trimethylbenzene		3.80E+01	2.19E+04	4.71E+01	4.71E+01	9.47E+01	2.19E+04	1.12E+02	1.12E+02	2.26E+02	2.19E+04	2.63E+02	2.63E+02	5.33E+02
Semi-volatile organic compounds														
Acenaphthene		3.20E+00	1.10E+05	3.75E+05	8.49E+04	5.70E+01	1.10E+05	8.95E+05	9.77E+04	1.41E+02	1.10E+05	2.00E+06	1.04E+05	3.36E+02
Acenaphthylene		1.61E+01	1.10E+05	3.64E+05	8.43E+04	8.61E+01	1.10E+05	8.68E+05	9.74E+04	2.12E+02	1.10E+05	1.94E+06	1.04E+05	5.06E+02
Anthracene		2.10E-02	5.49E+05	1.19E+07	5.25E+05	1.17E+00	5.49E+05	2.49E+07	5.37E+05	2.91E+00	5.49E+05	4.38E+07	5.42E+05	6.96E+00
Benzo(a)anthracene		3.80E-03	2.52E+02	1.39E+02	8.95E+01	1.71E+00	2.52E+02	1.52E+02	9.48E+01	4.28E+00	2.52E+02	1.59E+02	9.74E+01	1.03E+01
Benzo(b)fluoranthene		2.00E-03	2.60E+02	1.63E+02	1.00E+02	1.22E+00	2.60E+02	1.67E+02	1.02E+02	3.04E+00	2.60E+02	1.69E+02	1.03E+02	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	1.66E+03	1.08E+03	6.54E+02	1.54E-02	1.66E+03	1.09E+03	6.59E+02	3.85E-02	1.66E+03	1.10E+03	6.61E+02	9.23E-02
Benzo(k)fluoranthene		8.00E-04	3.66E+02	2.31E+02	1.41E+02	6.87E-01	3.66E+02	2.35E+02	1.43E+02	1.72E+00	3.66E+02	2.38E+02	1.44E+02	4.12E+00
Chrysene		2.00E-03	3.66E+02	2.20E+02	1.37E+02	4.40E-01	3.66E+02	2.29E+02	1.41E+02	1.10E+00	3.66E+02	2.34E+02	1.43E+02	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	3.29E+01	2.80E+01	1.27E+01	3.93E-03	3.29E+01	2.12E+01	1.29E+01	9.82E-03	3.29E+01	2.15E+01	1.30E+01	2.36E-02
Fluoranthene		2.30E-01	2.29E+04	2.01E+06	2.26E+04	1.89E+01	2.29E+04	2.89E+06	2.27E+04	4.73E+01	2.29E+04	3.52E+06	2.27E+04	1.13E+02
Fluorene		1.90E+00	7.31E+04	4.82E+05	6.35E+04	3.09E+01	7.31E+04	1.12E+06	6.87E+04	7.65E+01	7.31E+04	2.38E+06	7.10E+04	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	1.57E+02	9.71E+01	6.00E+01	6.13E-02	1.57E+02	9.98E+01	6.11E+01	1.53E-01	1.57E+02	1.01E+02	6.17E+01	3.68E-01
Phenanthrene		5.30E-01	2.28E+04	5.67E+05	2.19E+04	3.60E+01	2.28E+04	1.16E+06	2.24E+04	8.96E+01	2.28E+04	1.98E+06	2.26E+04	2.14E+02
Pyrene		1.30E-01	5.49E+04	4.74E+06	5.42E+04	2.20E+00	5.49E+04	6.86E+06	5.44E+04	5.49E+00	5.49E+04	8.39E+06	5.45E+04	1.32E+01
Benzo(a)pyrene		3.80E-03	3.66E+01	2.30E+01	1.41E+01	9.11E-01	3.66E+01	2.35E+01	1.43E+01	2.28E+00	3.66E+01	2.38E+01	1.44E+01	5.46E+00
Naphthalene		1.90E+01	3.64E+04	2.05E+02	2.04E+02	7.64E+01	3.64E+04	4.90E+02	4.83E+02	1.83E+02	3.64E+04	1.15E+03	1.12E+03	4.32E+02
Phenol	(b)(e)	-	1.54E+06	3.16E+04	3.10E+04	4.16E+04	1.00E+06	3.57E+04	3.49E+04	8.15E+04	1.54E+06	3.85E+04	3.76E+04	1.74E+05
Total petroleum hydrocarbons														
Aliphatic hydrocarbons EC_5–EC_6		3.60E+01	4.77E+06	3.38E+03	3.39E+03	3.04E+02	4.77E+06	6.21E+03	6.21E+03	5.58E+02	4.77E+06	1.28E+04	1.28E+04	1.15E+03
Aliphatic hydrocarbons >EC_6–EC_8		5.40E+00	4.77E+06	8.26E+03	8.25E+03	1.44E+02	4.77E+06	1.84E+04	1.84E+04	3.22E+02	4.77E+06	4.21E+04	4.20E+04	7.36E+02
Aliphatic hydrocarbons >EC_8–EC_{10}		4.30E-01	9.53E+04	2.14E+03	2.13E+03	7.77E+01	9.53E+04	5.21E+03	5.14E+03	1.90E+02	9.53E+04	1.24E+04	1.19E+04	4.51E+02
Aliphatic hydrocarbons >EC_{10}–EC_{12}		3.40E-02	9.53E+04	1.06E+04	1.03E+04	4.75E+01	9.53E+04	2.62E+04	2.42E+04	1.18E+02	9.53E+04	6.25E+04	4.93E+04	2.83E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 5

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	GrAC (mg/l)	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Aliphatic hydrocarbons >EC_{12}–EC_{16}		7.60E-04	9.53E+04	8.75E+04	6.08E+04	2.37E+01	9.53E+04	2.16E+05	8.26E+04	5.91E+01	9.53E+04	5.10E+05	9.50E+04	1.42E+02
Aliphatic hydrocarbons >EC_{16}–EC_{35}	(c)	-	1.59E+06	-	-	8.48E+00	1.76E+06	-	-	2.12E+01	1.83E+06	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}–EC_{44}	(c)	-	1.59E+06	-	-	8.48E+00	1.76E+06	-	-	2.12E+01	1.83E+06	-	-	5.09E+01
Aromatic hydrocarbons >EC_{8}–EC_{9} (styrene)		6.50E+01	1.14E+05	3.00E+04	2.77E+04	6.20E+02	1.14E+05	7.30E+04	5.81E+04	1.52E+03	1.14E+05	1.73E+05	9.00E+04	3.61E+03
Aromatic hydrocarbons >EC_{9}–EC_{10}		6.50E+01	3.81E+04	3.76E+03	3.67E+03	6.13E+02	3.81E+04	9.16E+03	8.56E+03	1.50E+03	3.81E+04	2.17E+04	1.78E+04	3.58E+03
Aromatic hydrocarbons >EC_{10}–EC_{12}		2.50E+01	3.81E+04	2.03E+04	1.69E+04	3.64E+02	3.81E+04	4.97E+04	2.85E+04	8.99E+02	3.81E+04	1.17E+05	3.45E+04	2.15E+03
Aromatic hydrocarbons >EC_{12}–EC_{16}	(c)	5.80E+00	3.81E+04	2.15E+05	3.63E+04	1.69E+02	3.81E+04	5.05E+05	3.74E+04	4.19E+02	3.81E+04	1.09E+06	3.78E+04	1.00E+03
Aromatic hydrocarbons >EC_{16}–EC_{21}	(c)	-	2.82E+04	-	-	5.37E+01	2.83E+04	-	-	1.34E+02	2.84E+04	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}–EC_{35}	(c)	-	2.84E+04	-	-	4.83E+00	2.84E+04	-	-	1.21E+01	2.84E+04	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}–EC_{44}	(c)	-	2.84E+04	-	-	4.83E+00	2.84E+04	-	-	1.21E+01	2.84E+04	-	-	2.90E+01

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway or an absence of toxicological data.

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater screening value. SAC - soil screening value.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red and the GrAC set at the solubility limit.

The SAC for organic compounds are dependent upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58; 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) RSK Lead GAC obtained following sensitivity analysis of blood lead concentrations.

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The same approach has been adopted for zinc.

(d) SAC for elemental mercury, chromium VI and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

(e) The GAC for phenol is based on a threshold which is protective of acute direct skin contact with phenol (the figure in brackets is based on health effects following long-term exposure and is provided for illustration only).

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 6
Selected human health generic assessment criteria for commercial scenario

Compound	GrAC for groundwater (mg/l)	SAC for soil SOM 1% (mg/kg)	SAC for soil SOM 2.5% (mg/kg)	SAC for soil SOM 6% (mg/kg)
Metals				
Arsenic	-	640	640	640
Cadmium	-	230	230	230
Chromium (III) - oxide	-	30,000	30,000	30,000
Chromium (VI) - hexavalent	-	35	35	35
Copper	-	72,000	72,000	72,000
Lead	-	600	600	600
Elemental mercury (Hg^0)	0.056	18 (4.3)	46 (11)	110 (26)
Inorganic mercury (Hg^{2+})	-	3,600	3,600	3,600
Methyl mercury (Hg^{4+})	100	370 (73)	391	410
Nickel	-	1,800	1,800	1,800
Selenium	-	13,000	13,000	13,000
Zinc	-	670,000	670,000	670,000
Cyanide	-	1,800	1,800	1,800
Volatile organic compounds				
Benzene	140	28	50	95
Toluene	590	59,000 (870)	110,000 (1,900)	189,000 (4,400)
Ethylbenzene	180	17,000 (520)	35,000 (1,200)	65,700 (2,800)
Xylene - m	200	6,500 (620)	15,000 (1,500)	32,700 (3,500)
Xylene - o	170	6,900 (480)	16,000 (1,100)	34,600 (2,600)
Xylene - p	200	6,200 (580)	14,000 (1,400)	31,400 (3,200)
Total xylene	200	6,500 (630)	15,000 (1,500)	32,700 (3,500)
Methyl tertiary butyl ether (MTBE)	48,000	8,200	8,600	8,900
Trichloroethene	36	12	25	55
Tetrachloroethene	230	130	1,400	660
1,1,1-Trichloroethane	1,300	700	1,400	3,100
1,1,1,2 Tetrachloroethane	1,100	120	260	590
1,1,2,2 Tetrachloroethane	1,100	290	580	1,200
Carbon tetrachloride (tetrachloromethane)	5.7	3.0	6.7	15
1,2-Dichloroethane	6.1	0.71	1.0	1.8
Vinyl chloride (chloroethene)	0.41	0.063	0.08	0.12
1,2,4-Trimethylbenzene	57	42	99	220
1,3,5-Trimethylbenzene	38	47	110	260
Semi-volatile organic compounds				
Acenaphthene	3.2	85,000 (57)	98,000 (141)	100,000
Acenaphthylene	16	84,000 (86)	97,000 (212)	100,000
Anthracene	0.021	530,000	540,000	540,000
Benzo(a)anthracene	0.0038	90	95	97
Benzo(b)fluoranthene	0.0020	100	100	100
Benzo(g,h,i)perylene	0.00026	650	660	660
Benzo(k)fluoranthene	0.00080	140	140	140
Chrysene	0.0020	140	140	140
Dibenzo(a,h)anthracene	0.00060	13	13	13
Fluoranthene	0.23	23,000	23,000	23,000
Fluorene	1.9	64,000 (31)	69,000	71,000
Indeno(1,2,3-cd)pyrene	0.00020	60	61	62
Phenanthrene	0.53	22,000	22,000	23,000
Pyrene	0.13	54,000	54,000	55,000
Benzo(a)pyrene	0.0038	14	14	14
Naphthalene	19	200 (76)	480 (183)	1100 (432)
Phenol	-	3,200 * (31,000)	3,200* (35,000)	3,200 * (38,000)
Total petroleum hydrocarbons				
Aliphatic hydrocarbons EC_5–EC_6	36	3,400 (304)	6,200 (558)	13,000 (1,150)
Aliphatic hydrocarbons >EC_6–EC_8	5.4	8,300 (144)	18,000 (322)	42,000 (736)
Aliphatic hydrocarbons >EC_8–EC_{10}	0.43	2,100 (78)	5,100 (190)	12,000 (451)
Aliphatic hydrocarbons >EC_{10}–EC_{12}	0.034	10,000 (48)	24,000 (118)	49,000 (283)
Aliphatic hydrocarbons >EC_{12}–EC_{16}	0.00076	61,000 (24)	83,000 (59)	91,000 (142)
Aliphatic hydrocarbons >EC_{16}–EC_{35}	-	1,000,000**	1,000,000**	1,000,000**
Aliphatic hydrocarbons >EC_{35}–EC_{44}	-	1,000,000**	1,000,000**	1,000,000**
Aromatic hydrocarbons >EC_8–EC_9 (styrene)	65	28,000 (620)	58,000 (1,500)	90,000 (3,600)
Aromatic hydrocarbons >EC_9–EC_{10}	65	3,700 (610)	8,600 (1,500)	18,000 (3,600)
Aromatic hydrocarbons >EC_{10}–EC_{12}	25	17,000 (364)	29,000 (899)	35,000 (2,150)
Aromatic hydrocarbons >EC_{12}–EC_{16}	5.8	36,000 (169)	37,000	38,000
Aromatic hydrocarbons >EC_{16}–EC_{21}	-	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{21}–EC_{35}	-	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{35}–EC_{44}	-	28,000	28,000	28,000

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway or an absence of toxicological data.

** Denotes SAC calculated exceeds 100% contaminant. Hence 100% taken as SAC.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for phenol is based on a threshold which is protective of direct skin contact with phenol (the figure in brackets is based on health effects following long-term exposure and is provided for illustration only).

The SAC for organic compounds are dependent on soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58; 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC are highly conservative as concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX C
COMPARISON OF SOIL LABORATORY DATA TO HUMAN HEALTH GAC

312598 - *M1 Junction 15 West: Northampton* - **Human Health Risk Assessment Soil Results Summary Table and Direct Comparison**

Sample Identity		Industrial/Commercial Screening Value (1% SOM)	CP1	WS1	WS8	WS9	WS10	WS11	WS14	TP6	TP7	TP8	TP8	TP9	TP14	TP16	TP24	TP25	CPBH2
Depth		GACs	**0.20**	**0.30**	**0.50**	**0.40**	**0.20**	**0.20**	**0.60**	**0.5**	**0.20**	**0.35**	**0.80**	**0.80**	**0.90**	**0.40**	**0.20**	**0.40**	**0.50**
Strata			**ATS**	**ATS**	**SS**	**ATS**	**ATS**	**ATS**	**OMc**	**ATS**	**ATS**	**OMc**	**OMc**	**OMc**	**OMc**	**SS**	**ATS**	**ATS**	**SS**
Determinants	**Units**																		
pH	pH		7.82	7.5	7.84	8.03	7.86	7.26	7.64	7.33	7.5	8.42	8.08	8.05	8.44		7.85	7.96	7.71
Phenols - Total by HPLC	mg/kg	3200	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2
Total Organic Carbon	% w/w		1.72	1.59	0.35	0.21	2.35	1.44	0.43	2.27	2.17	0.44	0.74	0.85	1.18		2.43	1.67	0.51
Metals																			
Arsenic	mg/kg	640	9	10	10	12	16	12	6	12	11	9	13	11	11		9	10	17
Cadmium	mg/kg	230	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5
Copper	mg/kg	72000	14	14	10	8	16	14	8	16	14	6	12	9	13		17	16	12
Chromium	mg/kg	30000	35	33	30	16	32	27	29	34	28	19	27	22	24		32	31	31
Chromium (hexavalent)	mg/kg	35	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1
Lead	mg/kg	600	27	31	12	12	31	28	11	30	30	12	21	18	11		30	26	20
Mercury	mg/kg	3600	0.18	0.29	0.17	<0.17	0.2	<0.17	0.18	0.18	<0.17	<0.17	<0.17	0.23	0.67		<0.17	0.26	<0.17
Nickel	mg/kg	1800.00	21	23	19	15	21	22	20	25	20	14	26	18	23		28	26	25
Selenium	mg/kg	13000	<1	<1	<1	<1	<1	<1	<1	1	1	<1	<1	1	<1		1	<1	<1
Zinc	mg/kg	670000	60	65	50	49	69	67	39	70	68	42	53	43	48		66	65	66
Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG)																			
Ali >C5-C6	mg/kg	3400	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Ali >C6-C8	mg/kg	8300	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Ali >C8-C10	mg/kg	2100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Ali >C10-C12	mg/kg	10000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Ali >C12-C16	mg/kg	61000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Ali >C16-C21	mg/kg	500000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Ali >C21-C35	mg/kg	500000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Total Aliphatics	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Aro >C5-C7	mg/kg	28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Aro >C7-C8	mg/kg	59000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Aro >C8-C9	mg/kg	28000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Aro >C9-C10	mg/kg	3700	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Aro >C10-C12	mg/kg	17000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Aro >C12-C16	mg/kg	36000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Aro >C16-C21	mg/kg	28000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Aro >C21-C35	mg/kg	28000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Total Aromatics	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
TPH (Ali & Aro)	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
BTEX - Benzene	mg/kg	28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
BTEX - Toluene	mg/kg	59000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	mg/kg	17000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
BTEX - m & p Xylene	mg/kg	6200	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
BTEX - o Xylene	mg/kg	6900	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
MTBE	mg/kg	8200	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
PAHs (Polycyclic Aromatic Hydrocarbons)																			
Acenapthene	mg/kg	85000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Acenapthylene	mg/kg	84000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Anthracene	mg/kg	530000	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02
Benzo(a)anthracene	mg/kg	90	<0.04	<0.04	<0.04	<0.04	0.04	0.05	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	<0.04	<0.04
Benzo(a)pyrene	mg/kg	14	<0.04	<0.04	<0.04	<0.04	0.05	0.07	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	<0.04	<0.04
Benzo(b)fluoranthene	mg/kg	100	<0.05	<0.05	<0.05	<0.05	0.07	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05
Benzo(ghi)perylene	mg/kg	650	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	140	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	<0.07	<0.07
Chrysene	mg/kg	140	<0.06	<0.06	<0.06	<0.06	0.07	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06		<0.06	<0.06	<0.06
Dibenzo(ah)anthracene	mg/kg	13	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		<0.04	<0.04	<0.04
Fluoranthene	mg/kg	23000	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08		<0.08	<0.08	<0.08
Fluorene	mg/kg	64000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	mg/kg	60	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03	<0.03
Napthalene	mg/kg	200	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03	<0.03
Phenanthrene	mg/kg	22000	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03	<0.03
Pyrene	mg/kg	54000	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	<0.07	<0.07
Total PAH	mg/kg		<0.08	<0.08	<0.08	<0.08	0.24	0.22	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08		<0.08	<0.08	<0.08
Organo Chlorine Pesticides (OCP) and Organo Phosphorous Pesticides (OPP)																			
Mevinphos	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Dichlorvos	µg/kg	842000	<50	<50		<50		<50			<50					<50		<50	
alpha-Hexachlorocyclohexane (HCH)	µg/kg	14000	<50	<50		<50		<50			<50					<50		<50	
Diazinon	µg/kg		<50	<50		<50		<50			<50					<50		<50	
gamma-Hexachlorocyclohexane (HCH / Lindane)	µg/kg	532000	<50	<50		<50		<50			<50					<50		<50	
Heptachlor	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Aldrin	µg/kg	54000	<50	<50		<50		<50			<50					<50		<50	
beta-Hexachlorocyclohexane (HCH)	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Methyl Parathion	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Malathion	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Fenitrothion	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Heptachlor Epoxide	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Parathion (Ethyl Parathion)	µg/kg		<50	<50		<50		<50			<50					<50		<50	
p,p-DDE	µg/kg		<50	<50		<50		<50			<50					<50		<50	
p,p-DDT	µg/kg		<50	<50		<50		<50			<50					<50		<50	
p,p-Methoxychlor	µg/kg		<50	<50		<50		<50			<50					<50		<50	
p,p-TDE (DDD)	µg/kg		<50	<50		<50		<50			<50					<50		<50	
o,p-DDE	µg/kg		<50	<50		<50		<50			<50					<50		<50	
o,p-DDT	µg/kg		<50	<50		<50		<50			<50					<50		<50	
o,p-Methoxychlor	µg/kg		<50	<50		<50		<50			<50					<50		<50	
o,p-TDE (DDD)	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Endosulphan I	µg/kg	2310000	<50	<50		<50		<50			<50					<50		<50	
Endosulphan II	µg/kg	2580000	<50	<50		<50		<50			<50					<50		<50	
Endosulphan Sulphate	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Endrin	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Ethion	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Dieldrin	µg/kg	90000	<50	<50		<50		<50			<50					<50		<50	
Azinphos-methyl	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Nitrogen Pests																			
Ametryn	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Atraton	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Atrazine	µg/kg	870000	<50	<50		<50		<50			<50					<50		<50	
Prometon	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Prometryn	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Propazine	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Simazine	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Simetryn	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Terbuthylazine	µg/kg		<50	<50		<50		<50			<50					<50		<50	
Terbutryn	µg/kg		<50	<50		<50		<50			<50					<50		<50	

= Exceedence of GAC for an industrial/commercial end-use

All GACs calculated by RSK or taken from EIC/AGS/CLAIRE Generic Assessment Criteria; and LQM/CIEH Generic Assessment Criteria

APPENDIX D
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as amended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to "***prevent harmful effects on soil, vegetation, animals and man".*** To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were amended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				

APPENDIX E
GENERIC ASSESSMENT CRITERIA FOR POTABLE WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to human health by permeating potable water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

The report concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GAC for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 0.75m below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used, providing the stratum is the same as that in which water supply pipes are likely to be located. The report specifies that sampling should characterise the ground conditions to a minimum of 0.5m below the proposed depth of the pipe.

It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table A3: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC (Not including compounds within group 1a)	0.5	0.125
1a	• BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10}) (Not including compounds within group 2e and 2f)	2	1.4
2e	• Phenols	2	0.4
2f	• Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as ‘suitable’, the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.			

APPENDIX F
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

APPENDIX F
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

The water environment in England and Wales is protected under a number of regulatory regimes, many regulated by the Environment Agency. The Environment Agency is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past. Controlled waters are coastal waters, inland freshwaters and groundwaters. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via various regulations and guidance, covering aspects of groundwater, surface water and drinking water supply policy. The regulations mainly apply to England and Wales, therefore if you are working on a site in Scotland or Northern Ireland, please review the equivalent legislation and guidance provided by the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA).

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out in the Environment Agency's Groundwater Protection: Principles and Practice (GP3) series of documents(1). When assessing risks to groundwater the following need to be taken into consideration:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
    - *Prevent the input of hazardous substances into groundwater (see description of hazardous substances below)*
    - *Limit the entry of other (non-hazardous) pollutants into groundwater so as to avoid pollution, and to avoid deterioration of the status of groundwater bodies or sustained, upward trends in pollutant concentration*
- Where hazardous substances or non-hazardous pollutants have already entered groundwater, the priority is to:
    - *Minimise further entry of hazardous substances and non-hazardous pollutants into groundwater*
    - *Take necessary and reasonable measures to limit the pollution of groundwater or impact on the status of the groundwater body from the future expansion of a contaminant 'plume', if necessary by actively reducing its extent.*

Definitions

Hazardous Substances are defined in the Water Framework Directive 2000/60/EC as 'substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. All List 1 substances under the old Groundwater Directive (80/68/EEC) are hazardous substances, all radioactive substances are hazardous substances.

Non-hazardous Substances are defined as 'substances capable of causing pollution that have not been classified as hazardous substances'. The non-hazardous list of pollutants does not simply replace the old WFD List II but includes a wider range.

For the current list of classified substances please visit the UKTAG website www.wfduk.org./jagdag/

When assessing the risks to surface waters, various standards apply, including Environmental Quality Standards which are protective of the water ecology[14].

The Water Supply (Water Quality) Regulations[2,3] are the primary source for assessing water bodies which may be used for public water supplies. There are also Private Water Supply Regulations which may be applicable in some cases.

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to controlled waters.

The RSK GAC for controlled waters are presented in Table 1. In line with the Environment Agency's (2006b) Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- whether the substance is classified as hazardous or non-hazardous by the EU under the Water Framework Directive (2000/60/EC) and Groundwater Daughter Directive (2006/118/EC) implemented though the Environmental Permitting Regulations 2010
- background concentrations in the aquifer
- published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2010 that are protective of drinking water
- Minimum Reporting Values (or method detection limits if MRV are not provided).

Table 1: Target concentrations for Controlled Waters

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified; according to JAGDAG Determination List June 2010

Target Concentrations shaded in GREEN are Statutory Values ORANGE are Non-Statutory Values

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Metals				
Arsenic	-	0.01[2]	0.05[13a]	0.025[13a]
Cadmium	0.0001[4]	0.005[2]	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 [13b]	0.0002[13c]
Chromium (total)	-	0.05[2]	Use values for chromium III and VI	
Chromium (III)	-	Use value for total chromium	0.0047 [13a]	0.032[13c]
Chromium (VI)			0.0034 [13a]	0.0006[13a]
Copper	-	2.0[2]	0.001, 0.006, 0.01, 0.028[13e]	0.005[13a]
Lead	-	0.025 (before 25/12/2013), 0.01 (after 25/12/2013)[2]	0.0072[13c]	0.0072[13c]
Mercury	0.00001[4]	0.001[2]	0.00005[13c]	0.00005[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Nickel	-	0.02[2]	0.02[13c]	0.02[13c]
Selenium	-	0.01[2]	-	-
Zinc	-	5[3]	0.008, 0.05, 0.075, 0.125 [13e]	0.04[13a]
Chlorinated solvents				
Trichloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
Tetrachloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
1,1,1-Trichloroethane	0.0001[4]	-	0.1[13c]	0.1[13c]
1,1,2-Trichloroethane	0.0001[4]	-	0.4[13c]	0.3[13c]
Carbon tetrachloride (Tetrachloromethane)	0.0001[4]	0.003[2]	0.012[13c]	0.012[13c]
1,2-Dichloroethane	0.001[4]	0.003[2]	0.01[13c]	0.01[13c]
Vinyl chloride (Chloroethene)	-	0.0005[2]	-	-
Trihalomethanes	-	0.1[2, 5]	-	-
Chloroform (Trichloromethane) (one of the trihalomethanes included above)	0.0001[4]	0.1[2, 5]	0.0025[13c]	0.0025[13c]
Polycyclic aromatic hydrocarbons				
Acenaphthene	-	-	0.0058[10]	
Acenaphthylene	-	-	0.0058[10]	
Anthracene	-	-	0.0001[13c]	0.0001[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Benzo(a)anthracene	-	-	0.000018[10]	
Benzo(b)fluoranthene	-	0.0001[2]	0.00003[13f]	0.00003[13f]
Benzo(k)fluoranthene	-			
Benzo(g,h,i)perylene	-		0.000002[13g]	0.000002[13g]
Indeno(1,2,3-cd)pyrene	-			
Chrysene	-	-	0.00001[10]	
Dibenzo(a,h)anthracene	-	-	0.00001[10]	
Fluoranthene	-	-	0.0001[13c]	0.0001[13c]
Fluorene	-	-	0.0021[10]	
Phenanthrene	-	-	0.003[10]	
Pyrene	-	-	0.00004[10]	
Benzo(a)pyrene	-	0.00001[2]	0.00005[13c]	0.00005[13c]
Naphthalene	-	-	0.0024[13c]	0.0012[13c]
Petroleum hydrocarbons				
Total petroleum hydrocarbons	-	0.01[3]	0.01[3, 11]	
Benzene	0.001[4]	0.001[2]	0.01[13c]	0.008[13c
Toluene	0.004[4]	0.7[9]	0.05[13a]	0.04[13a]
Ethylbenzene	-	0.3[9]	0.02[12]	0.02[12]
Xylene	0.003[4]	0.5[9]	0.03[13c]	0.03[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Methyl tertiary butyl ether	-	0.015[7]		
Pesticides and herbicides				
Aldrin	0.000003[4]	0.00003[2]	0.00001[13d]	0.000005[13d]
Dieldrin	0.003[4]	0.00003[2]		
Endrin	0.000003[4]	0.0006[9]		
Isodrin	0.000003[4]	-		
Heptachlor	-	0.00003[2]		
Heptachlor epoxide	-	0.00003[2]		
Other pesticides	-	0.0001[2]		
Total pesticides	-	0.0005[2]		
Total DDT	0.000004[4]	0.001[9]	0.000025[13c]	0.000025[13c]
Azinphos – methyl	0.000001[4]	-	0.00001[1]	
Cyfluthrin	0.0001[4]	-	0.000001[14]	
Demeton	0.00005[4]	-	0.0005[14	
Dichlorvos	-	-	0.000001[13c]	0.00004[13c]
Dimethoate	0.00001[4]	-	0.00048[13a]	0.00048[13a]
Endosulphan	0.000005[4]	-	0.000005[13c]	0.0000005[13c]
Fenitrothion	0.000001[4]	-	0.00001[13c]	0.00001[13c]
Flucofuron	0.0001[4]	-	0.001[14]	

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Malathion	0.000001[4]	-	0.00001[13c]	0.00002[13c]
Mevinphos	0.000005[4]	-	0.00002[14]	-
Omethoate	0.0001[4]	-	0.00001[14]	
PCSDs (cyfluthrin, sulcofuron, flucofuron and **permethrin**)	-	-	0.00005[15]	
Permethrin	0.000001[4]	-	0.00001[13a]	0.00001[13]
Sulcofuron	0.0001[4]	-	0.025[8,14]	
Triazaphos	0.0001[4]	-	0.000005[8]	
Atrazine	0.00003[4]	-	0.0006[13c]	0.0006[13c]
Simazine	0.00003[4]	-	0.001[13c]	0.001[13c]
Bentazone	0.1[4]	-	0.5[13c]	0.5[13a]
Linuron	0.0001[4]	-	0.0005[13a]	0.0005[13a]
Mecoprop	0.00004[4]	-	0.018[13a]	0.018[13a]
Trifluralin	0.00001[4]	-	0.00003[13c]	0.00003[13c]
Miscellaneous				
Cyanide (Hydrogen cyanide)	-	0.05[2]	0.001[13a]	0.001[13a]
Phenol	0.0005[4]	-	0.0077[13a]	0.0077[13a]
Sodium	-	200[2]	-	
Chloride	-	250[2]	250[6,14]	-

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Ammonium (as NH_4^+)	-	0.5[2]	0.3[13a]	
Ammonia (NH_3)	-	-	0.025[15]	0.021[13a]
Sulphate	-	250[2]	400[6,14]	-
Iron	-	0.20[2]	1[13a]	1[13a]
Manganese	-	0.05[2]	0.03[6,14]	No EQS required [12]
Aluminium	-	0.2[2]	-	
Nitrate (as NO_3)	-	50[2]	-	
Nitrite (as NO_2)	-	0.1[2]	0.01[15]	-

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified;
according to JAGDAG Determination List June 2010

Notes:

1. Environment Agency. Groundwater Protection: Principles and Policy (GP3). Part 1 – 4. Part 4 and 5 under consultation.
2. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000, as amended by SI 2001/2885, SI 2002/2469, SI 2005/2035, SI 2007/2734 and SI 2010/991 (applying from April 20 2010)
3. Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Minimum reporting values listed in Annex (j) of Horizontal Guidance Note H1 (H1 Environmental Risk Assessment Framework, Environment Agency, April 2010 v2.0). Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
6. Proposed list of EQS for implementation of the Dangerous Substances Directive (76/464.EEC).
7. Environment Agency MTBE guidance, 2006.
8. Freshwater Environmental Quality Standards: The Water Framework Directive 200/60/EC.
9. WHO (2004) guidelines for drinking-water quality.
10. WRc plc (2002), R&D Technical Report P45. Where predicted no-effect concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(a,h)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
11. Please note this is a very conservative value. If necessary please refer to EA, 2009. *Petroleum hydrocarbons in Groundwater Supplementary Guidance for Hydrogeological Risk Assessment, which* provides advice on risk rankings of TPH CWG fractions. It may be possible to eliminate low risk fractions and/or those not detected above LMDL from concern.
12. Environment Agency Chemical Standards Database (May 2011). http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx
13. The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010.
    - 13a. Annual mean concentration (mg/l) for 'Good' standard.
    - 13b. Applies to hardness ranges of <40mg/l $CaCO_3$, 40–<50mg/l $CaCO_3$, 50–<100mg/l $CaCO_3$, 100–<200mg/l $CaCO_3$ and >/=200mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations.
    - 13c Annual Average EQS (surface waters).
    - 13d. Sum of aldrin, dieldrin, endrin and isodrin.
    - 13e. Applies to hardness ranges of 0–50mg/l $CaCO_3$, 50–100mg/l $CaCO_3$, 100–250mg/l $CaCO_3$ and >250mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations; applies to annual mean concentration (mg/l) of $CaCO_3$. Applies to annual mean concentration of metal (mg/l) for 'Good' standard.

13f. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.

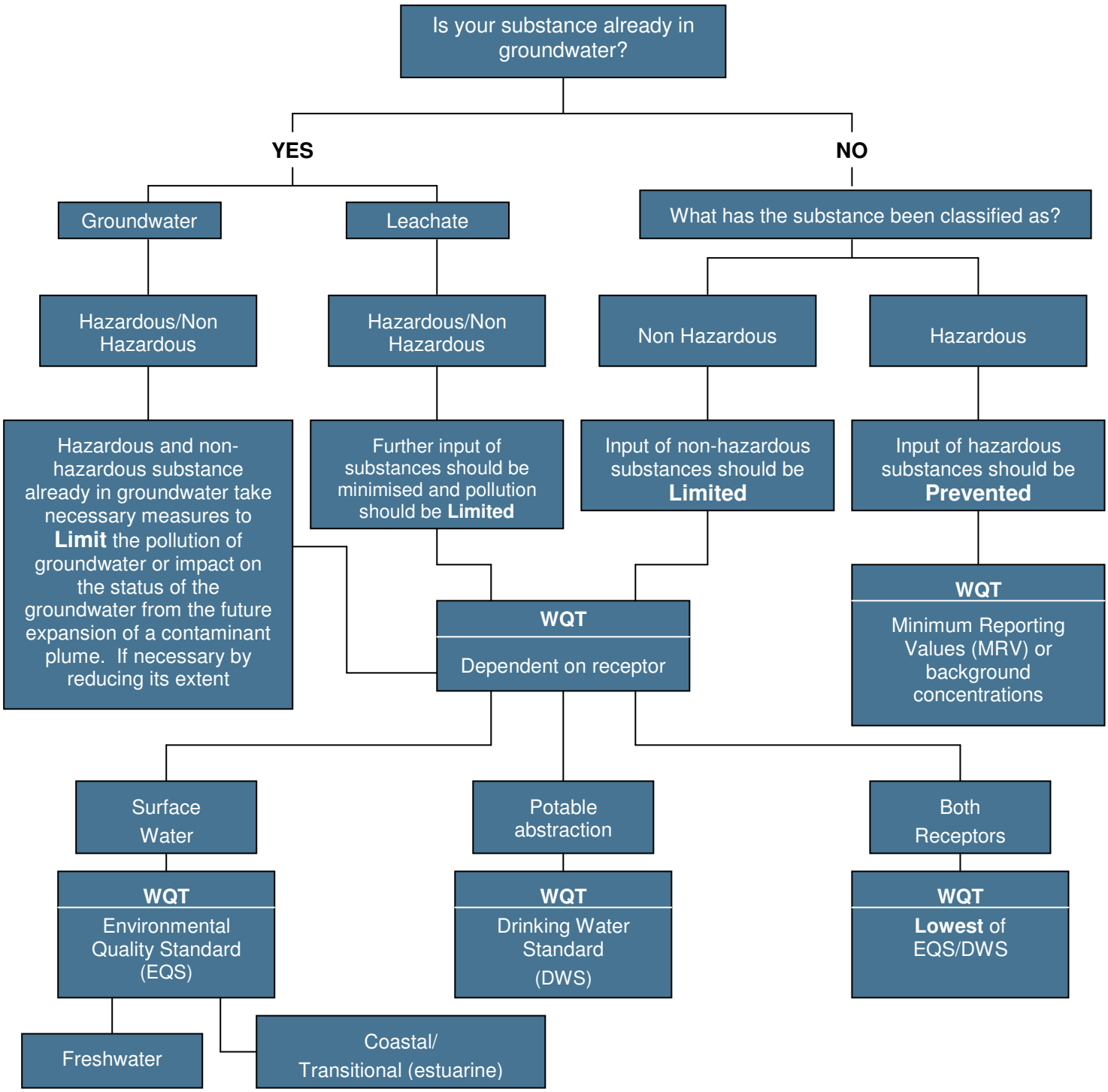
13g. Sum of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene.

14. Council Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community (Dangerous Substances Directive) - List II Substances. Council Directive 76/464/EEC and Surface Waters (Dangerous Substances) (Classification) Regulations 1998

15. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive). Surface Waters (Fishlife) (Classification) Regulations 1997.

Note: '-' A target concentration is not available.

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



WQT = Water Quality Target

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the WQT.

When directly assessing a receptor, e.g., a river, the appropriate WQT should be selected.

APPENDIX G
COMPARISON OF GROUNDWATER LABORATORY DATA TO CONTROLLED WATERS GAC

312598 - M1 Junction 15 West: Northampton - Controlled Waters Risk Assessment Groundwater Results Summary Table and Direct Comparison

Sample Identity		Tier 2 Target Concentration (LTC2)			CP3	WS6	WS8	CP5	CP6	CP14	CP7	CP11	CP13	CP9
Depth														
		Environmental Quality Standard or Best Equivalent												
Strata		Freshwater EQS	UK/EC DWS	WHO DWS										
Determinants	**Units**													
pH	pH	6 to 9	6.5-9.5		7.76	7.87	7.89	7.78	7.8	7.94	7.83	7.8	8.16	7.98
Hardness	mg/l Ca CO3				412	1169	2200	2382	630	1048	2189	522	1930	1713
Phenols (total)	mg/l	0.0077			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (NH3 as N)	mg/l	0.025	1.5		0.1	0.15	<0.02	0.04	0.07	0.09	0.08	0.1	0.59	0.22
Metals														
Arsenic (dissolved)	µg/l	50	10		1	1	5	1	3	5	9	2	5	2
Boron (dissolved)	µg/l	2000	1000		60	101	117	102	63	63	94	101	385	416
Cadmium (dissolved)	µg/l	0.25	5		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper (dissolved)	µg/l	28	2000		4	4	<1	<1	4	30	7	4	8	6
Chromium (dissolved) (III + VI)	µg/l	4.7	50		7	9	<1	<1	11	12	4	10	12	9
Chromium (dissolved) (VI)	mg/l	0.0034			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead (dissolved)	µg/l	7.2	25		8	4	<1	<1	5	116	2	6	10	9
Mercury (dissolved)	µg/l	0.05	1		<0.1	0.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel (dissolved)	µg/l	20	20		2	3	15	30	7	19	21	4	9	10
Selenium (dissolved)	µg/l		10		2	10	1	<1	<1	1.00	23	16	5	2.00
Zinc (dissolved)	µg/l	125	5000		27	53	27	21	23	68	78	33	1170	254
Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG)														
BTEX - Benzene	µg/l	10	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BTEX - Ethyl Benzene	µg/l	20		300	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BTEX - Toluene	µg/l	50		700	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BTEX - m & p Xylene	µg/l				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BTEX - o Xylene	µg/l				<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/l	15			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C5-C6	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C6-C8	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C8-C10	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C10-C12	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ali >C12-C16	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ali >C16-C21	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ali >C21-C35	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Aliphatics	µg/l				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Aro >C5-C7	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C7-C8	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C8-C9	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C9-C10	µg/l	10	10		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C10-C12	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Aro >C12-C16	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Aro >C16-C21	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Aro >C21-C35	µg/l	10	10		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Aromatics	µg/l				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
TPH (Ali & Aro)	µg/l				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

312598 - M1 Junction 15 West: Northampton - Controlled Waters Risk Assessment Groundwater Results Summary Table and Direct Comparison

Sample Identity		Tier 2 Target Concentration (LTC2)			CP3	WS6	WS8	CP5	CP6	CP14	CP7	CP11	CP13	CP9
Depth														
		Environmental Quality Standard or Best Equivalent												
Strata		Freshwater EQS	UK/EC DWS	WHO DWS										
Determinants	Units													
= exceedance of Tier 2 target concentrations														
* = Total PAH EQS (0.1) assessed via comparsion of guideline value to 4 compounds (benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene and indeno(1,2,3-cd)perylene)														
** = assessed using the guidance value for benzene														

APPENDIX H
GROUND GAS RISK ASSESSMENT

IN-SITU GAS MONITORING RESULTS

[Pressures]	Previous	During	Start	End	Equipment Used & Remarks
Round 1	Falling	Falling	1010	1007	Ground: Dry + Wind: Light + Air Temp: 16DegC
Round 2	Rising	Constant	1013	1013	Ground: Dry + Wind: None + Air Temp: 21DegC
Round 3	Falling	Fluctuating	1009	1010	Ground: Wet + Wind: Light + Air Temp: 14DegC
Round 4	Falling	Rising	1003	1005	Ground: Damp + Wind: Medium + Air Temp: 15DegC

Exploratory Position ID	Monitoring Round	Measured Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP1	1	11.52	05/09/2014 09:47:00	1009	1009	-0.1$_{(I)}$	11.44	0.0	0.0	20.7	0.0	0.0	0.0	
CP1	1	---	15 secs	-	-	0.0$_{(SS)}$	-	0.8	0.0	20.1	0.0	0.0	0.0	
CP1	1	---	30 secs	-	-	-	-	1.3	0.0	19.1	0.0	0.0	0.0	
CP1	1	---	60 secs	-	-	-	-	1.5	0.0	18.6	0.0	0.0	0.0	
CP1	1	---	90 secs	-	-	-	-	1.6	0.0	18.5	0.0	0.0	0.0	
CP1	1	---	120 secs	-	-	-	-	1.8	0.0	18.2	0.0	0.0	0.0	
CP1	1	---	180 secs	-	-	-	-	1.9	0.0	18.0	0.0	0.0	0.0	
CP1	1	---	240 secs	-	-	-	-	1.9	0.0	17.9	0.0	0.0	0.0	
CP1	1	---	300 secs	-	-	-	-	1.9	0.0	17.9	0.0	0.0	0.0	
CP1	1	---	360 secs	-	-	-	-	1.9	0.0	17.9	0.0	0.0	0.0	
CP1	2	11.51	09/09/2014 10:41:00	1014	1013	0.0$_{(I)}$	11.43	0.0	0.0	20.8	0.0	0.0	0.0	
CP1	2	---	15 secs	-	-	0.0$_{(SS)}$	-	0.0	0.1	20.9	1.0	0.0	0.0	
CP1	2	---	30 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	2	---	60 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	2	---	90 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	2	---	120 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	2	---	180 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	2	---	240 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Compiled By	Date	Checked By	Date
	30/09/14		

Contract Ref: **312598**

Contract: **M1 Junction 15, Northampton**

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP1	2	---	300 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP1	3	11.52	15/09/2014 10:27:00	1008	1009	$1.0_{(I)}$	11.43	0.0	0.0	20.6	0.0	0.0	0.0	
CP1	3	---	15 secs	-	-	$1.1_{(SS)}$	-	2.1	0.0	18.5	0.0	0.0	0.0	
CP1	3	---	30 secs	-	-	-	-	2.1	0.0	18.0	0.0	0.0	0.0	
CP1	3	---	60 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	3	---	90 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	3	---	120 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	3	---	180 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	3	---	240 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	3	---	300 secs	-	-	-	-	2.1	0.0	17.9	0.0	0.0	0.0	
CP1	4	11.52	24/09/2014 12:27:00	1005	1005	$0.0_{(I)}$	11.46	0.0	0.0	20.8	0.0	0.0	0.0	
CP1	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.9	0.0	18.4	0.0	0.0	0.0	
CP1	4	---	30 secs	-	-	-	-	1.9	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	60 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	90 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	120 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	180 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	240 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP1	4	---	300 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
CP2	1	5.00	05/09/2014 10:29:00	1007	1007	$0.1_{(I)}$	DRY	0.0	0.0	20.7	0.0	0.0	0.0	
CP2	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.0	0.0	18.4	0.0	0.0	0.0	
CP2	1	---	30 secs	-	-	-	-	1.2	0.0	17.3	0.0	0.0	0.0	
CP2	1	---	60 secs	-	-	-	-	1.3	0.0	16.8	0.0	0.0	0.0	
CP2	1	---	90 secs	-	-	-	-	1.3	0.0	16.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP2	1	---	120 secs	-	-	-	-	1.3	0.0	16.8	0.0	0.0	0.0	
CP2	1	---	180 secs	-	-	-	-	1.4	0.0	16.8	0.0	0.0	0.0	
CP2	1	---	240 secs	-	-	-	-	1.3	0.0	16.8	0.0	0.0	0.0	
CP2	1	---	300 secs	-	-	-	-	1.1	0.0	16.8	0.0	0.0	0.0	
CP2	2	5.07	09/09/2014 11:02:00	1013	1013	$0.0_{(I)}$	DRY	0.0	0.0	20.7	0.0	0.0	0.0	
CP2	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	19.9	0.0	0.0	0.0	
CP2	2	---	30 secs	-	-	-	-	0.1	0.0	19.7	0.0	0.0	0.0	
CP2	2	---	60 secs	-	-	-	-	0.2	0.0	19.6	0.0	0.0	0.0	
CP2	2	---	90 secs	-	-	-	-	0.2	0.0	19.4	0.0	0.0	0.0	
CP2	2	---	120 secs	-	-	-	-	0.2	0.0	19.3	0.0	0.0	0.0	
CP2	2	---	180 secs	-	-	-	-	0.2	0.0	19.1	0.0	0.0	0.0	
CP2	2	---	240 secs	-	-	-	-	0.3	0.0	18.9	0.0	0.0	0.0	
CP2	2	---	300 secs	-	-	-	-	0.3	0.1	18.7	1.0	0.0	0.0	
CP2	2	---	360 secs	-	-	-	-	0.3	0.0	18.6	0.0	0.0	0.0	
CP2	2	---	420 secs	-	-	-	-	0.3	0.0	18.6	0.0	0.0	0.0	
CP2	2	---	480 secs	-	-	-	-	0.3	0.0	18.6	0.0	0.0	0.0	
CP2	3	5.05	15/09/2014 11:05:00	1009	1009	$0.6_{(I)}$	DRY	0.0	0.0	20.8	0.0	0.0	0.0	
CP2	3	---	15 secs	-	-	$0.4_{(SS)}$	-	2.1	0.0	16.8	0.0	0.0	0.0	
CP2	3	---	30 secs	-	-	-	-	1.9	0.0	16.4	0.0	0.0	0.0	
CP2	3	---	60 secs	-	-	-	-	1.7	0.0	16.8	0.0	0.0	0.0	
CP2	3	---	90 secs	-	-	-	-	1.7	0.0	16.9	0.0	0.0	0.0	
CP2	3	---	120 secs	-	-	-	-	1.7	0.0	17.0	0.0	0.0	0.0	
CP2	3	---	180 secs	-	-	-	-	1.6	0.0	17.0	0.0	0.0	0.0	
CP2	3	---	240 secs	-	-	-	-	1.6	0.0	17.0	0.0	0.0	0.0	
CP2	3	---	300 secs	-	-	-	-	1.6	0.0	17.0	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP2	4	19.60	24/09/2014 10:50:00	1002	1003	$0.7_{(I)}$	16.52	0.0	0.0	20.8	0.0	0.0	0.0	
CP2	4	---	15 secs	-	-	$0.7_{(SS)}$	-	2.2	0.0	17.0	0.0	0.0	0.0	
CP2	4	---	30 secs	-	-	-	-	2.1	0.0	16.0	0.0	0.0	0.0	
CP2	4	---	60 secs	-	-	-	-	2.0	0.0	16.2	0.0	0.0	0.0	
CP2	4	---	90 secs	-	-	-	-	2.0	0.0	16.3	0.0	0.0	0.0	
CP2	4	---	120 secs	-	-	-	-	2.0	0.0	16.3	0.0	0.0	0.0	
CP2	4	---	180 secs	-	-	-	-	1.9	0.0	16.3	0.0	0.0	0.0	
CP2	4	---	240 secs	-	-	-	-	1.9	0.0	16.3	0.0	0.0	0.0	
CP2	4	---	300 secs	-	-	-	-	1.9	0.0	16.3	0.0	0.0	0.0	
CP3	1	12.33	05/09/2014 09:11:00	1009	1009	$0.0_{(I)}$	5.33	0.0	0.0	20.6	0.0	0.0	0.0	
CP3	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.3	0.0	20.1	0.0	0.0	0.0	
CP3	1	---	30 secs	-	-	-	-	0.3	0.0	20.0	0.0	0.0	0.0	
CP3	1	---	60 secs	-	-	-	-	0.2	0.0	20.1	0.0	0.0	0.0	
CP3	1	---	90 secs	-	-	-	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP3	1	---	120 secs	-	-	-	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP3	1	---	180 secs	-	-	-	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP3	1	---	240 secs	-	-	-	-	0.3	0.0	20.1	0.0	0.0	0.0	
CP3	1	---	300 secs	-	-	-	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP3	2	12.40	09/09/2014 10:16:00	1013	1013	$0.0_{(I)}$	5.49	0.0	0.0	20.9	0.0	0.0	0.0	
CP3	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	20.8	0.0	0.0	0.0	
CP3	2	---	30 secs	-	-	-	-	0.2	0.0	20.8	0.0	0.0	0.0	
CP3	2	---	60 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP3	2	---	90 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP3	2	---	120 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP3	2	---	180 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP3	2	---	240 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP3	2	---	300 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP3	3	12.41	15/09/2014 10:00:00	1009	1009	$0.0_{(I)}$	5.51	0.0	0.0	20.8	0.0	0.0	0.0	
CP3	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.3	0.0	20.8	0.0	0.0	0.0	
CP3	3	---	30 secs	-	-	-	-	0.2	0.0	20.8	0.0	0.0	0.0	
CP3	3	---	60 secs	-	-	-	-	0.2	0.0	20.9	0.0	0.0	0.0	
CP3	3	---	90 secs	-	-	-	-	0.2	0.0	20.9	0.0	0.0	0.0	
CP3	3	---	120 secs	-	-	-	-	0.2	0.0	20.9	0.0	0.0	0.0	
CP3	3	---	180 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP3	3	---	240 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP3	3	---	300 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP3	4	12.39	24/09/2014 12:57:00	1005	1005	$0.0_{(I)}$	5.65	0.0	0.0	20.5	0.0	0.0	0.0	
CP3	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.7	0.0	19.8	0.0	0.0	0.0	
CP3	4	---	30 secs	-	-	-	-	0.5	0.1	19.9	1.0	0.0	0.0	
CP3	4	---	60 secs	-	-	-	-	0.3	0.0	20.2	0.0	0.0	0.0	
CP3	4	---	90 secs	-	-	-	-	0.2	0.1	20.4	1.0	0.0	0.0	
CP3	4	---	120 secs	-	-	-	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP3	4	---	180 secs	-	-	-	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP3	4	---	240 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP3	4	---	300 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP4	1	5.16	04/09/2014 15:07:00	1007	1007	$0.0_{(I)}$	4.47	0.1	0.0	20.6	-	0.0	0.0	
CP4	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.2	0.0	18.5	-	1.0	0.0	
CP4	1	---	30 secs	-	-	-	-	1.2	0.0	18.0	-	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP4	1	---	60 secs	-	-	-	-	1.2	0.0	17.9	-	0.0	0.0	
CP4	1	---	90 secs	-	-	-	-	1.2	0.0	17.8	-	0.0	0.0	
CP4	1	---	120 secs	-	-	-	-	1.3	0.0	17.8	-	0.0	0.0	
CP4	1	---	180 secs	-	-	-	-	1.3	0.0	17.7	-	0.0	0.0	
CP4	1	---	240 secs	-	-	-	-	1.3	0.0	17.7	-	0.0	0.0	
CP4	1	---	300 secs	-	-	-	-	1.3	0.0	17.7	-	0.0	0.0	
CP4	2	5.15	09/09/2014 08:57:00	1013	1013	$0.0_{(I)}$	4.51	0.0	0.0	20.5	0.0	0.0	0.0	
CP4	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP4	2	---	30 secs	-	-	-	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP4	2	---	60 secs	-	-	-	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP4	2	---	90 secs	-	-	-	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP4	2	---	120 secs	-	-	-	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP4	2	---	180 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP4	2	---	240 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP4	2	---	300 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP4	3	5.15	15/09/2014 08:44:00	1009	1009	$0.0_{(I)}$	4.53	0.0	0.0	20.8	0.0	0.0	0.0	
CP4	3	---	15 secs	-	-	$0.0_{(SS)}$	-	1.4	0.0	18.6	0.0	0.0	0.0	
CP4	3	---	30 secs	-	-	-	-	1.4	0.0	17.9	0.0	0.0	0.0	
CP4	3	---	60 secs	-	-	-	-	1.4	0.0	17.8	0.0	0.0	0.0	
CP4	3	---	90 secs	-	-	-	-	1.4	0.0	17.9	0.0	0.0	0.0	
CP4	3	---	120 secs	-	-	-	-	1.4	0.0	18.2	0.0	0.0	0.0	
CP4	3	---	180 secs	-	-	-	-	1.4	0.0	18.3	0.0	0.0	0.0	
CP4	3	---	240 secs	-	-	-	-	1.4	0.0	18.1	0.0	0.0	0.0	
CP4	3	---	300 secs	-	-	-	-	1.4	0.0	18.1	0.0	0.0	0.0	
CP4	4	5.15	24/09/2014 13:16:00	1005	1005	$0.0_{(I)}$	4.56	0.0	0.0	20.8	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP4	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	20.4	0.0	0.0	0.0	
CP4	4	---	30 secs	-	-	-	-	0.6	0.0	20.3	0.0	0.0	0.0	
CP4	4	---	60 secs	-	-	-	-	0.6	0.0	20.3	0.0	0.0	0.0	
CP4	4	---	90 secs	-	-	-	-	0.7	0.0	20.1	0.0	0.0	0.0	
CP4	4	---	120 secs	-	-	-	-	0.9	0.0	19.6	0.0	0.0	0.0	
CP4	4	---	180 secs	-	-	-	-	1.0	0.0	19.1	0.0	0.0	0.0	
CP4	4	---	240 secs	-	-	-	-	1.1	0.1	18.4	1.0	0.0	0.0	
CP4	4	---	300 secs	-	-	-	-	1.2	0.0	18.0	0.0	0.0	0.0	
CP4	4	---	360 secs	-	-	-	-	1.2	0.0	17.8	0.0	0.0	0.0	
CP4	4	---	420 secs	-	-	-	-	1.2	0.0	17.8	0.0	0.0	0.0	
CP5	1	6.50	05/09/2014 13:05:00	1007	1007	$0.0_{(I)}$	5.11	0.0	0.0	20.6	0.0	0.0	0.0	
CP5	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.5	0.0	19.9	0.0	0.0	0.0	
CP5	1	---	30 secs	-	-	-	-	0.5	0.0	19.8	0.0	0.0	0.0	
CP5	1	---	60 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP5	1	---	90 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP5	1	---	120 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP5	1	---	180 secs	-	-	-	-	0.5	0.0	19.6	0.0	0.0	0.0	
CP5	1	---	240 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP5	1	---	300 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP5	2	6.46	09/09/2014 08:45:00	1013	1013	$-0.1_{(I)}$	5.14	0.1	0.0	20.7	0.0	0.0	0.0	
CP5	2	---	15 secs	-	-	$-0.1_{(SS)}$	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP5	2	---	30 secs	-	-	-	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP5	2	---	60 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP5	2	---	90 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP5	2	---	120 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP5	2	---	180 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP5	2	---	240 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP5	2	---	300 secs	-	-	-	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP5	3	6.44	15/09/2014 08:30:00	1009	1009	0.0$_{(I)}$	5.13	0.0	0.0	20.8	0.0	0.0	0.0	
CP5	3	---	15 secs	-	-	0.0$_{(SS)}$	-	0.6	0.0	20.0	0.0	0.0	0.0	
CP5	3	---	30 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
CP5	3	---	60 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
CP5	3	---	90 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
CP5	3	---	120 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
CP5	3	---	180 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	
CP5	3	---	240 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
CP5	3	---	300 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
CP5	3	---	360 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
CP5	4	6.39	24/09/2014 14:41:00	1004	1004	0.0$_{(I)}$	5.16	0.0	0.0	20.4	0.0	0.0	0.0	
CP5	4	---	15 secs	-	-	0.0$_{(SS)}$	-	0.8	0.0	19.2	0.0	0.0	0.0	
CP5	4	---	30 secs	-	-	-	-	0.9	0.0	18.9	0.0	0.0	0.0	
CP5	4	---	60 secs	-	-	-	-	0.9	0.0	18.9	0.0	0.0	0.0	
CP5	4	---	90 secs	-	-	-	-	0.9	0.0	18.9	0.0	0.0	0.0	
CP5	4	---	120 secs	-	-	-	-	0.9	0.0	18.8	0.0	0.0	0.0	
CP5	4	---	180 secs	-	-	-	-	0.9	0.0	18.8	0.0	0.0	0.0	
CP5	4	---	240 secs	-	-	-	-	0.9	0.0	18.8	0.0	0.0	0.0	
CP5	4	---	300 secs	-	-	-	-	0.9	0.0	18.7	0.0	0.0	0.0	
CP6	1	10.85	04/09/2014 14:24:00	1007	1007	0.1$_{(I)}$	3.33	0.1	0.0	20.5	-	0.0	0.0	

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RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Compiled By	Date	Checked By	Date	Contract Ref:
	30/09/14			**312598**

Contract: **M1 Junction 15, Northampton**

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP6	1	---	15 secs	-	-	$0.2_{(SS)}$	-	0.6	0.0	19.7	-	0.0	0.0	
CP6	1	---	30 secs	-	-	-	-	0.6	0.0	19.7	-	2.0	0.0	
CP6	1	---	60 secs	-	-	-	-	0.6	0.0	19.7	-	2.0	1.0	
CP6	1	---	90 secs	-	-	-	-	0.6	0.0	19.7	-	1.0	1.0	
CP6	1	---	120 secs	-	-	-	-	0.6	0.0	19.7	-	1.0	1.0	
CP6	1	---	180 secs	-	-	-	-	0.5	0.0	19.4	-	1.0	1.0	
CP6	1	---	240 secs	-	-	-	-	0.5	0.0	19.2	-	1.0	1.0	
CP6	1	---	300 secs	-	-	-	-	0.4	0.0	18.9	-	1.0	1.0	
CP6	1	---	360 secs	-	-	-	-	0.4	0.0	18.7	-	1.0	1.0	
CP6	1	---	420 secs	-	-	-	-	0.3	0.0	18.6	-	1.0	0.0	
CP6	1	---	480 secs	-	-	-	-	0.3	0.0	18.5	-	0.0	0.0	
CP6	1	---	540 secs	-	-	-	-	0.3	0.0	18.5	-	1.0	0.0	
CP6	1	---	600 secs	-	-	-	-	0.3	0.0	18.6	-	1.0	0.0	
CP6	2	10.42	09/09/2014 09:37:00	1013	1013	$-0.8_{(I)}$	3.38	0.1	0.0	20.6	0.0	0.0	0.0	
CP6	2	---	15 secs	-	-	$-0.2_{(SS)}$	-	0.4	0.0	20.3	0.0	0.0	0.0	
CP6	2	---	30 secs	-	-	-	-	0.4	0.0	20.2	0.0	0.0	0.0	
CP6	2	---	60 secs	-	-	-	-	0.4	0.0	20.2	0.0	0.0	0.0	
CP6	2	---	90 secs	-	-	-	-	0.4	0.0	20.3	0.0	0.0	0.0	
CP6	2	---	120 secs	-	-	-	-	0.5	0.0	19.1	0.0	0.0	0.0	
CP6	2	---	180 secs	-	-	-	-	0.6	0.0	17.6	0.0	0.0	0.0	
CP6	2	---	240 secs	-	-	-	-	0.7	0.0	16.5	0.0	0.0	0.0	
CP6	2	---	300 secs	-	-	-	-	0.8	0.0	15.6	0.0	0.0	0.0	
CP6	2	---	360 secs	-	-	-	-	0.8	0.0	15.0	0.0	0.0	0.0	
CP6	2	---	420 secs	-	-	-	-	0.9	0.0	14.9	0.0	0.0	0.0	
CP6	2	---	480 secs	-	-	-	-	0.9	0.0	14.9	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP6	2	---	540 secs	-	-	-	-	0.9	0.0	15.0	0.0	0.0	0.0	
CP6	3	10.40	15/09/2014 09:23:00	1009	1009	$1.0_{(I)}$	3.37	0.0	0.0	20.5	0.0	0.0	0.0	
CP6	3	---	15 secs	-	-	$0.1_{(SS)}$	-	0.5	0.0	19.2	0.0	0.0	0.0	
CP6	3	---	30 secs	-	-	-	-	0.5	0.0	19.1	0.0	0.0	0.0	
CP6	3	---	60 secs	-	-	-	-	0.5	0.0	19.1	0.0	0.0	0.0	
CP6	3	---	90 secs	-	-	-	-	0.5	0.0	19.1	0.0	0.0	0.0	
CP6	3	---	120 secs	-	-	-	-	0.5	0.0	19.1	0.0	0.0	0.0	
CP6	3	---	180 secs	-	-	-	-	0.6	0.0	18.4	0.0	0.0	0.0	
CP6	3	---	240 secs	-	-	-	-	1.0	0.0	16.1	0.0	0.0	0.0	
CP6	3	---	300 secs	-	-	-	-	1.3	0.0	14.8	0.0	0.0	0.0	
CP6	3	---	360 secs	-	-	-	-	1.4	0.0	14.5	0.0	0.0	0.0	
CP6	3	---	420 secs	-	-	-	-	1.4	0.0	14.8	0.0	0.0	0.0	
CP6	3	---	480 secs	-	-	-	-	1.3	0.0	15.4	0.0	0.0	0.0	
CP6	3	---	540 secs	-	-	-	-	1.2	0.0	16.0	0.0	0.0	0.0	
CP6	3	---	600 secs	-	-	-	-	1.2	0.0	16.6	0.0	0.0	0.0	
CP6	4	10.29	24/09/2014 14:03:00	1004	1004	$0.0_{(I)}$	3.40	0.0	0.0	20.7	0.0	0.0	0.0	
CP6	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	18.7	0.0	0.0	0.0	
CP6	4	---	30 secs	-	-	-	-	0.7	0.0	18.6	0.0	0.0	0.0	
CP6	4	---	60 secs	-	-	-	-	0.7	0.0	18.6	0.0	0.0	0.0	
CP6	4	---	90 secs	-	-	-	-	0.7	0.0	18.5	0.0	0.0	0.0	
CP6	4	---	120 secs	-	-	-	-	0.7	0.0	18.5	0.0	0.0	0.0	
CP6	4	---	180 secs	-	-	-	-	0.7	0.0	18.4	0.0	0.0	0.0	
CP6	4	---	240 secs	-	-	-	-	1.3	0.0	16.8	0.0	0.0	0.0	
CP6	4	---	300 secs	-	-	-	-	1.4	0.0	16.6	0.0	0.0	0.0	
CP6	4	---	360 secs	-	-	-	-	1.4	0.0	16.9	0.0	0.0	0.0	

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP6	4	---	420 secs	-	-	-	-	1.4	0.0	17.3	0.0	0.0	0.0	
CP7	1	3.85	04/09/2014 13:39:00	1008	1008	$0.1_{(I)}$	0.85	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.9	-	1.0	0.0	
CP7	1	---	30 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	60 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	90 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	120 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	180 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	240 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	1	---	300 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP7	2	3.47	09/09/2014 12:47:00	1013	1013	$0.0_{(I)}$	0.83	0.0	0.0	20.7	0.0	0.0	0.0	
CP7	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP7	2	---	30 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP7	2	---	60 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP7	2	---	90 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP7	2	---	120 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP7	2	---	180 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP7	2	---	240 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP7	2	---	300 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP7	3	3.46	15/09/2014 12:40:00	1010	1010	$0.0_{(I)}$	0.83	0.0	0.0	20.5	0.0	0.0	0.0	
CP7	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	30 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	60 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	90 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP7	3	---	120 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	180 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	240 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP7	3	---	300 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP7	4	3.46	24/09/2014 15:15:00	1005	1005	$0.0_{(I)}$	0.85	0.0	0.0	20.4	0.0	0.0	0.0	
CP7	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	30 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	60 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	90 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	120 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	180 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP7	4	---	240 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP7	4	---	300 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP8	1	2.46	04/09/2014 12:32:00	1009	1009	$0.1_{(I)}$	1.50	0.1	0.0	20.9	-	0.0	0.0	
CP8	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.3	0.0	19.5	-	1.0	0.0	
CP8	1	---	30 secs	-	-	-	-	1.3	0.0	19.0	-	0.0	0.0	
CP8	1	---	60 secs	-	-	-	-	1.3	0.0	18.9	-	0.0	0.0	
CP8	1	---	90 secs	-	-	-	-	1.3	0.0	18.9	-	0.0	0.0	
CP8	1	---	120 secs	-	-	-	-	1.3	0.0	18.9	-	1.0	0.0	
CP8	1	---	180 secs	-	-	-	-	1.4	0.0	18.8	-	0.0	0.0	
CP8	1	---	240 secs	-	-	-	-	1.6	0.0	18.4	-	0.0	0.0	
CP8	1	---	300 secs	-	-	-	-	1.9	0.0	17.9	-	0.0	0.0	
CP8	1	---	360 secs	-	-	-	-	2.0	0.0	17.9	-	0.0	0.0	
CP8	1	---	420 secs	-	-	-	-	2.0	0.0	17.8	-	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP8	1	---	480 secs	-	-	-	-	2.0	0.0	17.8	-	0.0	0.0	
CP8	2	2.42	09/09/2014 13:27:00	1013	1013	$-0.1_{(I)}$	1.50	0.0	0.0	20.6	0.0	0.0	0.0	
CP8	2	---	15 secs	-	-	$-0.1_{(SS)}$	-	1.6	0.0	18.3	0.0	0.0	0.0	
CP8	2	---	30 secs	-	-	-	-	1.6	0.0	18.2	0.0	0.0	0.0	
CP8	2	---	60 secs	-	-	-	-	1.6	0.0	18.1	0.0	0.0	0.0	
CP8	2	---	90 secs	-	-	-	-	1.6	0.0	18.1	0.0	0.0	0.0	
CP8	2	---	120 secs	-	-	-	-	1.6	0.0	18.1	0.0	0.0	0.0	
CP8	2	---	180 secs	-	-	-	-	1.7	0.0	18.0	0.0	1.0	0.0	
CP8	2	---	240 secs	-	-	-	-	2.0	0.0	17.6	0.0	0.0	0.0	
CP8	2	---	300 secs	-	-	-	-	2.2	0.0	17.4	0.0	0.0	0.0	
CP8	2	---	360 secs	-	-	-	-	2.2	0.0	17.4	0.0	0.0	0.0	
CP8	2	---	420 secs	-	-	-	-	2.2	0.0	17.4	0.0	0.0	0.0	
CP8	3	2.35	15/09/2014 13:30:00	1010	1010	$0.0_{(I)}$	1.47	0.0	0.0	20.8	0.0	0.0	0.0	
CP8	3	---	15 secs	-	-	$0.0_{(SS)}$	-	1.8	0.0	19.1	0.0	0.0	0.0	
CP8	3	---	30 secs	-	-	-	-	1.8	0.0	18.5	0.0	0.0	0.0	
CP8	3	---	60 secs	-	-	-	-	1.8	0.0	18.5	0.0	0.0	0.0	
CP8	3	---	90 secs	-	-	-	-	1.8	0.0	18.4	0.0	0.0	0.0	
CP8	3	---	120 secs	-	-	-	-	1.8	0.0	18.4	0.0	0.0	0.0	
CP8	3	---	180 secs	-	-	-	-	1.9	0.0	18.4	0.0	0.0	0.0	
CP8	3	---	240 secs	-	-	-	-	2.1	0.0	18.1	0.0	0.0	0.0	
CP8	3	---	300 secs	-	-	-	-	2.1	0.0	18.1	0.0	0.0	0.0	
CP8	3	---	360 secs	-	-	-	-	2.1	0.0	18.1	0.0	0.0	0.0	
CP8	4	2.35	24/09/2014 16:08:00	1005	1005	$0.0_{(I)}$	1.47	0.0	0.0	20.4	0.0	0.0	0.0	
CP8	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.5	0.0	19.0	0.0	0.0	0.0	
CP8	4	---	30 secs	-	-	-	-	1.5	0.0	18.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP8	4	---	60 secs	-	-	-	-	1.5	0.0	18.6	0.0	0.0	0.0	
CP8	4	---	90 secs	-	-	-	-	1.5	0.0	18.5	0.0	0.0	0.0	
CP8	4	---	120 secs	-	-	-	-	1.6	0.0	18.4	0.0	0.0	0.0	
CP8	4	---	180 secs	-	-	-	-	1.6	0.0	18.3	0.0	0.0	0.0	
CP8	4	---	240 secs	-	-	-	-	1.7	0.0	18.2	0.0	0.0	0.0	
CP8	4	---	300 secs	-	-	-	-	1.7	0.0	18.2	0.0	0.0	0.0	
CP8	4	---	360 secs	-	-	-	-	1.7	0.0	18.2	0.0	0.0	0.0	
CP9	1	10.57	04/09/2014 10:53:00	1010	1010	$0.1_{(I)}$	4.83	0.1	0.0	20.7	-	0.0	0.0	
CP9	1	---	15 secs	-	-	$0.1_{(SS)}$	-	0.5	0.0	19.6	-	1.0	0.0	
CP9	1	---	30 secs	-	-	-	-	0.4	0.0	19.8	-	1.0	0.0	
CP9	1	---	60 secs	-	-	-	-	0.3	0.0	20.1	-	1.0	0.0	
CP9	1	---	90 secs	-	-	-	-	0.3	0.0	20.1	-	1.0	0.0	
CP9	1	---	120 secs	-	-	-	-	0.2	0.0	20.1	-	0.0	0.0	
CP9	1	---	180 secs	-	-	-	-	0.2	0.0	20.1	-	0.0	0.0	
CP9	1	---	240 secs	-	-	-	-	0.3	0.0	20.1	-	0.0	0.0	
CP9	1	---	300 secs	-	-	-	-	0.3	0.0	20.1	-	0.0	0.0	
CP9	1	---	360 secs	-	-	-	-	0.3	0.0	20.1	-	0.0	0.0	
CP9	2	10.55	09/09/2014 14:15:00	1013	1013	$0.0_{(I)}$	4.83	0.0	0.0	20.8	0.0	0.0	0.0	
CP9	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP9	2	---	30 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP9	2	---	60 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP9	2	---	90 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP9	2	---	120 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP9	2	---	180 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP9	2	---	240 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP9	2	---	300 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP9	2	---	360 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP9	3	10.55	15/09/2014 14:18:00	1010	1010	$0.0_{(I)}$	4.70	0.0	0.0	20.4	0.0	0.0	0.0	
CP9	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.4	0.0	19.9	0.0	0.0	0.0	
CP9	3	---	30 secs	-	-	-	-	0.2	0.0	20.1	0.0	0.0	0.0	
CP9	3	---	60 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP9	3	---	90 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP9	3	---	120 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP9	3	---	180 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP9	3	---	240 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP9	3	---	300 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP9	4	10.57	24/09/2014 16:46:00	1005	1005	$0.0_{(I)}$	4.95	0.0	0.0	20.8	0.0	0.0	0.0	
CP9	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.4	0.0	20.3	0.0	0.0	0.0	
CP9	4	---	30 secs	-	-	-	-	0.4	0.0	20.3	0.0	0.0	0.0	
CP9	4	---	60 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP9	4	---	90 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP9	4	---	120 secs	-	-	-	-	0.1	0.0	20.6	0.0	0.0	0.0	
CP9	4	---	180 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP9	4	---	240 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP9	4	---	300 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP9	4	---	360 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP9	4	---	420 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP10	1	4.96	04/09/2014 10:38:00	1010	1010	$-0.1_{(I)}$	DRY	0.1	0.0	20.5	-	0.0	0.0	

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP10	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.3	-	0.0	0.0	
CP10	1	---	30 secs	-	-	-	-	0.1	0.0	19.9	-	1.0	0.0	
CP10	1	---	60 secs	-	-	-	-	0.1	0.0	19.7	-	1.0	0.0	
CP10	1	---	90 secs	-	-	-	-	0.1	0.0	19.5	-	1.0	0.0	
CP10	1	---	120 secs	-	-	-	-	0.1	0.0	19.3	-	1.0	0.0	
CP10	1	---	180 secs	-	-	-	-	0.1	0.0	19.1	-	1.0	0.0	
CP10	1	---	240 secs	-	-	-	-	0.1	0.0	18.9	-	1.0	0.0	
CP10	1	---	300 secs	-	-	-	-	0.1	0.0	18.8	-	1.0	0.0	
CP10	2	4.96	09/09/2014 14:29:00	1013	1013	$0.0_{(I)}$	4.90	0.0	0.0	20.7	0.0	0.0	0.0	
CP10	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	18.8	0.0	0.0	0.0	
CP10	2	---	30 secs	-	-	-	-	0.1	0.0	18.5	0.0	0.0	0.0	
CP10	2	---	60 secs	-	-	-	-	0.1	0.0	18.4	0.0	0.0	0.0	
CP10	2	---	90 secs	-	-	-	-	0.1	0.0	18.3	0.0	0.0	0.0	
CP10	2	---	120 secs	-	-	-	-	0.1	0.0	18.2	0.0	0.0	0.0	
CP10	2	---	180 secs	-	-	-	-	0.1	0.0	17.9	0.0	0.0	0.0	
CP10	2	---	240 secs	-	-	-	-	0.1	0.0	17.8	0.0	0.0	0.0	
CP10	2	---	300 secs	-	-	-	-	0.1	0.0	17.6	0.0	0.0	0.0	
CP10	3	4.99	15/09/2014 14:40:00	1010	1010	$0.0_{(I)}$	4.70	0.0	0.0	20.4	0.0	0.0	0.0	
CP10	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	18.1	0.0	0.0	0.0	
CP10	3	---	30 secs	-	-	-	-	0.2	0.0	17.5	0.0	0.0	0.0	
CP10	3	---	60 secs	-	-	-	-	0.2	0.0	17.4	0.0	0.0	0.0	
CP10	3	---	90 secs	-	-	-	-	0.2	0.0	17.2	0.0	0.0	0.0	
CP10	3	---	120 secs	-	-	-	-	0.2	0.0	17.0	0.0	0.0	0.0	
CP10	3	---	180 secs	-	-	-	-	0.2	0.0	16.8	0.0	0.0	0.0	
CP10	3	---	240 secs	-	-	-	-	0.2	0.0	16.4	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP10	3	---	300 secs	-	-	-	-	0.2	0.0	16.2	0.0	0.0	0.0	
CP10	4	4.99	24/09/2014 16:59:00	1005	1005	$0.0_{(I)}$	4.31	0.0	0.0	20.8	0.0	0.0	0.0	
CP10	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.3	0.0	17.2	0.0	0.0	0.0	
CP10	4	---	30 secs	-	-	-	-	0.4	0.0	16.2	0.0	0.0	0.0	
CP10	4	---	60 secs	-	-	-	-	0.4	0.0	16.0	0.0	0.0	0.0	
CP10	4	---	90 secs	-	-	-	-	0.4	0.0	15.8	0.0	0.0	0.0	
CP10	4	---	120 secs	-	-	-	-	0.4	0.0	15.7	0.0	0.0	0.0	
CP10	4	---	180 secs	-	-	-	-	0.4	0.0	15.4	0.0	0.0	0.0	
CP10	4	---	240 secs	-	-	-	-	0.4	0.0	15.2	0.0	0.0	0.0	
CP10	4	---	300 secs	-	-	-	-	0.4	0.0	14.8	0.0	0.0	0.0	
CP11	1	10.48	04/09/2014 12:16:00	1009	1009	$0.0_{(I)}$	4.36	0.1	0.0	20.8	-	0.0	0.0	
CP11	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	30 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	60 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	90 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	120 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	180 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	240 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	1	---	300 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP11	2	10.45	09/09/2014 13:39:00	1013	1013	$0.0_{(I)}$	4.40	0.1	0.0	20.6	0.0	0.0	0.0	
CP11	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP11	2	---	30 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP11	2	---	60 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	2	---	90 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP11	2	---	120 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	2	---	180 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	2	---	240 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	2	---	300 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	3	10.45	15/09/2014 13:41:00	1010	1010	$0.0_{(I)}$	4.39	0.0	0.0	20.4	0.0	0.0	0.0	
CP11	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP11	3	---	30 secs	-	-	-	-	0.2	0.0	20.3	0.0	0.0	0.0	
CP11	3	---	60 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP11	3	---	90 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP11	3	---	120 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP11	3	---	180 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP11	3	---	240 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP11	3	---	300 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP11	4	10.44	24/09/2014 16:19:00	1004	1005	$0.0_{(I)}$	4.41	0.0	0.0	20.8	0.0	0.0	0.0	
CP11	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	20.6	0.0	0.0	0.0	
CP11	4	---	30 secs	-	-	-	-	0.2	0.0	20.6	0.0	0.0	0.0	
CP11	4	---	60 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
CP11	4	---	90 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP11	4	---	120 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP11	4	---	180 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP11	4	---	240 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP11	4	---	300 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
CP12	1	4.12	04/09/2014 11:54:00	1010	1010	$0.2_{(I)}$	1.48	0.1	0.0	20.9	-	0.0	0.0	
CP12	1	---	15 secs	-	-	$0.2_{(SS)}$	-	0.1	0.0	20.2	-	2.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP12	1	---	30 secs	-	-	-	-	0.2	0.0	19.8	-	3.0	0.0	
CP12	1	---	60 secs	-	-	-	-	0.2	0.0	19.7	-	3.0	0.0	
CP12	1	---	90 secs	-	-	-	-	0.2	0.0	19.7	-	3.0	0.0	
CP12	1	---	120 secs	-	-	-	-	0.2	0.0	19.6	-	3.0	0.0	
CP12	1	---	180 secs	-	-	-	-	0.2	0.0	19.4	-	3.0	0.0	
CP12	1	---	240 secs	-	-	-	-	0.2	0.0	19.4	-	3.0	0.0	
CP12	1	---	300 secs	-	-	-	-	0.2	0.0	19.4	-	3.0	0.0	
CP12	2	4.01	09/09/2014 13:51:00	1013	1013	$0.0_{(I)}$	1.53	0.0	0.0	20.4	0.0	0.0	0.0	
CP12	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	19.4	0.0	0.0	0.0	
CP12	2	---	30 secs	-	-	-	-	0.1	0.0	19.4	0.0	0.0	0.0	
CP12	2	---	60 secs	-	-	-	-	0.1	0.0	19.3	0.0	0.0	0.0	
CP12	2	---	90 secs	-	-	-	-	0.1	0.0	19.3	0.0	0.0	0.0	
CP12	2	---	120 secs	-	-	-	-	0.1	0.0	19.3	0.0	0.0	0.0	
CP12	2	---	180 secs	-	-	-	-	0.1	0.0	19.1	0.0	0.0	0.0	
CP12	2	---	240 secs	-	-	-	-	0.1	0.0	19.1	0.0	0.0	0.0	
CP12	2	---	300 secs	-	-	-	-	0.1	0.0	19.1	0.0	0.0	0.0	
CP12	3	4.00	15/09/2014 13:55:00	1010	1010	$0.0_{(I)}$	1.50	0.0	0.0	20.5	0.0	0.0	0.0	
CP12	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.2	0.0	19.8	0.0	0.0	0.0	
CP12	3	---	30 secs	-	-	-	-	0.3	0.0	19.6	0.0	0.0	0.0	
CP12	3	---	60 secs	-	-	-	-	0.3	0.0	19.6	0.0	0.0	0.0	
CP12	3	---	90 secs	-	-	-	-	0.3	0.0	19.5	0.0	0.0	0.0	
CP12	3	---	120 secs	-	-	-	-	0.3	0.0	19.5	0.0	0.0	0.0	
CP12	3	---	180 secs	-	-	-	-	0.3	0.0	19.4	0.0	0.0	0.0	
CP12	3	---	240 secs	-	-	-	-	0.3	0.0	19.4	0.0	0.0	0.0	
CP12	3	---	300 secs	-	-	-	-	0.3	0.0	19.4	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP12	4	---	24/09/2014 16:28:00	-	1005	-	-	-	-	-	-	-	-	
	Remarks: Installation buried as a result of the field being ploughed.													
CP13	1	12.14	04/09/2014 11:11:00	1010	1010	0.1$_{(I)}$	2.76	0.1	0.0	20.8	-	0.0	0.0	
CP13	1	---	15 secs	-	-	0.0$_{(SS)}$	-	0.8	0.0	20.1	-	2.0	0.0	
CP13	1	---	30 secs	-	-	-	-	0.7	0.0	19.8	-	2.0	0.0	
CP13	1	---	60 secs	-	-	-	-	0.7	0.0	19.8	-	2.0	0.0	
CP13	1	---	90 secs	-	-	-	-	0.7	0.0	19.8	-	2.0	0.0	
CP13	1	---	120 secs	-	-	-	-	0.7	0.0	19.8	-	2.0	0.0	
CP13	1	---	180 secs	-	-	-	-	0.7	0.0	19.7	-	2.0	0.0	
CP13	1	---	240 secs	-	-	-	-	0.7	0.0	19.7	-	2.0	0.0	
CP13	1	---	300 secs	-	-	-	-	0.8	0.0	19.4	-	2.0	0.0	
CP13	1	---	360 secs	-	-	-	-	0.8	0.0	19.3	-	2.0	0.0	
CP13	1	---	420 secs	-	-	-	-	0.8	0.0	19.3	-	2.0	0.0	
CP13	2	12.05	09/09/2014 14:05:00	1013	1013	0.0$_{(I)}$	2.59	0.0	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	15 secs	-	-	0.0$_{(SS)}$	-	0.2	0.0	20.4	0.0	0.0	0.0	
CP13	2	---	30 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	60 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	90 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	120 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	180 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	240 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	2	---	300 secs	-	-	-	-	0.2	0.0	20.5	0.0	0.0	0.0	
CP13	3	12.04	15/09/2014 14:07:00	1010	1010	0.0$_{(I)}$	2.44	0.0	0.0	20.4	0.0	0.0	0.0	
CP13	3	---	15 secs	-	-	0.0$_{(SS)}$	-	0.3	0.0	20.0	0.0	0.0	0.0	
CP13	3	---	30 secs	-	-	-	-	0.2	0.0	20.1	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP13	3	---	60 secs	-	-	-	-	0.2	0.0	20.2	0.0	0.0	0.0	
CP13	3	---	90 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP13	3	---	120 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP13	3	---	180 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP13	3	---	240 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP13	3	---	300 secs	-	-	-	-	0.1	0.0	20.3	0.0	0.0	0.0	
CP13	4	12.01	24/09/2014 16:36:00	1005	1005	$0.0_{(I)}$	2.34	0.0	0.0	20.9	0.0	0.0	0.0	
CP13	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	30 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	60 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	90 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	120 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	180 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	240 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP13	4	---	300 secs	-	-	-	-	0.1	0.0	20.8	0.0	0.0	0.0	
CP14	1	5.20	04/09/2014 13:22:00	1009	1009	$0.1_{(I)}$	0.55	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.7	-	0.0	0.0	
CP14	1	---	30 secs	-	-	-	-	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	60 secs	-	-	-	-	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	90 secs	-	-	-	-	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	120 secs	-	-	-	-	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	180 secs	-	-	-	-	0.1	0.0	20.8	-	0.0	0.0	
CP14	1	---	240 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP14	1	---	300 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP14	2	5.02	09/09/2014 12:58:00	1013	1013	$0.0_{(I)}$	0.55	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	30 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	60 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	90 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	120 secs	-	-	-	-	0.0	0.0	21.0	0.0	0.0	0.0	
CP14	2	---	180 secs	-	-	-	-	0.0	0.0	21.0	0.0	0.0	0.0	
CP14	2	---	240 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	2	---	300 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
CP14	3	5.14	15/09/2014 12:52:00	1010	1010	$0.0_{(I)}$	0.55	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP14	3	---	30 secs	-	-	-	-	0.0	0.0	20.4	0.0	0.0	0.0	
CP14	3	---	60 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	90 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	120 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	180 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	240 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	3	---	300 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	
CP14	4	5.10	24/09/2014 15:29:00	1005	1005	$0.0_{(I)}$	0.54	0.0	0.0	20.6	0.0	0.0	0.0	
CP14	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP14	4	---	30 secs	-	-	-	-	0.1	0.0	20.4	0.0	0.0	0.0	
CP14	4	---	60 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP14	4	---	90 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP14	4	---	120 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP14	4	---	180 secs	-	-	-	-	0.0	0.0	20.5	0.0	0.0	0.0	

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IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP14	4	---	240 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP14	4	---	300 secs	-	-	-	-	-	-	-	-	-	-	
	Remarks: Test stopped short at 250 seconds after water drawn up analyser hose.													
CP15	1	7.80	04/09/2014 13:06:00	1009	1009	$0.1_{(I)}$	1.10	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	30 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	60 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	90 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	120 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	180 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	240 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	1	---	300 secs	-	-	-	-	0.1	0.0	20.9	-	0.0	0.0	
CP15	2	7.78	09/09/2014 13:07:00	1013	1013	$0.0_{(I)}$	1.11	0.0	0.0	20.8	0.0	0.0	0.0	
CP15	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	2	---	30 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	2	---	60 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	2	---	90 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	2	---	120 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP15	2	---	180 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP15	2	---	240 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP15	2	---	300 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
CP15	3	7.78	15/09/2014 13:03:00	1010	1010	$0.0_{(I)}$	1.10	0.0	0.0	20.6	0.0	0.0	0.0	
CP15	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP15	3	---	30 secs	-	-	-	-	0.1	0.0	20.5	0.0	0.0	0.0	
CP15	3	---	60 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP15	3	---	90 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP15	3	---	120 secs	-	-	-	-	0.0	0.0	20.6	0.0	0.0	0.0	
CP15	3	---	180 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	3	---	240 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	3	---	300 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
CP15	4	7.76	24/09/2014 15:43:00	1005	1005	$0.0_{(I)}$	1.13	0.0	0.0	20.4	0.0	0.0	0.0	
CP15	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	30 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	60 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	90 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	120 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	180 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
CP15	4	---	240 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP15	4	---	300 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
CP16	1	4.51	04/09/2014 12:50:00	1009	1009	$0.1_{(I)}$	1.19	0.1	0.0	20.6	-	0.0	0.0	
CP16	1	---	15 secs	-	-	$0.1_{(SS)}$	-	0.3	0.0	20.5	-	0.0	0.0	
CP16	1	---	30 secs	-	-	-	-	0.3	0.0	20.5	-	0.0	0.0	
CP16	1	---	60 secs	-	-	-	-	0.3	0.0	20.5	-	0.0	0.0	
CP16	1	---	90 secs	-	-	-	-	0.3	0.0	20.6	-	0.0	0.0	
CP16	1	---	120 secs	-	-	-	-	0.3	0.0	20.6	-	0.0	0.0	
CP16	1	---	180 secs	-	-	-	-	0.3	0.0	20.6	-	0.0	0.0	
CP16	1	---	240 secs	-	-	-	-	0.3	0.0	20.7	-	0.0	0.0	
CP16	1	---	300 secs	-	-	-	-	0.3	0.0	20.7	-	0.0	0.0	
CP16	2	4.54	09/09/2014 13:16:00	1013	1013	$0.0_{(I)}$	1.23	0.0	0.0	20.6	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP16	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	19.7	0.0	0.0	0.0	
CP16	2	---	30 secs	-	-	-	-	0.5	0.0	19.8	0.0	0.0	0.0	
CP16	2	---	60 secs	-	-	-	-	0.4	0.0	19.9	0.0	0.0	0.0	
CP16	2	---	90 secs	-	-	-	-	0.4	0.0	19.9	0.0	0.0	0.0	
CP16	2	---	120 secs	-	-	-	-	0.4	0.0	20.0	0.0	0.0	0.0	
CP16	2	---	180 secs	-	-	-	-	0.4	0.0	20.0	0.0	0.0	0.0	
CP16	2	---	240 secs	-	-	-	-	0.4	0.0	20.1	0.0	0.0	0.0	
CP16	2	---	300 secs	-	-	-	-	0.4	0.0	20.1	0.0	0.0	0.0	
CP16	3	4.51	15/09/2014 13:18:00	1010	1010	$0.0_{(I)}$	1.21	0.0	0.0	20.8	0.0	0.0	0.0	
CP16	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	20.2	0.0	0.0	0.0	
CP16	3	---	30 secs	-	-	-	-	0.5	0.0	20.1	0.0	0.0	0.0	
CP16	3	---	60 secs	-	-	-	-	0.5	0.0	20.2	0.0	0.0	0.0	
CP16	3	---	90 secs	-	-	-	-	0.5	0.0	20.2	0.0	0.0	0.0	
CP16	3	---	120 secs	-	-	-	-	0.5	0.0	20.2	0.0	0.0	0.0	
CP16	3	---	180 secs	-	-	-	-	0.5	0.0	20.3	0.0	0.0	0.0	
CP16	3	---	240 secs	-	-	-	-	0.4	0.0	20.3	0.0	0.0	0.0	
CP16	3	---	300 secs	-	-	-	-	0.5	0.0	20.3	0.0	0.0	0.0	
CP16	3	---	360 secs	-	-	-	-	0.5	0.0	20.2	0.0	0.0	0.0	
CP16	3	---	420 secs	-	-	-	-	0.5	0.0	20.2	0.0	0.0	0.0	
CP16	4	4.51	24/09/2014 15:56:00	1005	1005	$-0.1_{(I)}$	1.27	0.0	0.0	20.4	0.0	0.0	0.0	
CP16	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.7	0.0	19.5	0.0	0.0	0.0	
CP16	4	---	30 secs	-	-	-	-	0.6	0.0	19.5	0.0	0.0	0.0	
CP16	4	---	60 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	
CP16	4	---	90 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	
CP16	4	---	120 secs	-	-	-	-	0.5	0.0	19.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
CP16	4	---	180 secs	-	-	-	-	0.5	0.0	19.8	0.0	0.0	0.0	
CP16	4	---	240 secs	-	-	-	-	0.5	0.0	19.8	0.0	0.0	0.0	
CP16	4	---	300 secs	-	-	-	-	0.5	0.0	19.8	0.0	0.0	0.0	
WS2	1	3.18	04/09/2014 13:59:00	1008	1008	$0.1_{(I)}$	DRY	0.1	0.0	20.7	-	0.0	0.0	
WS2	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.4	0.0	19.2	-	0.0	0.0	
WS2	1	---	30 secs	-	-	-	-	1.4	0.0	19.1	-	0.0	0.0	
WS2	1	---	60 secs	-	-	-	-	1.4	0.0	19.1	-	0.0	0.0	
WS2	1	---	90 secs	-	-	-	-	1.5	0.0	19.0	-	0.0	0.0	
WS2	1	---	120 secs	-	-	-	-	1.5	0.0	19.0	-	0.0	0.0	
WS2	1	---	180 secs	-	-	-	-	1.5	0.0	18.9	-	0.0	0.0	
WS2	1	---	240 secs	-	-	-	-	1.6	0.0	18.9	-	0.0	0.0	
WS2	1	---	300 secs	-	-	-	-	1.6	0.0	18.9	-	0.0	0.0	
WS2	1	---	360 secs	-	-	-	-	1.6	0.0	18.9	-	0.0	0.0	
WS2	2	3.19	09/09/2014 09:25:00	1013	1013	$0.0_{(I)}$	DRY	0.0	0.0	20.7	0.0	0.0	0.0	
WS2	2	---	15 secs	-	-	$0.0_{(SS)}$	-	1.6	0.0	19.4	0.0	0.0	0.0	
WS2	2	---	30 secs	-	-	-	-	1.6	0.0	19.1	0.0	0.0	0.0	
WS2	2	---	60 secs	-	-	-	-	1.6	0.0	19.0	0.0	0.0	0.0	
WS2	2	---	90 secs	-	-	-	-	1.7	0.0	19.0	0.0	0.0	0.0	
WS2	2	---	120 secs	-	-	-	-	1.7	0.0	19.0	0.0	0.0	0.0	
WS2	2	---	180 secs	-	-	-	-	1.7	0.0	19.0	0.0	0.0	0.0	
WS2	2	---	240 secs	-	-	-	-	1.7	0.0	19.0	0.0	0.0	0.0	
WS2	2	---	300 secs	-	-	-	-	1.7	0.0	18.9	0.0	0.0	0.0	
WS2	3	3.18	15/09/2014 09:10:00	1009	1009	$0.1_{(I)}$	DRY	0.0	0.0	20.6	0.0	0.0	0.0	
WS2	3	---	15 secs	-	-	$0.1_{(SS)}$	-	1.7	0.0	19.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS2	3	---	30 secs	-	-	-	-	1.7	0.0	19.4	0.0	0.0	0.0	
WS2	3	---	60 secs	-	-	-	-	1.7	0.0	19.3	0.0	0.0	0.0	
WS2	3	---	90 secs	-	-	-	-	1.8	0.0	19.3	0.0	0.0	0.0	
WS2	3	---	120 secs	-	-	-	-	1.8	0.0	19.3	0.0	0.0	0.0	
WS2	3	---	180 secs	-	-	-	-	1.8	0.0	19.3	0.0	0.0	0.0	
WS2	3	---	240 secs	-	-	-	-	1.8	0.0	19.3	0.0	0.0	0.0	
WS2	3	---	300 secs	-	-	-	-	1.8	0.0	19.3	0.0	0.0	0.0	
WS2	4	3.18	24/09/2014 13:49:00	1004	1004	$0.0_{(I)}$	DRY	0.0	0.0	20.7	0.0	0.0	0.0	
WS2	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.5	0.0	20.0	0.0	0.0	0.0	
WS2	4	---	30 secs	-	-	-	-	1.5	0.0	19.8	0.0	0.0	0.0	
WS2	4	---	60 secs	-	-	-	-	1.5	0.0	19.8	0.0	0.0	0.0	
WS2	4	---	90 secs	-	-	-	-	1.5	0.0	19.8	0.0	0.0	0.0	
WS2	4	---	120 secs	-	-	-	-	1.5	0.0	19.7	0.0	0.0	0.0	
WS2	4	---	180 secs	-	-	-	-	1.6	0.0	19.7	0.0	0.0	0.0	
WS2	4	---	240 secs	-	-	-	-	1.6	0.0	19.7	0.0	0.0	0.0	
WS2	4	---	300 secs	-	-	-	-	1.6	0.0	19.7	0.0	0.0	0.0	
WS3	1	4.67	04/09/2014 15:19:00	1006	1006	$0.2_{(I)}$	4.47	0.1	0.0	20.5	-	0.0	0.0	
WS3	1	---	15 secs	-	-	$0.3_{(SS)}$	-	1.4	0.0	19.3	-	1.0	0.0	
WS3	1	---	30 secs	-	-	-	-	1.4	0.0	18.8	-	0.0	0.0	
WS3	1	---	60 secs	-	-	-	-	1.4	0.0	18.7	-	0.0	0.0	
WS3	1	---	90 secs	-	-	-	-	1.4	0.0	18.7	-	0.0	0.0	
WS3	1	---	120 secs	-	-	-	-	1.4	0.0	18.7	-	0.0	0.0	
WS3	1	---	180 secs	-	-	-	-	1.5	0.0	18.6	-	0.0	0.0	
WS3	1	---	240 secs	-	-	-	-	1.6	0.0	18.5	-	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS3	1	---	300 secs	-	-	-	-	1.7	0.0	18.5	-	0.0	0.0	
WS3	1	---	360 secs	-	-	-	-	1.7	0.0	18.4	-	0.0	0.0	
WS3	1	---	420 secs	-	-	-	-	1.8	0.0	18.3	-	0.0	0.0	
WS3	1	---	480 secs	-	-	-	-	1.9	0.0	18.2	-	0.0	0.0	
WS3	1	---	540 secs	-	-	-	-	1.9	0.0	18.1	-	0.0	0.0	
WS3	1	---	600 secs	-	-	-	-	2.0	0.0	18.1	-	0.0	0.0	
WS3	2	4.66	09/09/2014 09:06:00	1013	1013	$0.0_{(I)}$	4.49	0.0	0.0	20.5	0.0	0.0	0.0	
WS3	2	---	15 secs	-	-	$0.0_{(SS)}$	-	1.3	0.0	19.4	0.0	0.0	0.0	
WS3	2	---	30 secs	-	-	-	-	1.3	0.0	19.1	0.0	0.0	0.0	
WS3	2	---	60 secs	-	-	-	-	1.3	0.0	19.1	0.0	0.0	0.0	
WS3	2	---	90 secs	-	-	-	-	1.3	0.0	19.0	0.0	0.0	0.0	
WS3	2	---	120 secs	-	-	-	-	1.3	0.0	19.0	0.0	0.0	0.0	
WS3	2	---	180 secs	-	-	-	-	1.4	0.0	19.0	0.0	0.0	0.0	
WS3	2	---	240 secs	-	-	-	-	1.4	0.0	18.9	0.0	0.0	0.0	
WS3	2	---	300 secs	-	-	-	-	1.6	0.0	18.8	0.0	0.0	0.0	
WS3	2	---	360 secs	-	-	-	-	1.7	0.0	18.6	0.0	0.0	0.0	
WS3	2	---	420 secs	-	-	-	-	1.8	0.0	18.5	0.0	0.0	0.0	
WS3	2	---	480 secs	-	-	-	-	1.9	0.0	18.4	0.0	0.0	0.0	
WS3	2	---	540 secs	-	-	-	-	2.0	0.0	18.2	0.0	0.0	0.0	
WS3	2	---	600 secs	-	-	-	-	2.2	0.0	18.0	0.0	0.0	0.0	
WS3	3	4.66	15/09/2014 08:53:00	1009	1009	$0.1_{(I)}$	4.50	0.0	0.0	20.5	0.0	0.0	0.0	
WS3	3	---	15 secs	-	-	$0.1_{(SS)}$	-	1.9	0.0	19.1	0.0	0.0	0.0	
WS3	3	---	30 secs	-	-	-	-	1.9	0.0	18.6	0.0	0.0	0.0	
WS3	3	---	60 secs	-	-	-	-	1.9	0.0	18.6	0.0	0.0	0.0	
WS3	3	---	90 secs	-	-	-	-	2.0	0.0	18.5	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS3	3	---	120 secs	-	-	-	-	2.0	0.0	18.5	0.0	0.0	0.0	
WS3	3	---	180 secs	-	-	-	-	2.1	0.0	18.4	0.0	0.0	0.0	
WS3	3	---	240 secs	-	-	-	-	2.1	0.0	18.4	0.0	0.0	0.0	
WS3	3	---	300 secs	-	-	-	-	2.2	0.0	18.3	0.0	0.0	0.0	
WS3	3	---	360 secs	-	-	-	-	2.2	0.0	18.3	0.0	0.0	0.0	
WS3	3	---	420 secs	-	-	-	-	2.3	0.0	18.2	0.0	0.0	0.0	
WS3	3	---	480 secs	-	-	-	-	2.3	0.0	18.1	0.0	0.0	0.0	
WS3	3	---	540 secs	-	-	-	-	2.4	0.0	18.1	0.0	0.0	0.0	
WS3	3	---	600 secs	-	-	-	-	2.4	0.0	18.1	0.0	0.0	0.0	
WS3	4	4.65	24/09/2014 13:30:00	1005	1005	$0.0_{(I)}$	4.52	0.0	0.0	20.7	0.0	0.0	0.0	
WS3	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.8	0.0	18.9	0.0	0.0	0.0	
WS3	4	---	30 secs	-	-	-	-	1.8	0.0	18.5	0.0	0.0	0.0	
WS3	4	---	60 secs	-	-	-	-	1.9	0.0	18.5	0.0	0.0	0.0	
WS3	4	---	90 secs	-	-	-	-	1.9	0.0	18.5	0.0	0.0	0.0	
WS3	4	---	120 secs	-	-	-	-	1.9	0.0	18.6	0.0	0.0	0.0	
WS3	4	---	180 secs	-	-	-	-	1.9	0.0	18.6	0.0	0.0	0.0	
WS3	4	---	240 secs	-	-	-	-	1.9	0.0	18.5	0.0	0.0	0.0	
WS3	4	---	300 secs	-	-	-	-	1.9	0.0	18.4	0.0	0.0	0.0	
WS4	1	4.86	05/09/2014 09:32:00	1009	1009	$0.0_{(I)}$	DRY	0.0	0.0	20.6	0.0	0.0	0.0	
WS4	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.1	0.0	19.6	0.0	0.0	0.0	
WS4	1	---	30 secs	-	-	-	-	1.1	0.0	19.2	0.0	0.0	0.0	
WS4	1	---	60 secs	-	-	-	-	1.1	0.0	19.2	0.0	0.0	0.0	
WS4	1	---	90 secs	-	-	-	-	1.1	0.0	19.2	0.0	0.0	0.0	
WS4	1	---	120 secs	-	-	-	-	1.1	0.0	19.3	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS4	1	---	180 secs	-	-	-	-	1.0	0.0	19.5	0.0	0.0	0.0	
WS4	1	---	240 secs	-	-	-	-	1.0	0.0	19.5	0.0	0.0	0.0	
WS4	1	---	300 secs	-	-	-	-	1.0	0.0	19.5	0.0	0.0	0.0	
WS4	2	4.83	09/09/2014 10:28:00	1013	1013	$-0.1_{(I)}$	DRY	0.0	0.0	20.9	0.0	0.0	0.0	
WS4	2	---	15 secs	-	-	$-0.1_{(SS)}$	-	0.3	0.0	20.5	0.0	0.0	0.0	
WS4	2	---	30 secs	-	-	-	-	0.3	0.0	20.4	0.0	0.0	0.0	
WS4	2	---	60 secs	-	-	-	-	0.3	0.0	20.4	0.0	0.0	0.0	
WS4	2	---	90 secs	-	-	-	-	0.3	0.0	20.4	0.0	0.0	0.0	
WS4	2	---	120 secs	-	-	-	-	0.3	0.0	20.4	0.0	0.0	0.0	
WS4	2	---	180 secs	-	-	-	-	0.3	0.0	20.5	0.0	0.0	0.0	
WS4	2	---	240 secs	-	-	-	-	0.3	0.0	20.5	0.0	0.0	0.0	
WS4	2	---	300 secs	-	-	-	-	0.3	0.0	20.4	0.0	0.0	0.0	
WS4	3	4.83	15/09/2014 10:11:00	1009	1009	$0.0_{(I)}$	DRY	0.0	0.0	20.8	0.0	0.0	0.0	
WS4	3	---	15 secs	-	-	$0.0_{(SS)}$	-	1.2	0.0	19.8	0.0	0.0	0.0	
WS4	3	---	30 secs	-	-	-	-	1.2	0.0	19.3	0.0	0.0	0.0	
WS4	3	---	60 secs	-	-	-	-	1.3	0.0	19.3	0.0	0.0	0.0	
WS4	3	---	90 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	3	---	120 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	3	---	180 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	3	---	240 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	3	---	300 secs	-	-	-	-	1.4	0.0	19.1	0.0	0.0	0.0	
WS4	3	---	360 secs	-	-	-	-	1.3	0.0	19.1	0.0	0.0	0.0	
WS4	3	---	420 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	3	---	480 secs	-	-	-	-	1.3	0.0	19.2	0.0	0.0	0.0	
WS4	4	4.83	24/09/2014 12:10:00	1005	1005	$0.0_{(I)}$	DRY	0.0	0.0	20.8	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS4	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.2	0.0	19.6	0.0	0.0	0.0	
WS4	4	---	30 secs	-	-	-	-	1.2	0.0	19.3	0.0	0.0	0.0	
WS4	4	---	60 secs	-	-	-	-	1.2	0.0	19.4	0.0	0.0	0.0	
WS4	4	---	90 secs	-	-	-	-	1.1	0.0	19.5	0.0	0.0	0.0	
WS4	4	---	120 secs	-	-	-	-	1.1	0.0	19.6	0.0	0.0	0.0	
WS4	4	---	180 secs	-	-	-	-	0.9	0.0	20.1	0.0	0.0	0.0	
WS4	4	---	240 secs	-	-	-	-	0.9	0.0	20.1	0.0	0.0	0.0	
WS4	4	---	300 secs	-	-	-	-	0.9	0.0	20.0	0.0	0.0	0.0	
WS6	1	5.60	05/09/2014 10:15:00	1009	1009	$-0.1_{(I)}$	0.51	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	30 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	60 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	90 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	120 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	180 secs	-	-	-	-	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	240 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	1	---	300 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	5.58	09/09/2014 10:52:00	1013	1013	$0.0_{(I)}$	0.57	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	---	30 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	---	60 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	---	90 secs	-	-	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
WS6	2	---	120 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
WS6	2	---	180 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS6	2	---	240 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
WS6	2	---	300 secs	-	-	-	-	0.0	0.0	20.8	0.0	0.0	0.0	
WS6	3	5.63	15/09/2014 10:37:00	1009	1009	$0.0_{(I)}$	0.58	0.1	0.0	20.7	0.0	0.0	0.0	
WS6	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.1	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	30 secs	-	-	-	-	0.1	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	60 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	90 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	120 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	180 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	240 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	3	---	300 secs	-	-	-	-	0.0	0.0	20.9	0.0	0.0	0.0	
WS6	4	5.53	24/09/2014 11:25:00	1004	1004	$0.2_{(I)}$	0.53	0.0	0.0	20.4	0.0	0.0	0.0	
WS6	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.0	0.0	20.2	0.0	0.0	0.0	
WS6	4	---	30 secs	-	-	-	-	0.0	0.0	20.2	0.0	0.0	0.0	
WS6	4	---	60 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS6	4	---	90 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS6	4	---	120 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS6	4	---	180 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS6	4	---	240 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS6	4	---	300 secs	-	-	-	-	0.0	0.0	20.3	0.0	0.0	0.0	
WS8	1	2.40	05/09/2014 11:15:00	1007	1007	$0.0_{(I)}$	1.42	0.0	0.0	20.7	0.0	0.0	0.0	
WS8	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	19.9	0.0	0.0	0.0	
WS8	1	---	30 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
WS8	1	---	60 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS8	1	---	90 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	
WS8	1	---	120 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	
WS8	1	---	180 secs	-	-	-	-	0.5	0.0	19.6	0.0	0.0	0.0	
WS8	1	---	240 secs	-	-	-	-	0.5	0.0	20.1	0.0	0.0	0.0	
WS8	1	---	300 secs	-	-	-	-	0.5	0.0	20.1	0.0	0.0	0.0	
WS8	2	2.39	09/09/2014 11:16:00	1013	1013	$0.0_{(I)}$	1.36	0.0	0.0	20.6	0.0	0.0	0.0	
WS8	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.4	0.0	20.0	0.0	0.0	0.0	
WS8	2	---	30 secs	-	-	-	-	0.4	0.1	19.9	1.0	0.0	0.0	
WS8	2	---	60 secs	-	-	-	-	0.4	0.1	19.9	1.0	0.0	0.0	
WS8	2	---	90 secs	-	-	-	-	0.4	0.1	19.9	1.0	0.0	0.0	
WS8	2	---	120 secs	-	-	-	-	0.4	0.1	19.9	1.0	0.0	0.0	
WS8	2	---	180 secs	-	-	-	-	0.5	0.1	19.8	1.0	0.0	0.0	
WS8	2	---	240 secs	-	-	-	-	0.8	0.1	19.4	1.0	0.0	0.0	
WS8	2	---	300 secs	-	-	-	-	0.8	0.1	19.3	1.0	0.0	0.0	
WS8	2	---	360 secs	-	-	-	-	0.8	0.1	19.3	1.0	0.0	0.0	
WS8	3	2.38	15/09/2014 10:52:00	1009	1009	$-0.1_{(I)}$	1.33	0.0	0.0	20.9	0.0	0.0	0.0	
WS8	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.7	0.0	20.2	0.0	0.0	0.0	
WS8	3	---	30 secs	-	-	-	-	0.7	0.0	19.9	0.0	0.0	0.0	
WS8	3	---	60 secs	-	-	-	-	0.7	0.0	19.9	0.0	0.0	0.0	
WS8	3	---	90 secs	-	-	-	-	0.7	0.0	19.9	0.0	0.0	0.0	
WS8	3	---	120 secs	-	-	-	-	0.7	0.0	19.9	0.0	0.0	0.0	
WS8	3	---	180 secs	-	-	-	-	0.8	0.0	19.9	0.0	0.0	0.0	
WS8	3	---	240 secs	-	-	-	-	0.9	0.0	19.8	0.0	0.0	0.0	
WS8	3	---	300 secs	-	-	-	-	1.0	0.0	19.8	0.0	0.0	0.0	
WS8	3	---	360 secs	-	-	-	-	1.0	0.0	19.8	0.0	0.0	0.0	

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RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Compiled By	Date	Checked By	Date
	30/09/14		

Contract Ref: **312598**

Contract: **M1 Junction 15, Northampton**

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS8	3	---	420 secs	-	-	-	-	1.0	0.0	19.8	0.0	0.0	0.0	
WS8	4	2.36	24/09/2014 11:10:00	1003	1003	$0.0_{(I)}$	1.34	0.0	0.0	20.8	0.0	0.0	0.0	
WS8	4	---	15 secs	-	-	$0.0_{(SS)}$	-	0.7	0.0	20.2	0.0	0.0	0.0	
WS8	4	---	30 secs	-	-	-	-	0.7	0.0	20.0	0.0	0.0	0.0	
WS8	4	---	60 secs	-	-	-	-	0.7	0.0	20.0	0.0	0.0	0.0	
WS8	4	---	90 secs	-	-	-	-	0.7	0.0	19.8	0.0	0.0	0.0	
WS8	4	---	120 secs	-	-	-	-	0.8	0.0	19.7	0.0	0.0	0.0	
WS8	4	---	180 secs	-	-	-	-	0.9	0.0	19.5	0.0	0.0	0.0	
WS8	4	---	240 secs	-	-	-	-	0.9	0.0	19.4	0.0	0.0	0.0	
WS8	4	---	300 secs	-	-	-	-	0.9	0.0	19.4	0.0	0.0	0.0	
WS9	1	5.58	05/09/2014 11:23:00	1006	1007	$0.0_{(I)}$	5.56	0.0	0.0	20.7	0.0	0.0	0.0	
WS9	1	---	15 secs	-	-	$0.0_{(SS)}$	-	1.5	0.0	18.2	0.0	0.0	0.0	
WS9	1	---	30 secs	-	-	-	-	1.6	0.0	17.6	0.0	0.0	0.0	
WS9	1	---	60 secs	-	-	-	-	1.6	0.0	17.6	0.0	0.0	0.0	
WS9	1	---	90 secs	-	-	-	-	1.6	0.0	17.5	0.0	0.0	0.0	
WS9	1	---	120 secs	-	-	-	-	1.6	0.0	17.5	0.0	0.0	0.0	
WS9	1	---	180 secs	-	-	-	-	1.6	0.0	17.4	0.0	0.0	0.0	
WS9	1	---	240 secs	-	-	-	-	1.5	0.0	17.5	0.0	0.0	0.0	
WS9	1	---	300 secs	-	-	-	-	1.5	0.0	17.6	0.0	0.0	0.0	
WS9	2	5.45	09/09/2014 11:29:00	1013	1013	$0.0_{(I)}$	DRY	0.0	0.0	20.5	0.0	0.0	0.0	
WS9	2	---	15 secs	-	-	$0.0_{(SS)}$	-	1.3	0.0	18.3	0.0	0.0	0.0	
WS9	2	---	30 secs	-	-	-	-	1.3	0.0	18.0	0.0	0.0	0.0	
WS9	2	---	60 secs	-	-	-	-	1.4	0.0	18.0	0.0	0.0	0.0	
WS9	2	---	90 secs	-	-	-	-	1.4	0.0	17.9	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS9	2	---	120 secs	-	-	-	-	1.4	0.0	17.8	0.0	0.0	0.0	
WS9	2	---	180 secs	-	-	-	-	1.4	0.0	17.7	0.0	0.0	0.0	
WS9	2	---	240 secs	-	-	-	-	1.5	0.0	17.5	0.0	0.0	0.0	
WS9	2	---	300 secs	-	-	-	-	1.6	0.0	17.3	0.0	0.0	0.0	
WS9	2	---	360 secs	-	-	-	-	1.6	0.0	17.1	0.0	0.0	0.0	
WS9	2	---	420 secs	-	-	-	-	1.7	0.1	17.0	1.0	0.0	0.0	
WS9	2	---	480 secs	-	-	-	-	1.8	0.1	16.8	1.0	0.0	0.0	
WS9	2	---	540 secs	-	-	-	-	1.8	0.1	16.9	1.0	0.0	0.0	
WS9	2	---	600 secs	-	-	-	-	1.8	0.0	17.2	0.0	0.0	0.0	
WS9	3	5.52	15/09/2014 11:16:00	1009	1009	$0.0_{(I)}$	5.07	0.0	0.0	20.3	0.0	0.0	0.0	
WS9	3	---	15 secs	-	-	$0.0_{(SS)}$	-	1.8	0.0	18.6	0.0	0.0	0.0	
WS9	3	---	30 secs	-	-	-	-	1.8	0.0	18.1	0.0	0.0	0.0	
WS9	3	---	60 secs	-	-	-	-	1.8	0.0	18.0	0.0	0.0	0.0	
WS9	3	---	90 secs	-	-	-	-	1.8	0.0	18.0	0.0	0.0	0.0	
WS9	3	---	120 secs	-	-	-	-	1.9	0.0	18.0	0.0	0.0	0.0	
WS9	3	---	180 secs	-	-	-	-	1.9	0.0	17.9	0.0	0.0	0.0	
WS9	3	---	240 secs	-	-	-	-	2.0	0.0	17.8	0.0	0.0	0.0	
WS9	3	---	300 secs	-	-	-	-	2.0	0.0	17.6	0.0	0.0	0.0	
WS9	3	---	360 secs	-	-	-	-	2.1	0.0	17.5	0.0	0.0	0.0	
WS9	3	---	420 secs	-	-	-	-	2.2	0.0	17.4	0.0	0.0	0.0	
WS9	3	---	480 secs	-	-	-	-	2.2	0.0	17.2	0.0	0.0	0.0	
WS9	3	---	540 secs	-	-	-	-	2.3	0.0	17.3	0.0	0.0	0.0	
WS9	3	---	600 secs	-	-	-	-	2.1	0.0	17.7	0.0	0.0	0.0	
WS9	4	5.50	24/09/2014 12:45:00	1005	1005	$0.0_{(I)}$	4.30	0.0	0.0	20.7	0.0	0.0	0.0	
WS9	4	---	15 secs	-	-	$0.0_{(SS)}$	-	1.9	0.0	18.5	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS9	4	---	30 secs	-	-	-	-	1.9	0.0	17.8	0.0	0.0	0.0	
WS9	4	---	60 secs	-	-	-	-	1.9	0.0	17.7	0.0	0.0	0.0	
WS9	4	---	90 secs	-	-	-	-	2.0	0.0	17.7	0.0	0.0	0.0	
WS9	4	---	120 secs	-	-	-	-	2.0	0.0	17.5	0.0	0.0	0.0	
WS9	4	---	180 secs	-	-	-	-	2.1	0.0	17.4	0.0	0.0	0.0	
WS9	4	---	240 secs	-	-	-	-	2.1	0.0	17.3	0.0	0.0	0.0	
WS9	4	---	300 secs	-	-	-	-	2.1	0.0	17.2	0.0	0.0	0.0	
WS11	1	3.98	04/09/2014 14:45:00	1007	1007	$0.1_{(I)}$	2.78	0.1	0.0	20.8	-	0.0	0.0	
WS11	1	---	15 secs	-	-	$0.1_{(SS)}$	-	2.0	0.0	19.2	-	0.0	0.0	
WS11	1	---	30 secs	-	-	-	-	2.1	0.0	18.8	-	0.0	0.0	
WS11	1	---	60 secs	-	-	-	-	2.1	0.0	18.8	-	0.0	0.0	
WS11	1	---	90 secs	-	-	-	-	2.1	0.0	18.8	-	1.0	0.0	
WS11	1	---	120 secs	-	-	-	-	2.1	0.0	18.8	-	0.0	0.0	
WS11	1	---	180 secs	-	-	-	-	2.1	0.0	18.7	-	0.0	0.0	
WS11	1	---	240 secs	-	-	-	-	2.2	0.0	18.7	-	0.0	0.0	
WS11	1	---	300 secs	-	-	-	-	2.2	0.0	18.6	-	0.0	0.0	
WS11	1	---	360 secs	-	-	-	-	2.2	0.0	18.6	-	0.0	0.0	
WS11	2	3.97	09/09/2014 09:52:00	1013	1013	$0.0_{(I)}$	2.79	0.1	0.0	20.5	0.0	0.0	0.0	
WS11	2	---	15 secs	-	-	$0.0_{(SS)}$	-	2.2	0.0	19.4	0.0	0.0	0.0	
WS11	2	---	30 secs	-	-	-	-	2.2	0.0	19.1	0.0	0.0	0.0	
WS11	2	---	60 secs	-	-	-	-	2.2	0.0	19.0	0.0	0.0	0.0	
WS11	2	---	90 secs	-	-	-	-	2.2	0.0	18.9	0.0	0.0	0.0	
WS11	2	---	120 secs	-	-	-	-	2.3	0.0	18.9	0.0	0.0	0.0	
WS11	2	---	180 secs	-	-	-	-	2.3	0.0	18.7	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS11	2	---	240 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS11	2	---	300 secs	-	-	-	-	2.4	0.0	18.4	0.0	0.0	0.0	
WS11	2	---	360 secs	-	-	-	-	2.4	0.0	18.3	0.0	0.0	0.0	
WS11	2	---	420 secs	-	-	-	-	2.4	0.0	18.1	0.0	0.0	0.0	
WS11	3	3.98	15/09/2014 09:39:00	1009	1009	$0.0_{(I)}$	2.80	0.0	0.0	20.3	0.0	0.0	0.0	
WS11	3	---	15 secs	-	-	$0.0_{(SS)}$	-	2.3	0.0	19.1	0.0	0.0	0.0	
WS11	3	---	30 secs	-	-	-	-	2.3	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	60 secs	-	-	-	-	2.3	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	90 secs	-	-	-	-	2.3	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	120 secs	-	-	-	-	2.3	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	180 secs	-	-	-	-	2.4	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	240 secs	-	-	-	-	2.4	0.0	18.8	0.0	0.0	0.0	
WS11	3	---	300 secs	-	-	-	-	2.4	0.0	18.8	0.0	0.0	0.0	
WS11	4	3.97	24/09/2014 14:24:00	1004	1004	$0.0_{(I)}$	2.85	0.0	0.0	20.4	0.0	0.0	0.0	
WS11	4	---	15 secs	-	-	$0.0_{(SS)}$	-	2.2	0.0	18.9	0.0	0.0	0.0	
WS11	4	---	30 secs	-	-	-	-	2.3	0.0	18.7	0.0	0.0	0.0	
WS11	4	---	60 secs	-	-	-	-	2.3	0.0	18.7	0.0	0.0	0.0	
WS11	4	---	90 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS11	4	---	120 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS11	4	---	180 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS11	4	---	240 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS11	4	---	300 secs	-	-	-	-	2.3	0.0	18.6	0.0	0.0	0.0	
WS15	1	5.31	05/09/2014 13:46:00	1007	1007	$0.0_{(I)}$	1.50	0.0	0.0	20.6	0.0	0.0	0.0	
WS15	1	---	15 secs	-	-	$0.0_{(SS)}$	-	0.7	0.0	19.6	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS15	1	---	30 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	1	---	60 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	1	---	90 secs	-	-	-	-	0.8	0.0	19.4	0.0	0.0	0.0	
WS15	1	---	120 secs	-	-	-	-	0.8	0.0	19.4	0.0	0.0	0.0	
WS15	1	---	180 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	1	---	240 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	1	---	300 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	2	5.28	09/09/2014 12:24:00	1011	1011	$0.0_{(I)}$	1.48	0.0	0.0	20.5	0.0	0.0	0.0	
WS15	2	---	15 secs	-	-	$0.0_{(SS)}$	-	0.5	0.0	19.6	0.0	0.0	0.0	
WS15	2	---	30 secs	-	-	-	-	0.5	0.0	19.5	0.0	0.0	0.0	
WS15	2	---	60 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	2	---	90 secs	-	-	-	-	0.6	0.0	19.2	0.0	0.0	0.0	
WS15	2	---	120 secs	-	-	-	-	0.7	0.0	19.1	0.0	0.0	0.0	
WS15	2	---	180 secs	-	-	-	-	0.7	0.0	19.1	0.0	0.0	0.0	
WS15	2	---	240 secs	-	-	-	-	0.7	0.0	19.1	0.0	0.0	0.0	
WS15	2	---	300 secs	-	-	-	-	0.7	0.0	19.1	0.0	0.0	0.0	
WS15	3	5.29	15/09/2014 12:15:00	1008	1008	$0.0_{(I)}$	1.48	0.0	0.0	20.4	0.0	0.0	0.0	
WS15	3	---	15 secs	-	-	$0.0_{(SS)}$	-	0.6	0.0	19.8	0.0	0.0	0.0	
WS15	3	---	30 secs	-	-	-	-	0.6	0.0	19.7	0.0	0.0	0.0	
WS15	3	---	60 secs	-	-	-	-	0.6	0.0	19.6	0.0	0.0	0.0	
WS15	3	---	90 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	3	---	120 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	3	---	180 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	3	---	240 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	
WS15	3	---	300 secs	-	-	-	-	0.7	0.0	19.5	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Compiled By	Date	Checked By	Date	Contract Ref:
	30/09/14			**312598**

Contract: **M1 Junction 15, Northampton**

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
WS15	4	5.28	24/09/2014 15:01:00	1004	1004	$-0.1_{(I)}$	1.50	0.1	0.0	20.3	0.0	0.0	0.0	
WS15	4	---	15 secs	-	-	$-0.1_{(SS)}$	-	0.5	0.0	19.5	0.0	0.0	0.0	
WS15	4	---	30 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	60 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	90 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	120 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	180 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	240 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	
WS15	4	---	300 secs	-	-	-	-	0.5	0.0	19.4	0.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Compiled By	Date	Checked By	Date	Contract Ref:
	30/09/14			**312598**

Contract: **M1 Junction 15, Northampton**

Job Number:
Client:
Site:

Revised Wilson and Card Classification Ground Gas Risk Assessment

Job No.:	312598
Client:	
Site:	

For low-rise residential developments without a clear ventilated sub-floor void, flats and commercial / industrial sites

Characteristic Situation	Risk	GSV
1	Very Low	0.07
2	Low	0.7
3	Moderate	3.5
4	Moderate to High	15
5	High	70
6	Very High	>70

From CIRIA Report 659 (2006) "Assessing Risks Posed By Hazardous Ground Gases To Buildings", Wilson **et al.**

KEY:
GSV Gas Screening Value

GSV cannot be calculated on a site-specific basis

GSV indicates very low risk
GSV indicates low to moderate risk
GSV indicates moderate or greater risk; Concentrations of CH4 ≥20%V/V; CO2 ≥30%V/V
Oxygen concentration ≤10%v/v
Total ground gas concentrations >100%v/v

BH NO.	DATE	CH4 I %v/v	CH4 SS %v/v	CO2 I %v/v	CO2 SS %v/v	O2 I %v/v	O2 SS %v/v	Flow l/hr	Baro mbar	BH Press mbar	I SUM %v/v	SS SUM %v/v	GSV CH4	GSV CO2	CS No.
CP1	05/09/2014	<0.1	<0.1	0.8	1.9	20.1	17.9	0	1009	1009	20.9	19.8	0.00	0.00	CS1
	09/09/2014	0.1	<0.1	<0.1	<0.1	20.9	20.9	0	1013	1014	21.0	20.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	2.1	2.1	18.5	17.9	1.1	1009	1008	20.6	20.0	0.00	0.02	CS1
	24/09/2014	<0.1	<0.1	1.9	2.0	18.4	17.8	0	1005	1005	20.3	19.8	0.00	0.00	CS1
CP2	05/09/2014	<0.1	<0.1	1.0	1.1	18.4	16.8	0	1007	1007	19.4	17.9	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.1	0.3	19.9	18.6	0	1013	1013	20.0	18.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	2.1	1.6	16.8	17.0	0.4	1009	1009	18.9	18.6	0.00	0.01	CS1
	24/09/2014	<0.1	<0.1	2.2	1.9	17.0	16.3	0.7	1003	1002	19.2	18.2	0.00	0.01	CS1
CP3	05/09/2014	<0.1	<0.1	0.3	0.2	20.1	20.2	0	1009	1009	20.4	20.4	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.2	<0.1	20.8	20.9	0	1013	1013	21.0	20.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.3	0.1	20.8	20.9	0	1009	1009	21.1	21.0	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.7	0.1	19.8	20.8	0	1005	1005	20.5	20.9	0.00	0.00	CS1
CP4	04/09/2014	<0.1	<0.1	1.2	1.3	18.5	17.7	0	1007	1007	19.7	19.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.2	0.2	20.4	20.5	0	1013	1013	20.6	20.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.4	1.4	18.6	18.1	0	1009	1009	20.0	19.5	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.6	1.2	20.4	17.8	0	1005	1005	21.0	19.0	0.00	0.00	CS1
CP5	05/09/2014	<0.1	<0.1	0.5	0.5	19.9	19.7	0	1007	1007	20.4	20.2	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.1	0.1	20.6	20.6	-0.1	1013	1013	20.7	20.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.6	0.7	20.0	19.5	0	1009	1009	20.6	20.2	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.8	0.9	19.2	18.7	0	1004	1004	20.0	19.6	0.00	0.00	CS1
CP6	04/09/2014	<0.1	<0.1	0.6	0.3	19.7	18.6	0.2	1007	1007	20.3	18.9	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.4	0.9	20.3	15.0	-0.2	1013	1013	20.7	15.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.5	1.2	19.2	16.6	0.1	1009	1009	19.7	17.8	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.6	1.4	18.7	17.3	0	1004	1004	19.3	18.7	0.00	0.00	CS1
CP7	04/09/2014	<0.1	<0.1	0.1	0.1	20.9	20.9	0	1008	1008	21.0	21.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	<0.1	<0.1	20.7	20.7	0	1013	1013	20.7	20.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.1	<0.1	20.4	20.4	0	1010	1010	20.5	20.4	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.1	0.1	20.5	20.6	0	1005	1005	20.6	20.7	0.00	0.00	CS1
CP8	04/09/2014	<0.1	<0.1	1.3	2.0	19.5	17.8	0	1009	1009	20.8	19.8	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	1.6	2.2	18.3	17.4	-0.1	1013	1013	19.9	19.6	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.8	2.1	19.1	18.1	0	1010	1010	20.9	20.2	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	1.5	1.7	19.0	18.2	0	1005	1005	20.5	19.9	0.00	0.00	CS1
CP9	04/09/2014	<0.1	<0.1	0.5	0.3	19.6	20.1	0.1	1010	1010	20.1	20.4	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.1	<0.1	20.6	20.9	0	1013	1013	20.7	20.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.4	<0.1	19.9	20.4	0	1010	1010	20.3	20.4	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.4	<0.1	20.3	20.8	0	1005	1005	20.7	20.8	0.00	0.00	CS1
CP10	04/09/2014	<0.1	<0.1	0.1	0.1	20.3	18.8	0	1010	101	20.4	18.9	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.1	0.1	18.8	17.6	0	1013	1013	18.9	17.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.2	0.2	19.1	16.2	0	1010	1010	19.3	16.4	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.3	0.4	17.2	14.8	0	1005	1005	17.5	15.2	0.00	0.00	CS1
CP11	04/09/2014	<0.1	<0.1	0.1	0.1	20.9	20.9	0	1009	1009	21.0	21.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	<0.1	<0.1	20.7	20.8	0	1013	1013	20.7	20.8	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.2	0.1	20.2	20.5	0	1010	1010	20.4	20.6	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.2	0.1	20.6	20.9	0	1005	1005	20.8	21.0	0.00	0.00	CS1
CP12	04/09/2014	<0.1	<0.1	0.1	0.2	20.2	19.4	0.2	1010	1010	20.3	19.6	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.1	0.1	19.4	19.1	0	1013	1013	19.5	19.2	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.2	0.3	19.8	19.4	0	1010	1010	20.0	19.7	0.00	0.00	CS1
CP13	04/09/2014	<0.1	<0.1	0.8	0.8	20.1	19.3	0	1010	1010	20.9	20.1	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.2	0.2	20.4	20.5	0	1013	1013	20.6	20.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.3	0.1	20.0	20.3	0	1010	1010	20.3	20.4	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.1	0.1	20.8	20.8	0	1005	1005	20.9	20.9	0.00	0.00	CS1
CP14	04/09/2014	<0.1	<0.1	0.1	0.1	20.7	20.9	0	1009	1009	20.8	21.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	<0.1	<0.1	20.9	20.9	0	1013	1013	20.9	20.9	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	<0.1	<0.1	20.4	20.5	0	1010	1010	20.4	20.5	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.1	<0.1	20.5	20.6	0	1005	1005	20.6	20.6	0.00	0.00	CS1
CP15	04/09/2014	<0.1	<0.1	0.1	0.1	20.9	20.9	0	1009	1009	21.0	21.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	<0.1	<0.1	20.7	20.8	0	1013	1013	20.7	20.8	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.1	<0.1	20.5	20.7	0	1010	1010	20.6	20.7	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	<0.1	<0.1	20.2	20.2	0	1005	1005	20.2	20.2	0.00	0.00	CS1
CP16	04/09/2014	<0.1	<0.1	0.3	0.3	20.5	20.7	0.1	1009	1009	20.8	21.0	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.6	0.4	19.7	20.1	0	1013	1013	20.3	20.5	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.6	0.5	20.2	20.2	0	1010	1010	20.8	20.7	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.7	0.5	19.5	19.8	0	1005	1005	20.2	20.3	0.00	0.00	CS1
WS2	04/09/2014	<0.1	<0.1	1.4	1.6	19.2	18.9	0	1008	1008	20.6	20.5	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	1.6	1.7	19.4	18.9	0	1013	1013	21.0	20.6	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.7	1.8	19.7	19.3	0.1	1009	1009	21.4	21.1	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	1.5	1.5	20.0	19.7	0	1004	1004	21.5	21.2	0.00	0.00	CS1
WS3	04/09/2014	<0.1	<0.1	1.4	2.0	19.3	18.1	0.3	1006	1006	20.7	20.1	0.00	0.01	CS1
	09/09/2014	<0.1	<0.1	1.3	2.2	19.4	18.0	0.1	1013	1013	20.7	20.2	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.9	2.4	19.1	18.1	0.1	1009	1009	21.0	20.5	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	1.8	1.9	18.9	18.4	0	1005	1005	20.7	20.3	0.00	0.00	CS1
WS4	05/09/2014	<0.1	<0.1	1.1	1.0	19.6	19.5	0	1009	1009	20.7	20.5	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.3	0.3	20.5	20.4	-0.1	1013	1013	20.8	20.7	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.2	1.3	19.8	19.2	0	1009	1009	21.0	20.5	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	1.2	0.9	19.6	20.0	0	1005	1005	20.8	20.9	0.00	0.00	CS1
WS6	05/09/2014	<0.1	<0.1	0.1	<0.1	20.7	20.7	0	1009	1009	20.8	20.7	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	<0.1	<0.1	20.7	20.8	0	1013	1013	20.7	20.8	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.1	<0.1	20.9	20.9	0	1009	1009	21.0	20.9	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	<0.1	<0.1	20.2	20.3	0	1004	1004	20.2	20.3	0.00	0.00	CS1
WS8	05/09/2014	<0.1	<0.1	0.6	0.5	19.9	20.1	0	1007	1007	20.5	20.6	0.00	0.00	CS1
	09/09/2014	<0.1	0.1	0.4	0.8	20.0	19.3	0	1013	1013	20.4	20.2	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.7	1.0	20.2	19.8	0	1009	1009	20.9	20.8	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.7	0.9	20.2	19.4	0	1003	1003	20.9	20.3	0.00	0.00	CS1
WS9	05/09/2014	<0.1	<0.1	1.5	1.5	18.2	17.6	0	1007	1007	19.7	19.1	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	1.3	1.8	18.3	17.2	0	1013	1013	19.6	19.0	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	1.8	2.1	18.6	17.7	0	1009	1009	20.4	19.8	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	1.9	2.1	18.5	17.2	0	1005	1005	20.4	19.3	0.00	0.00	CS1
WS11	05/09/2014	<0.1	<0.1	2.0	2.2	19.2	18.6	0.1	1007	1007	21.2	20.8	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	2.2	2.4	19.4	18.1	0	1013	1013	21.6	20.5	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	2.3	2.4	19.1	18.8	0	1009	1009	21.4	21.2	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	2.2	2.3	18.9	18.6	0	1004	1004	21.1	20.9	0.00	0.00	CS1

Job Number:
Client:
Site:

Characteristic Situation	Risk	GSV
1	Very Low	0.07
2	Low	0.7
3	Moderate	3.5
4	Moderate to High	15
5	High	70
6	Very High	>70

From CIRIA Report 659 (2006) "Assessing Risks Posed By Hazardous Ground Gases To Buildings", Wilson et al.

KEY:
GSV Gas Screening Value

GSV cannot be calculated on a site-specific basis

GSV indicates very low risk
GSV indicates low to moderate risk
GSV indicates moderate or greater risk; Concentrations of CH4 ≥20%V/V; CO2 ≥30%V/V
Oxygen concentration ≤10%v/v
Total ground gas concentrations >100%v/v

BH NO.	DATE	CH4 I %v/v	CH4 SS %v/v	CO2 I %v/v	CO2 SS %v/v	O2 I %v/v	O2 SS %v/v	Flow l/hr	Baro mbar	BH Press mbar	I SUM %v/v	SS SUM %v/v	GSV CH4	GSV CO2	CS No.
WS15	05/09/2014	<0.1	<0.1	0.7	0.7	19.6	19.5	0	1007	1007	20.3	20.2	0.00	0.00	CS1
	09/09/2014	<0.1	<0.1	0.5	0.7	19.6	19.1	0	1011	1011	20.1	19.8	0.00	0.00	CS1
	15/09/2014	<0.1	<0.1	0.6	0.7	19.8	19.5	0	1008	1008	20.4	20.2	0.00	0.00	CS1
	24/09/2014	<0.1	<0.1	0.5	0.5	19.5	19.4	-0.1	1004	1004	20.0	19.9	0.00	0.00	CS1

WORST-CASE VALUES PER BOREHOLE

		Maximum CH4		Maximum CO2		Minimum O2		Max Flow	Not Applicable		Maximum Total		Maximum GSVs		CS No
CP1		0.1	<0.1	2.1	2.1	18.4	17.8	1.1			20.6	19.9	0.00	0.02	CS1
CP2		<0.1	<0.1	2.2	1.9	16.8	16.3	0.7			19.0	18.2	0.00	0.01	CS1
CP3		<0.1	<0.1	0.7	0.2	19.8	20.2	<0.1			20.5	20.4	0.00	0.00	CS1
CP4		<0.1	<0.1	1.4	1.4	18.5	17.7	<0.1			19.9	19.1	0.00	0.00	CS1
CP5		<0.1	<0.1	0.8	0.9	19.2	18.7	<0.1			20.0	19.6	0.00	0.00	CS1
CP6		<0.1	<0.1	0.6	1.4	18.7	15.0	0.2			19.3	16.4	0.00	0.00	CS1
CP7		<0.1	<0.1	0.1	0.1	20.4	20.4	<0.1			20.5	20.5	0.00	0.00	CS1
CP8		<0.1	<0.1	1.8	2.2	18.3	17.4	<0.1			20.1	19.6	0.00	0.00	CS1
CP9		<0.1	<0.1	0.5	0.3	19.6	20.1	0.1			20.1	20.4	0.00	0.00	CS1
CP10		<0.1	<0.1	0.3	0.4	17.2	14.8	<0.1			17.5	15.2	0.00	0.00	CS1
CP11		<0.1	<0.1	0.2	0.1	20.2	20.5	<0.1			20.4	20.6	0.00	0.00	CS1
CP12		<0.1	<0.1	0.2	0.3	19.4	19.1	0.2			19.6	19.4	0.00	0.00	CS1
CP13		<0.1	<0.1	0.8	0.8	20.0	19.3	<0.1			20.8	20.1	0.00	0.00	CS1
CP14		<0.1	<0.1	0.1	0.1	20.4	20.5	<0.1			20.5	20.6	0.00	0.00	CS1
CP15		<0.1	<0.1	0.1	0.1	20.2	20.2	<0.1			20.3	20.3	0.00	0.00	CS1
CP16		<0.1	<0.1	0.7	0.5	19.5	19.8	0.1			20.2	20.3	0.00	0.00	CS1
WS2		<0.1	<0.1	1.7	1.8	19.2	18.9	0.1			20.9	20.7	0.00	0.00	CS1
WS3		<0.1	<0.1	1.9	2.4	18.9	18.0	0.3			20.8	20.4	0.00	0.01	CS1
WS4		<0.1	<0.1	1.2	1.3	19.6	19.2	<0.1			20.8	20.5	0.00	0.00	CS1
WS6		<0.1	<0.1	0.1	<0.1	20.2	20.3	<0.1			20.3	20.3	0.00	0.00	CS1
WS8		<0.1	0.1	0.7	1.0	19.9	19.3	<0.1			20.6	20.4	0.00	0.00	CS1
WS9		<0.1	<0.1	1.9	2.1	18.2	17.2	<0.1			20.1	19.3	0.00	0.00	CS1
WS11		<0.1	<0.1	2.3	2.4	18.9	18.1	0.1			21.2	20.5	0.00	0.00	CS1
WS15		<0.1	<0.1	0.7	0.7	19.5	19.1	<0.1			20.2	19.8	0.00	0.00	CS1
Total across all		0.1	0.1	2.3	2.4	16.8	14.8	1.1			19.2	17.3	0.00	0.03	CS1

APPENDIX I
CONTAMINATED LAND RISK ASSESSMENT MATRIX

Contaminated Land Risk Assessment

In accordance with Environment Agency publication CLR 11 '*Model Procedures for the Management of Land Contamination*', a preliminary contaminated land risk assessment has been developed for the Site.

The risk assessment has been carried out using the risk model defined and outlined in the following table.

Potential sources have been identified from the desk study information and the guidance provided in EA publication CLR 8 '*Potential Contaminants for the Assessment of Land*'.

Hazard linkages will be determined by the proposed investigation and the risk re-assessed on the basis of the viability of the linkage.

If the hazard linkage is confirmed then remediation or management solutions will be proposed to ensure that no unacceptable risk remains following development.

	Category	Definition
Potential Severity	***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	***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

		Potential severity			
		Severe	***Medium***	***Mild***	***Minor***
Probability of Risk	***High Likelihood***	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

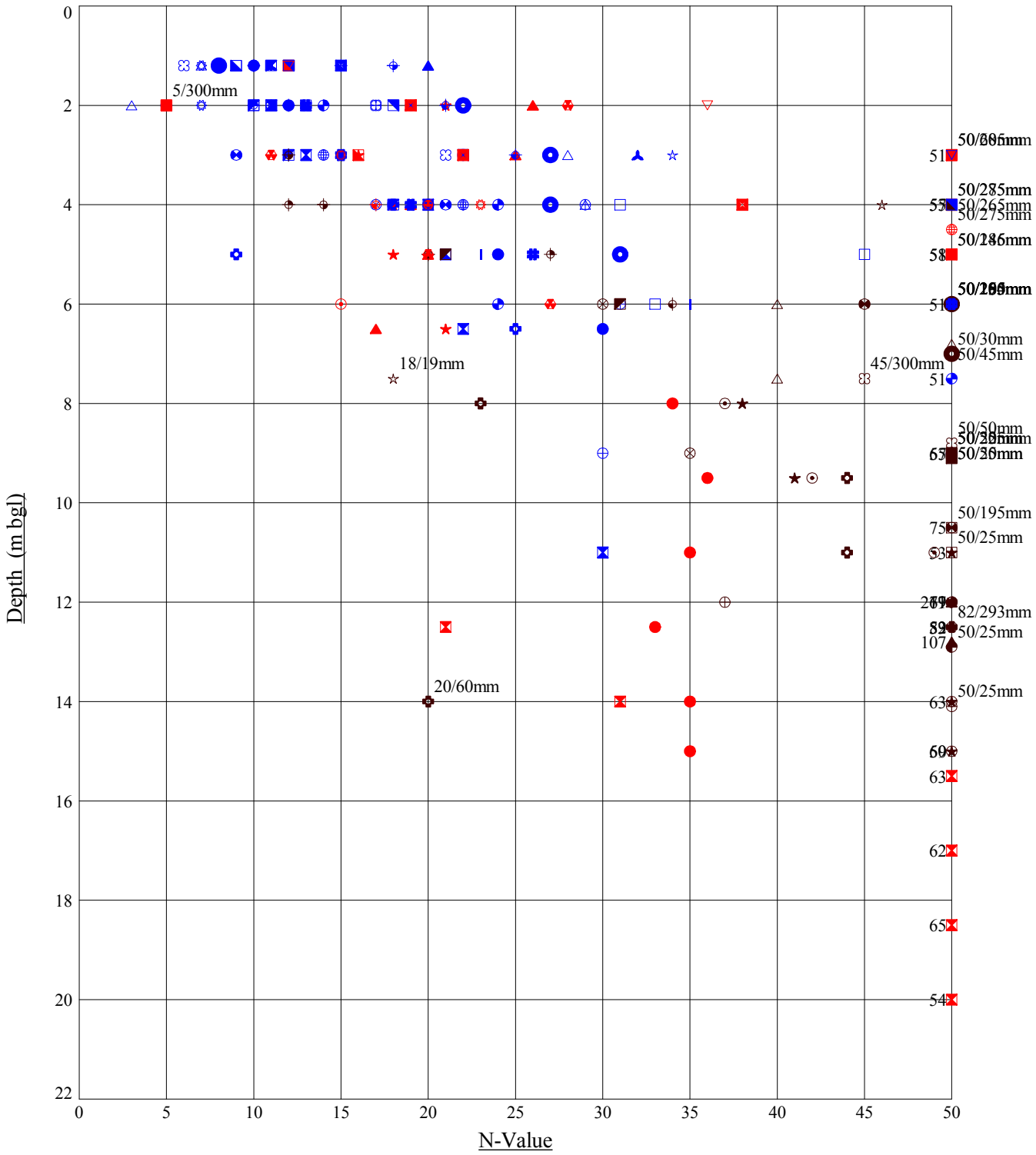
Contaminated Land Risk Assessment (Conceptual Site Model)

Source (type and location)	Pathway	Receptor	Initial Assessment from Desk Study Information			Proposed Investigation /Comments	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Petroleum hydrocarbon compounds (petrol, diesel & oil) and associated volatile organic compounds within shallow soil / groundwater (associated with minor spills and releases within agricultural fields and the fuel tanks identified within the agricultural barn area)	Inhalation of vapour	Site workers	Medium	Low likelihood	**Moderate /Low**	Site appears to be Greenfield no sources identified. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. General screening testing of shallow near surface site soil samples has been undertaken. **No significant contamination detected.** Groundwater sampling has been undertaken on one occasion from monitoring wells installed, where feasible volumes of groundwater were present. The samples taken were tested for a general suit of contaminants. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Low likelihood	**Moderate /Low**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Low likelihood	**Moderate /Low**		Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by liquid flow	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Mild	Unlikely	**Very Low**		Absent	Negligible		Negligible
Toxic & phytotoxic heavy metals and semi metals within shallow soil / groundwater (associated with the shooting range or other sources)	Inhalation of fugitive dust	Site workers	Medium	Unlikely	**Low**	Site appears to be Greenfield no sources identified. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. General screening testing of shallow near surface site soil samples has been undertaken. **No significant contamination detected.** Groundwater sampling has been undertaken on one occasion from monitoring wells installed, where feasible volumes of groundwater were present. The samples taken were tested for a general suit of contaminants. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Likely	**Moderate**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		End users	Medium	Likely	**Moderate**		Absent	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration in solution via groundwater	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Mild	Likely	**Moderate/ Low**		Absent	Negligible		Negligible
Fly Tipped Material	Ingestion and absorption via direct contact	Site workers	Medium	Low Likelihood	**Low**	Site walkover suggests there is no evidence of fly tipped material at the site although stockpiles of crushed concrete and brick are located in the centre of the site. No additional material noted during site investigation.	Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**					

Source (type and location)	Pathway	Receptor	Initial Assessment from Desk Study Information			Proposed Investigation	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Asbestos within Made Ground (associated with the derelict barns)	Inhalation of fugitive dust	Site workers	Medium	Low Likelihood	**Moderate to Low**	Site appears to be Greenfield no sources identified. Asbestos in roofing at derelict farm would need care when demolition is undertaken. **General Ground Investigation has been undertaken** to confirm the expected ground model. No asbestos or suspected asbestos identified or suspected to be present within strata encountered. All natural strata present.	Likely	Moderate	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely. Demolition and enabling works of derelict farm buildings to be controlled separately ensuring that suitable asbestos surveys are undertaken in advance. Any identified asbestos containing materials shall be removed and disposed of to suitably licensed waste disposal facilities under suitable H&S notifications and controlled procedures.	Negligible
		End users	Medium	Low Likelihood	**Moderate to Low**		Absent	Negligible		Negligible
Ground Gas from Made Ground and natural strata	Migration in to excavations	Site workers	Severe	Unlikely	**Moderate to Low**	Site appears to be greenfield with no naturally occurring organic soils likely to be a potential source of soil gas. **General Ground Investigation has been undertaken and 4 monitoring visits to monitor soil gas and groundwater have been undertaken.** This monitoring confirms that no significant or elevated concentrations of harmful gases are present within the strata beneath the site.	Absent	Negligible	Construction workers should still ensure that any works that need to be undertaken below ground level or within excavation are treated as confined space works and all normal confined space H&S protocols are adopted including but not limited to atmosphere testing and suitable excavation support.	Negligible
	Migration in to development	End Users	Severe	Unlikely	**Moderate to Low**		Absent	Negligible		Negligible
Aggressive substances (sulphates, acids, phenols, petroleum) in Shallow soils / groundwater	Direct contact with construction materials	Buried Structures	Medium	Low Likelihood	**Moderate to Low**	Available data suggests the presence of naturally occurring high sulphates levels. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. Testing of various strata has been undertaken to define the sulphate potential of the various strata in plan and with depth across the site.	High likelihood	High	Design of in ground concrete will take account of the anticipated ground conditions and available test results to ensure a suitably robust concrete mix design is utilised in accordance with BRE SD1:2005.	Negligible
		Buried Services	Medium	Low Likelihood	**Moderate to Low**		High likelihood	High		Negligible
Herbicides and Pesticides within shallow soil (associated with the arable fields)	Inhalation of vapour	Site workers	Medium	Unlikely	**Low**	Site is a modern arable farm. Modern arable farming should only utilise non persistent biodegradable safe pesticides and herbicides for crop production which are licensed and controlled. However, the use of environmentally persistent pesticides and herbicides have historically been used in arable farming and as such the presence of widespread soil contamination by older uncontrolled and unlicensed persistent and dangerous herbicides and pesticides is considered possible though is unlikely. General **Ground Investigation has been undertaken** to confirm the expected ground model. General screening testing of shallow near surface site soils has been undertaken. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by liquid flow	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
Ground Gas migration from landfill 144m north.	Migration in to excavations	Site workers	Severe	Unlikely	**Moderate to Low**	Currently active landfill located 144m north east of the site, beyond the current Junction 15. **General Ground Investigation has been undertaken and 4 monitoring visits to monitor soil gas and groundwater have been undertaken.** This monitoring confirms that no significant or elevated concentrations of harmful gases are present within the strata beneath the site.	Absent	Negligible	Construction workers should still ensure that any works that need to be undertaken below ground level or within excavation are treated as confined space works and all normal confined space H&S protocols are adopted including but not limited to atmosphere testing and suitable excavation support.	Negligible
	Migration in to development	End Users	Severe	Unlikely	**Moderate to Low**		Absent	Negligible		Negligible

APPENDIX J
GEOTECHNICAL DATA PLOTS

STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH



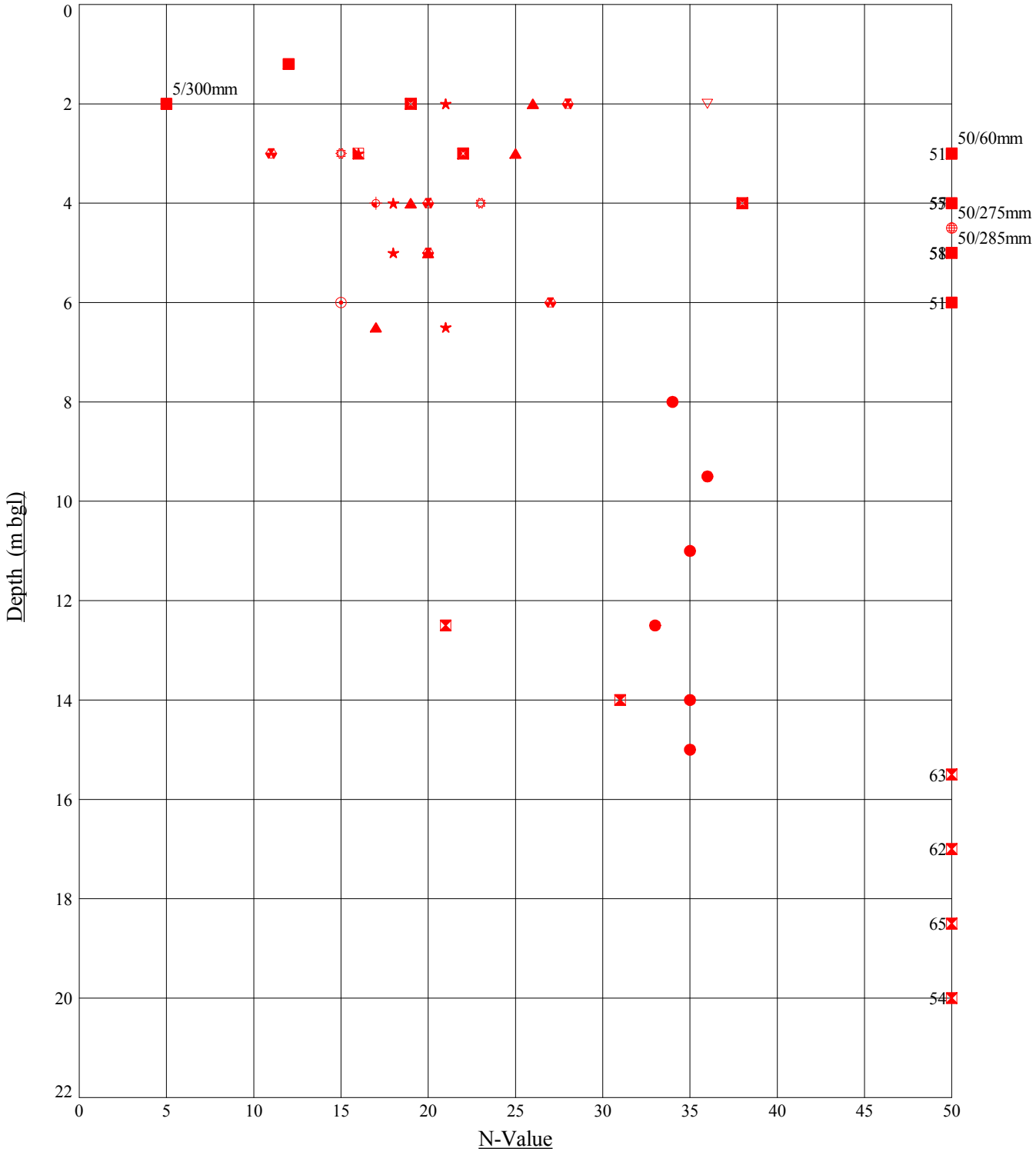
Key: ● = CP1, ⊕ = CP10, □ = CP11, ⊗ = CP12, ◕ = CP13, ☆ = CP14, ⊠ = CP15, ■ = CP16, ⊠ = CP2, ▲ = CP3, ★ = CP4, ⊙ = CP5, ✿ = CP6, ◉ = CP7, △ = CP8, ⊗ = CP9, ⅄ = WS1, ◪ = WS10, ◹ = WS11, ◹ = WS12, ◩ = WS13, ⌖ = WS14, ⌖ = WS15, ⌖ = WS16, ▽ = WS2, ✾ = WS3, ⊠ = WS4, ✸ = WS5, ❙ = WS6, ◍ = WS7, ☼ = WS8, ☺ = WS9

Geology code colour legend: Glaciofluvial Deposits, Oadby Member, Whitby Mudstone Formation

RSK Environment Ltd
Abbey Park
Humber Road
Coventry
CV3 4AQ

Contract	Date	Compiled By
M1 Junction 15, Northampton	**07.11.14**	
Client: **Roxhill Developments Ltd**	Contract Ref: **312598**	

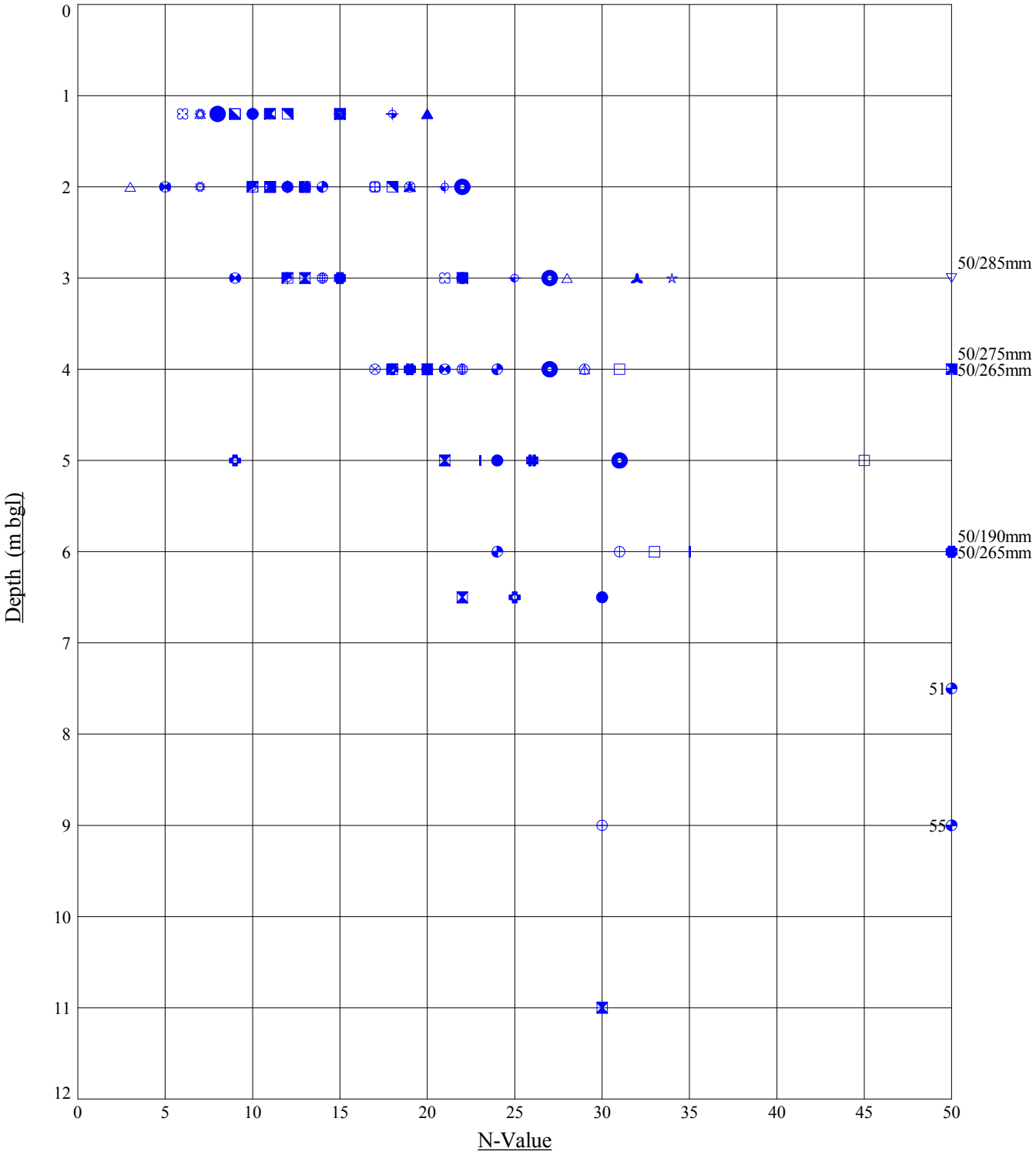
STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH



Key: ● = CP1, ⊠ = CP15, ■ = CP16, ⊠ = CP2, ▲ = CP3, ★ = CP4, ⊙ = CP5, ◪ = WS10, ◪ = WS11, ⊕ = WS16, ▽ = WS2, ⬟ = WS3, ⊠ = WS4, ⊕ = WS7, ☼ = WS8
Data filtered by geological unit: **Glaciofluvial Deposits**

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

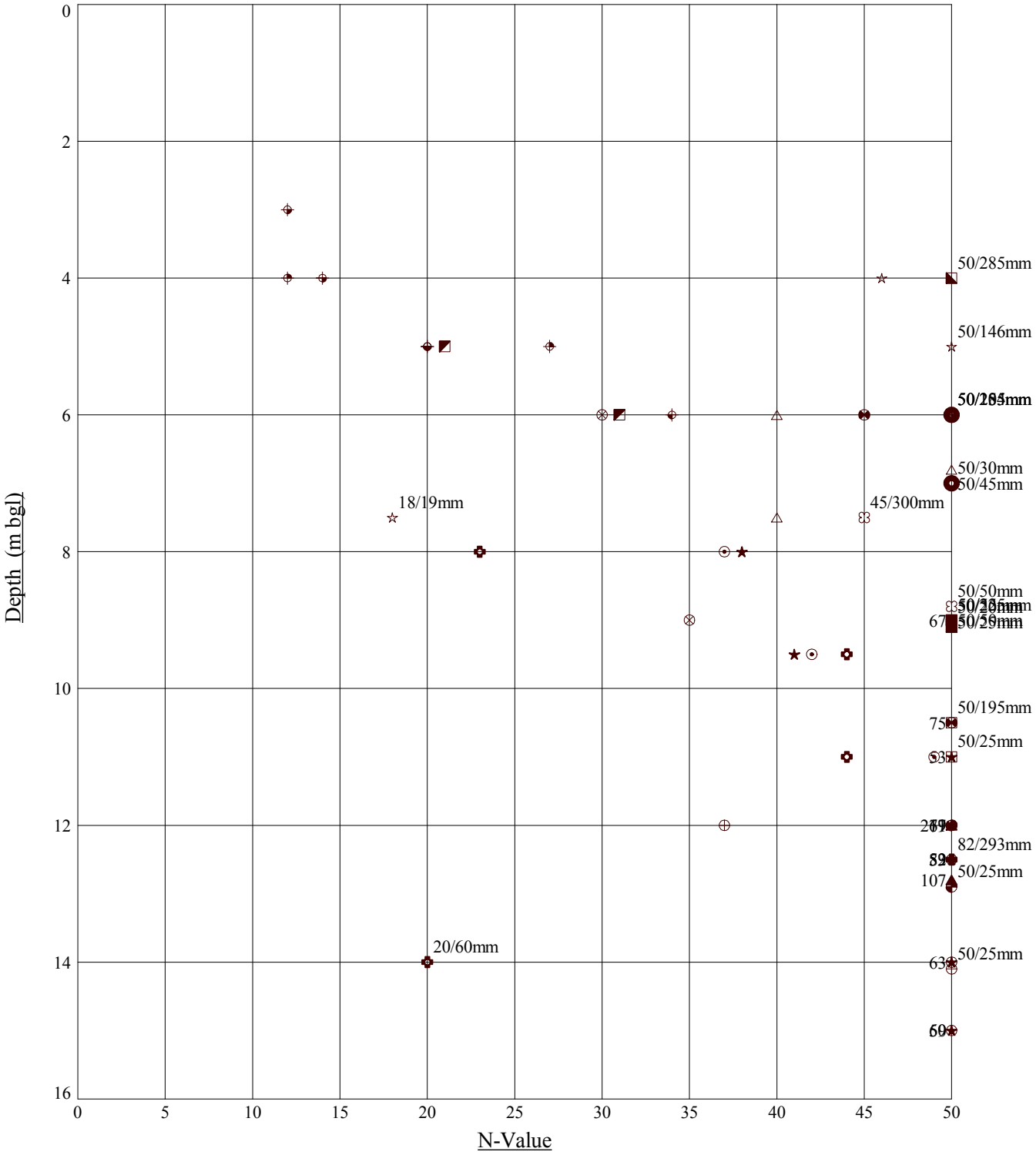
STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH



Key: ● = CP1, ⊕ = CP10, □ = CP11, ⊗ = CP12, ◔ = CP13, ☆ = CP14, ⊠ = CP15, ◪ = CP2, ▲ = CP3, ✿ = CP6, ◉ = CP7, △ = CP8, ⊗ = CP9, ⅄ = WS1, ◪ = WS10, ◹ = WS11, ◹ = WS12, ◩ = WS13, ⌖ = WS14, ⌖ = WS15, ⌖ = WS16, ▽ = WS2, ☢ = WS3, ▣ = WS4, ❋ = WS5, ❙ = WS6, ◍ = WS7, ☼ = WS8, ☺ = WS9
Data filtered by geological unit: **Oadby Member**

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

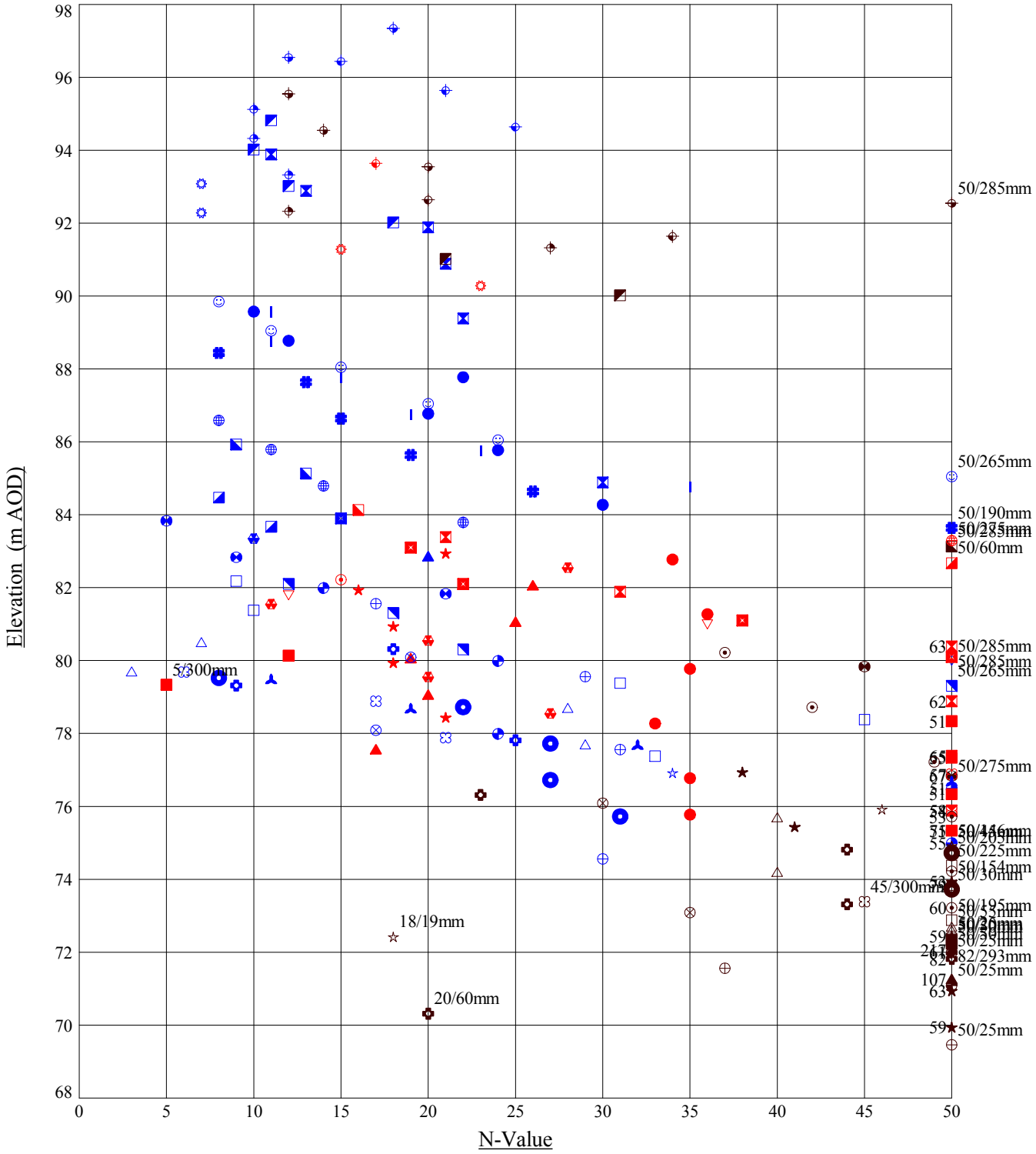
STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH



Key: ⊕ = CP10, □ = CP11, ⊗ = CP12, ◕ = CP13, ☆ = CP14, ⊠ = CP15, ■ = CP16, ▲ = CP3, ★ = CP4, ⊙ = CP5, ✿ = CP6, ● = CP7, △ = CP8, ⊗ = CP9, ◺ = WS11, ◩ = WS13, ⊕ = WS14, ⊕ = WS15, ⊕ = WS16
Data filtered by geological unit: **Whitby Mudstone Formation**

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION

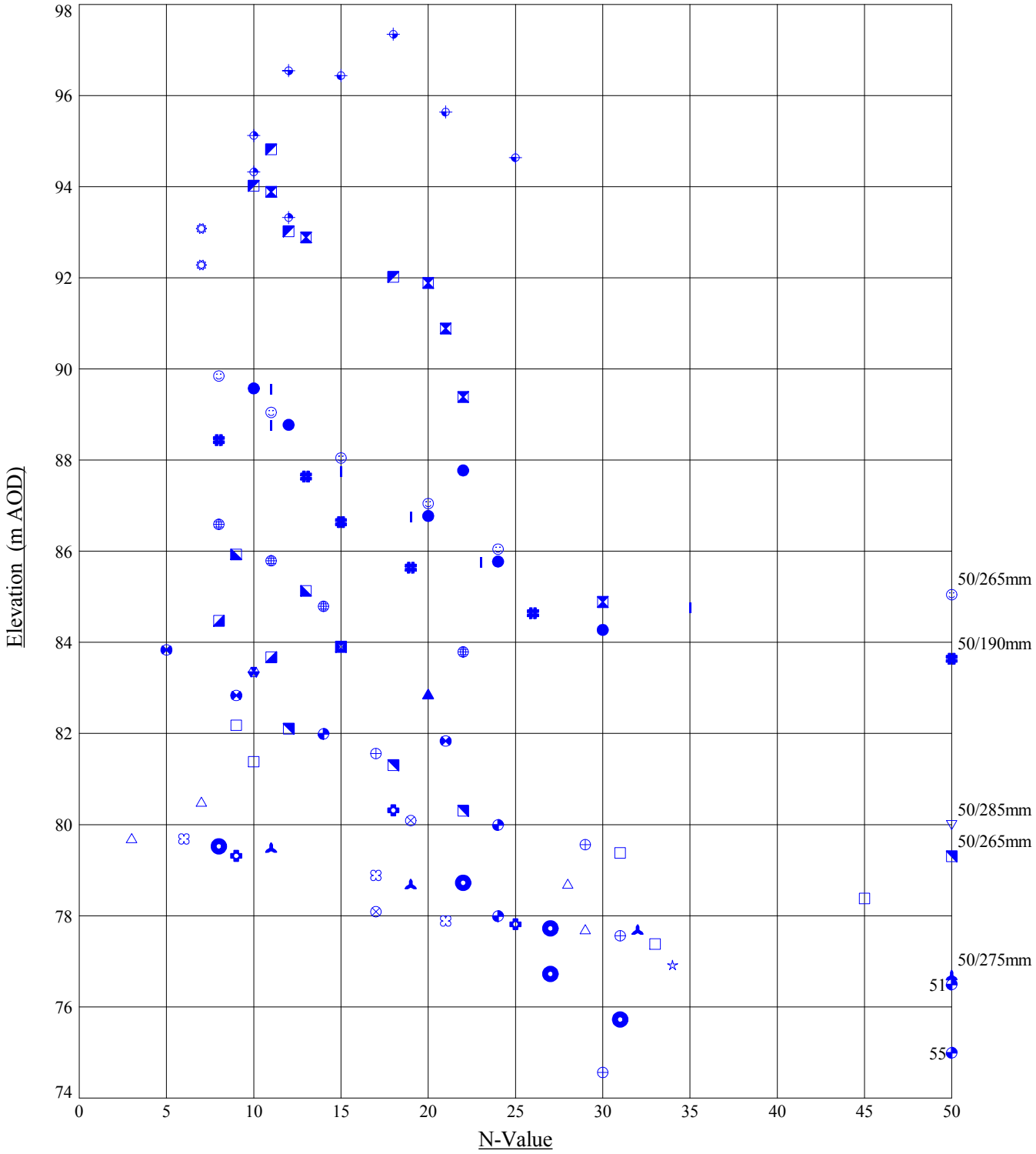


Key: ● = CP1, ⊕ = CP10, □ = CP11, ⊗ = CP12, ◕ = CP13, ☆ = CP14, ⊠ = CP15, ■ = CP16, ⊠ = CP2, ▲ = CP3, ★ = CP4, ⊙ = CP5, ✿ = CP6, ◉ = CP7, △ = CP8, ⊗ = CP9, ⅄ = WS1, ◪ = WS10, ◺ = WS11, ◹ = WS12, ◩ = WS13, ⌖ = WS14, ⌖ = WS15, ⌖ = WS16, ▽ = WS2, ✾ = WS3, ⊠ = WS4, ✸ = WS5, ❙ = WS6, ◍ = WS7, ☼ = WS8, ☺ = WS9

Geology code colour legend: Glaciofluvial Deposits, Oadby Member, Whitby Mudstone Formation

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION

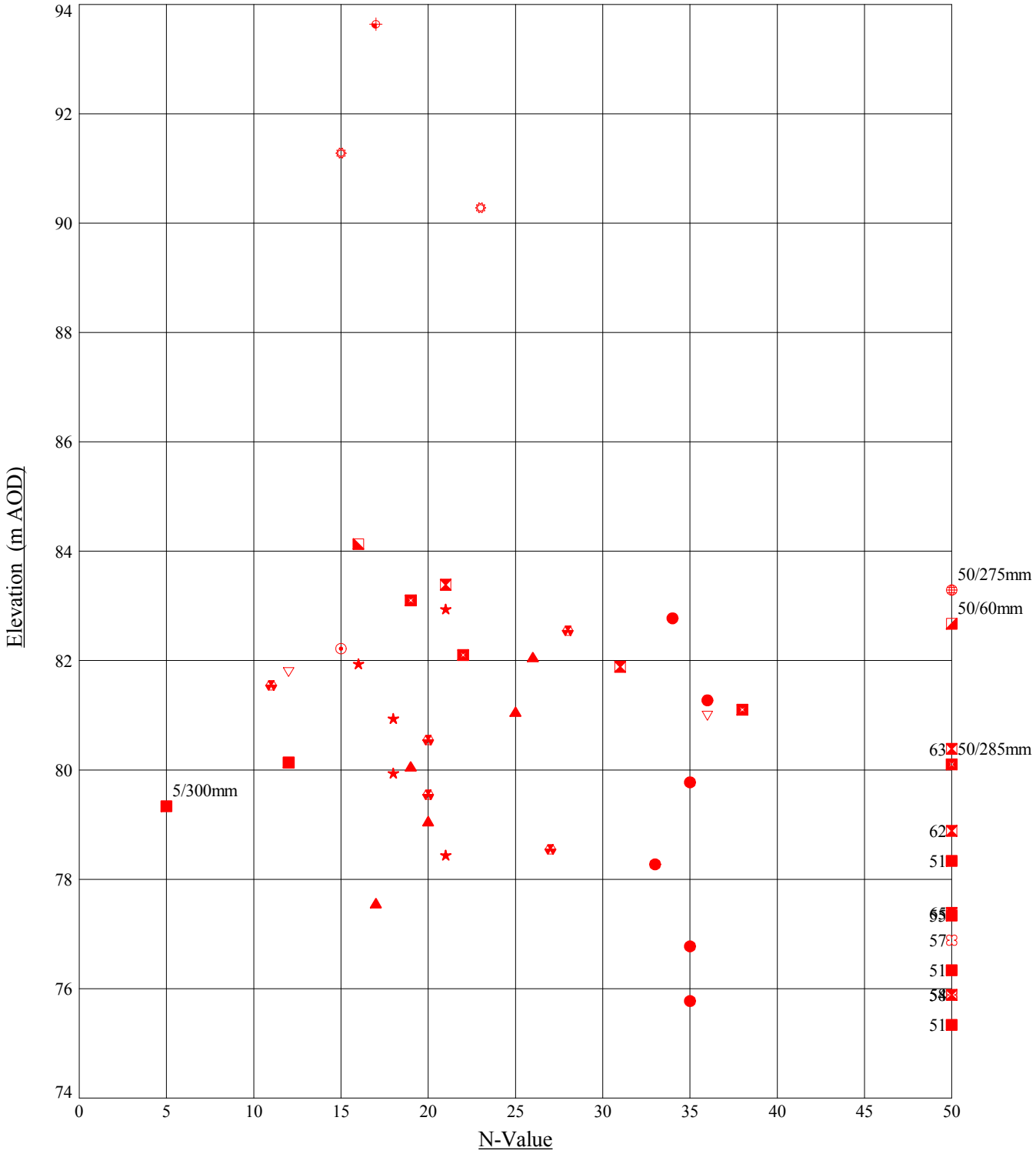


Key: ● = CP1, ⊕ = CP10, □ = CP11, ⊗ = CP12, ◔ = CP13, ☆ = CP14, ⊠ = CP15, ⊠ = CP2, ▲ = CP3, ✿ = CP6, ◉ = CP7, △ = CP8, ⊗ = CP9, ⅄ = WS1, ◪ = WS10, ◹ = WS11, ◹ = WS12, ◩ = WS13, ⌖ = WS14, ⌖ = WS15, ⌖ = WS16, ▽ = WS2, ☢ = WS3, ⊠ = WS4, ✱ = WS5, ❙ = WS6, ◍ = WS7, ☼ = WS8, ☺ = WS9

Data filtered by geological unit: **Oadby Member**

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

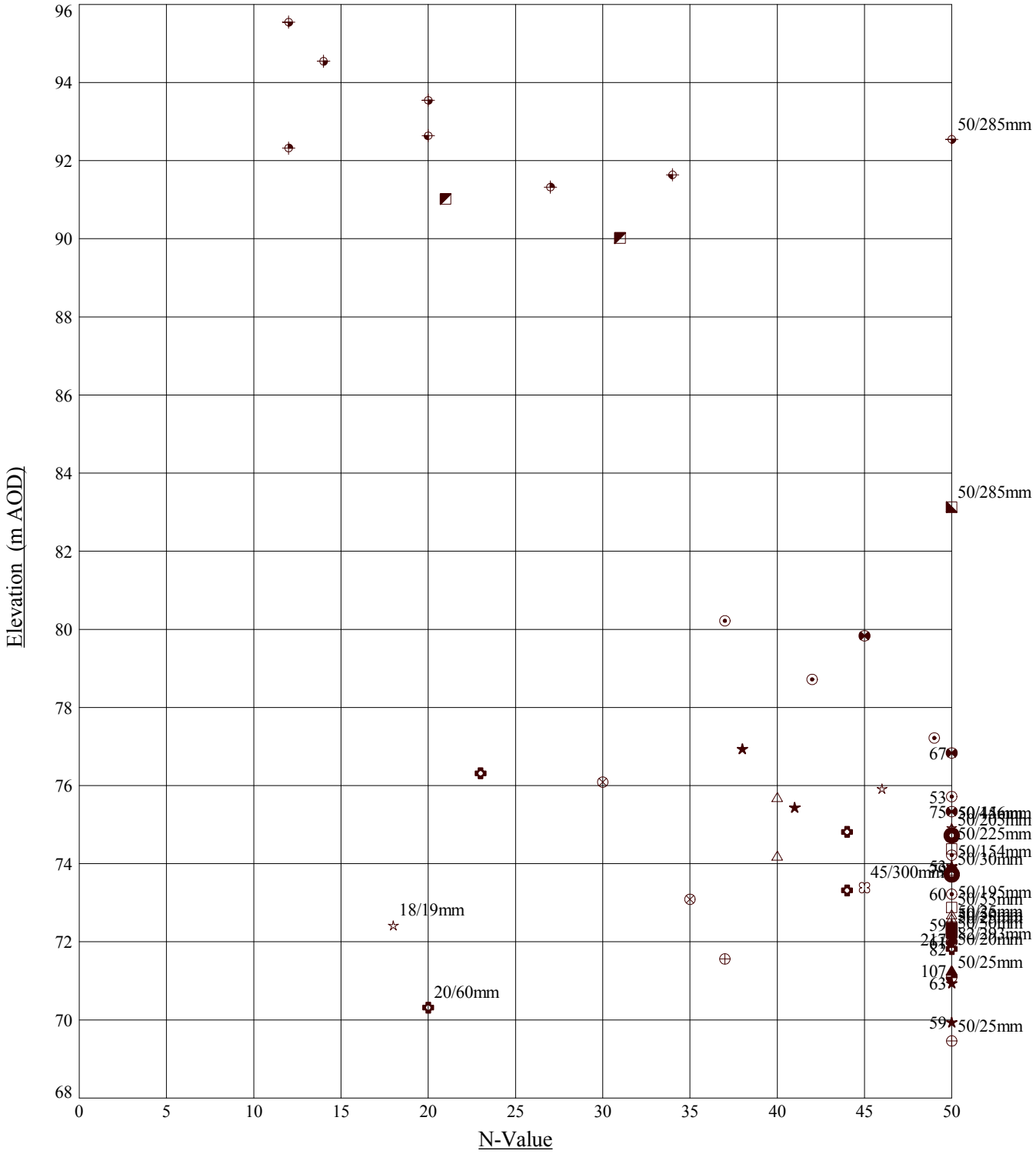
STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION



Key: ● = CP1, ⊠ = CP15, ■ = CP16, ⧓ = CP2, ▲ = CP3, ★ = CP4, ⊙ = CP5, ◪ = WS10, ◹ = WS11, ⌖ = WS16, ▽ = WS2, ⬟ = WS3, ⧓ = WS4, ⊕ = WS7, ☼ = WS8
Data filtered by geological unit: **Glaciofluvial Deposits**

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION



Key: ⊕ = CP10, □ = CP11, ⊗ = CP12, ◔ = CP13, ☆ = CP14, ⊠ = CP15, ■ = CP16, ▲ = CP3, ★ = CP4, ⊙ = CP5, ✿ = CP6, ● = CP7, △ = CP8, ⊗ = CP9, ◹ = WS11, ◩ = WS13, ⊕ = WS14, ⊕ = WS15, ⊕ = WS16
Data filtered by geological unit: **Whitby Mudstone Formation**

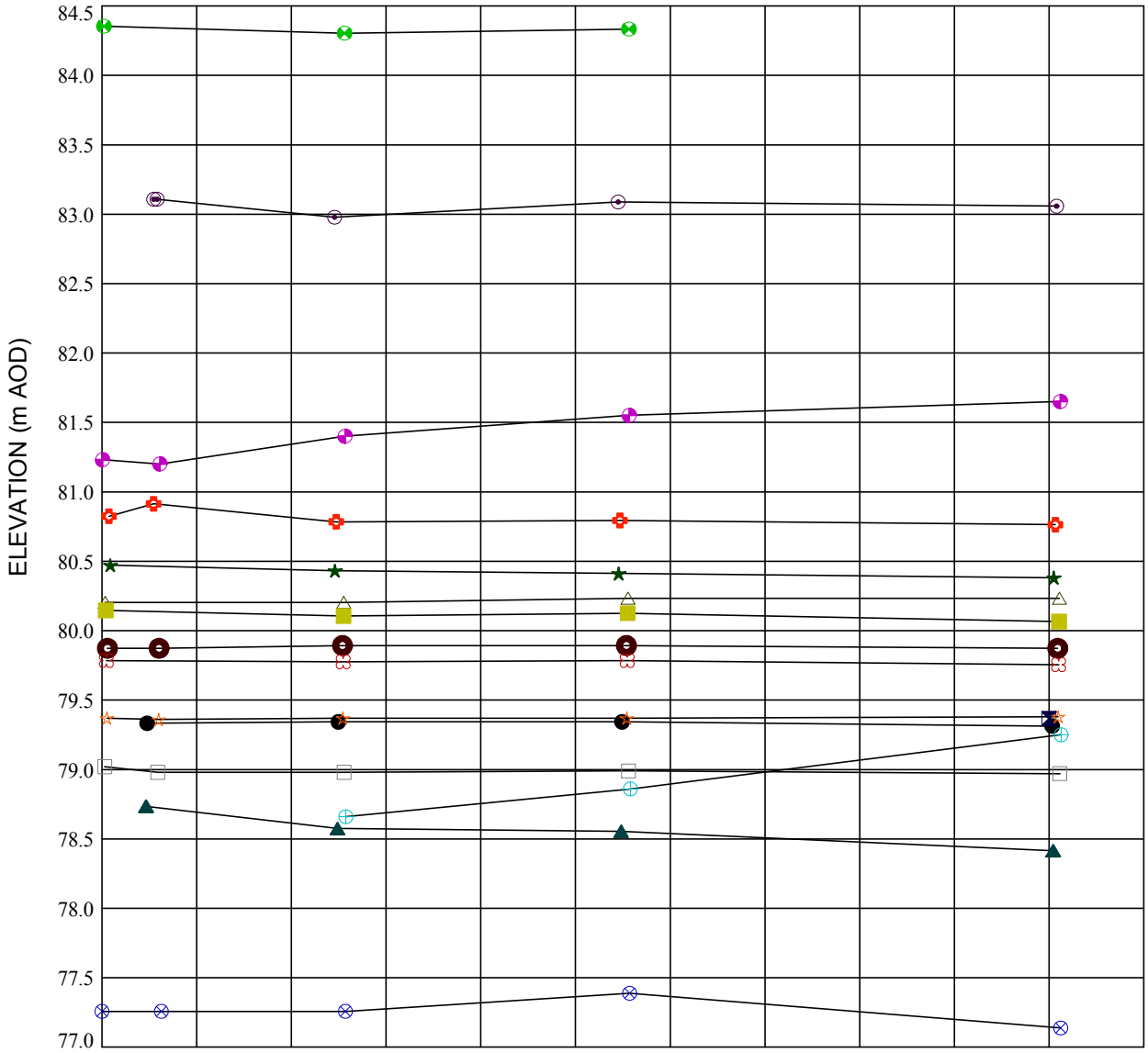
RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **M1 Junction 15, Northampton**	Date **07.11.14**	Compiled By
	Client **Roxhill Developments Ltd**	Contract Ref: **312598**	

Loc	Depth	Stratum	Water Soluble Sulphate g/l	Acid Soluble Sulphate (%)	Sulphur (Total) as Sulphate (%)	pH	Water Soluble Sulphate SO_4 g/l	Acid Soluble Sulphate SO_4 %	Total Sulphur SO_4 %	Oxidisable Sulphides as SO_4 %	Potentially pyritic	Total Potential Sulphate SO_4 %	Design Class based on w/s sulphate	Design Class based on TPS
BH1	2.60	OMC	1.610 ☑ SO4	2.490 ☑ SO4	0.97 ☑ SO4	7.8	1.610	2.490	0.970	0.42	YES	2.91	DS3	DS5
BH1	6.00	OMC	0.575 ☑ SO4	0.240 ☑ SO4	0.40 ☑ SO4	7.9	0.575	0.240	0.400	0.96	YES	1.20	DS2	DS3
BH1	8.60	OMG	0.041 ☑ SO4	0.020 ☑ SO4	0.010 ☑ SO4	9.0	0.041	0.020	0.010	0.01		0.03	DS1	DS1
BH1	12.00	OMG	0.011 ☑ SO4	0.020 ☑ SO4	0.010 ☑ SO4	8.8	0.011	0.020	0.010	0.01		0.03	DS1	DS1
BH2	1.80	OMC	0.059 ☑ SO4	0.070 ☑ SO4	0.040 ☑ SO4	8.5	0.059	0.070	0.040	0.05		0.12	DS1	DS1
BH2	3.80	OMC	0.344 ☑ SO4	0.230 ☑ SO4	0.560 ☑ SO4	8.0	0.344	0.230	0.560	1.45	YES	1.68	DS1	DS4
BH2	7.50	OMC	0.345 ☑ SO4	0.210 ☑ SO4	0.530 ☑ SO4	8.0	0.345	0.210	0.530	1.38	YES	1.59	DS1	DS4
BH2	10.50	OMC	0.200 ☑ SO4	0.050 ☑ SO4	0.030 ☑ SO4	8.2	0.200	0.050	0.030	0.04		0.09	DS1	DS1
BH2	13.50	OMG	0.089 ☑ SO4	0.050 ☑ SO4	0.030 ☑ SO4	8.5	0.089	0.050	0.030	0.04		0.09	DS1	DS1
BH3	2.80	OMG	0.010 ☑ SO4	0.020 ☑ SO4	0.010 ☑ SO4	7.8	0.010	0.020	0.010	0.01		0.03	DS1	DS1
BH3	4.80	OMG	0.010 ☑ SO4	0.020 ☑ SO4	0.010 ☑ SO4	7.9	0.010	0.020	0.010	0.01		0.03	DS1	DS1
BH8	8.50	WMF	0.578 ☑ SO4	0.240 ☑ SO4	0.890 ☑ SO4	7.6	0.578	0.240	0.890	2.43	YES	2.67	DS2	DS5
BH9	1.70	OMC	0.149 ☑ SO4	0.060 ☑ SO4	0.050 ☑ SO4	8.3	0.149	0.060	0.050	0.09		0.15	DS1	DS1
BH9	7.00	WMF	0.290 ☑ SO4	0.140 ☑ SO4	0.260 ☑ SO4	8.1	0.290	0.140	0.260	0.64	YES	0.78	DS1	DS3

Loc	Depth	Stratum	Water Soluble Sulphate g/l	Acid Soluble Sulphate (%)	Sulphur (Total) as Sulphate (%)	pH	Water Soluble Sulphate SO_4 g/l	Acid Soluble Sulphate SO_4 %	Total Sulphur SO_4 %	Oxidisable Sulphides as SO_4 %	Potentially pyritic	Total Potential Sulphate SO_4 %	Design Class based on w/s sulphate	Design Class based on TPS
BH13	1.70	OMC	0.072 ☑ SO4	0.040 ☑ SO4	0.02 ☑ SO4	8.4	0.072	0.040	0.020	0.02		0.06	DS1	DS1
BH13	7.50	OMG	0.821 ☑ SO4	0.240 ☑ SO4	0.80 ☑ SO4	8.0	0.821	0.240	0.800	2.16	YES	2.40	DS2	DS5
BH13	11.50	WMF	0.628 ☑ SO4	0.220 ☑ SO4	1.040 ☑ SO4	7.8	0.628	0.220	1.040	2.90	YES	3.12	DS2	DS5
BH14	1.70	OMC	0.219 ☑ SO4	0.140 ☑ SO4	0.710 ☑ SO4	8.0	0.219	0.140	0.710	1.99	YES	2.13	DS1	DS4
BH14	2.80	OMC	0.327 ☑ SO4	0.170 ☑ SO4	0.690 ☑ SO4	7.9	0.327	0.170	0.690	1.90	YES	2.07	DS1	DS4
TP14	1.50	OMC	0.083 ☑ SO4	0.050 ☑ SO4	0.030 ☑ SO4	8.4	0.083	0.050	0.030	0.04		0.09	DS1	DS1
			☑ SO4	☑ SO4	☑ SO4									
			☑ SO4	☑ SO4	☑ SO4									
			☑ SO4 ☑ SO4 ☑ SO4	☑ SO4 ☑ SO4 ☑ SO4	☑ SO4 ☑ SO4 ☑ SO4									
			☑ SO4 ☑ SO4	☑ SO4 ☑ SO4	☑ SO4 ☑ SO4									
			☑ SO4	☑ SO4	☑ SO4									

BOREHOLE WATER OBSERVATIONS

PLOT OF WATER LEVEL (ELEVATION) AGAINST TIME



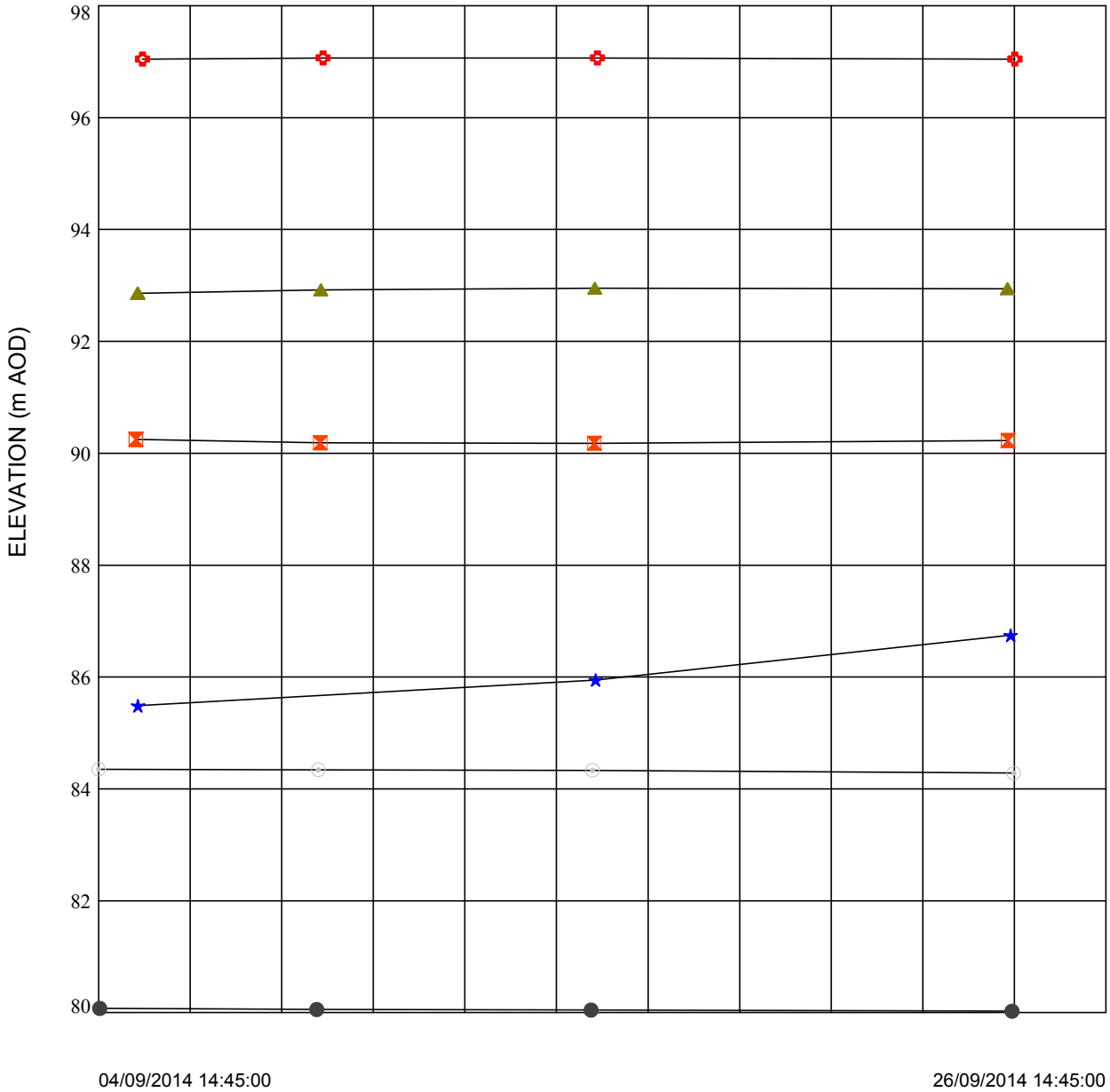
Legend:

● = 'CP1' ⧓ = 'CP2' ▲ = 'CP3' ★ = 'CP4' ⊙ = 'CP5' ✿ = 'CP6' ◉ = 'CP7' △ = 'CP8' ⊗ = 'CP9' ⊕ = 'CP10' □ = 'CP11'
⊛ = 'CP12' ◕ = 'CP13' ☆ = 'CP14' ⊠ = 'CP15' ■ = 'CP16'

	Compiled By	Date	Checked By	Date
RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ		10/11/14		
	Contract **M1 Junction 15, Northampton**		Contract Ref: **312598**	

BOREHOLE WATER OBSERVATIONS

PLOT OF WATER LEVEL (ELEVATION) AGAINST TIME



Legend:

● = 'WS3' ⧓ = 'WS6' ▲ = 'WS8' ★ = 'WS9' ⊙ = 'WS11' ✿ = 'WS15'

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Compiled By	Date	Checked By	Date
		10/11/14		
	Contract **M1 Junction 15, Northampton**		Contract Ref: **312598**	

APPENDIX K
GEOTECHNICAL RISK REGISTER

Geotechnical Risk Register

The site covers an area of approximately 1721Ha, the centre of which is defined by the following National Grid co-ordinates: 474940, 254715. The site is bound to the north east by the M1 road, to the south east by the A508 road and to the south west adn north west by fields; to the north west there are no physical boundaries other than the hedgerows which form the field boundaries, while to the south west is a small unnamed brook.

Geotechnical Risk Register

The Geotechnical Risk Register has been compiled to show the degree of risk attached to various ground related aspects of the proposed development. The purpose of the register is to provide an assessment of the risk to the project posed by common ground related problems, and to identify suitable mitigation measures for the control of risk to an acceptable level. The risk register should be developed and refined as the geotechnical design and assessment progresses such that the register will allow the management of the geotechnical risks.

The inclusion of a risk in the register does not constitute confirmation that the problem actually exists at the site. A probability of 'very unlikely' is indicative of a condition which the available data suggests should not be present. The calculated risk is not the risk that the impact will occur it is the risk that the mitigation will be required to enable the project to progress. For the purposes of this risk register the magnitude of each impact and the resulting severity of risk is measured against that which would could 'normally' be expected for each element. Before incorporation into a project risk register the impacts and risks for each element should be moderated by an assessment of the cost and time implication of individual mitigation measures.

The Geotechnical Risk Register has been developed in general accordance with the guidance presented in ICE/DETR Document 'Managing Geotechnical Risk' (2001) and the HA documents HD41/03 and HD22/02. The degree of risk (R) is determined by combining an assessment of the probability (P) of the hazard occurring with an assessment of the Impact (I) the hazard and associated mitigation will cause if it occurs (R = P x I). The scale against which the probability and impact are measure and the resulting degree of risk determined is presented below.

Probability	(P)
Very Likely (VLk)	5
Likely (Lk)	4
Plausible (P)	3
Unlikely (U)	2
Very Unlikely (VU)	1

x

Impact	(I)
Very High (VH)	5
High (H)	4
Medium (M)	3
Low (Lw)	2
Very Low (VLw)	1

=

(R)	Risk
20 – 25	Severe (Sv)
15 – 19	Substantial (Sb)
10 – 14	Moderate (Md)
5 – 9	Minor (Mn)
1 – 4	None / Negligible (N)

	Site / Ground Conditions	Hazard	Potential Impact	Before Control			Comments and Proposed Mitigation	RR
				P	I	R		
Contaminated Land	Previous site use	Contaminated Ground	Health and safety, environmental damage, pollution requiring Remediation	U 2	H 3	Mn 6	Ground investigation has confirmed the site is primarily greenfield with the exception of a small areas around the the gun club and the derelict barns areas. Site wide testing does not indicate the presence of any significant contamination. See seperate Contaminated Land Risk Assessments for further details.	N
Underground Voids	Mine Shafts	Shaft Collapse	Surface deformation, structural damage. Health and Safety	VU 1	H 4	N 4	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Shallow Mining	Workings Collapse crown holes, subsidence	Surface deformation, structural damage.	VU 1	H 4	N 4	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Deep Mining	Workings Consolidation, subsidence	Surface deformation	VU 1	M 3	N 3	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Natural cavities; solution features, Caves and Gulls	Unstable natural ground	Surface deformation, structural damage. Health and Safety	U 2	M 3	Mn 6	Geology not conducive to the formation of major solution features. Gypsum known to occur at depth in very thin veins and nodules but not of sufficient nature for commercial exploitation. Localised minor removal plausible through natural groundwater movements. **Ground Investigation undertaken, geology confirmed and no naturally occurring voids indicated to be present.**	N
	Other voids; basements, sumps, tanks, wells and adits etc.	Collapse, subsidence	Surface deformation, structural damage. Health and Safety	P 3	Lw 2	Mn 6	The vast majority of the site is undisturbed farm land. There is a recessed concrete tank located within the derelict farm buildings at the site, although the walkover has not indicated any other possible voids, man made or otherwise, at the site. **Vigilance required during construction works in order to ensure tank is appropriately remediated and suitably filled with compacted engineered fill materials..**	N

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Slopes and Earthworks	Existing steep slopes on site	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways and adjoining property.	VU 1	H 4	N 4	There are no significant steep slopes located within the development area	N
	Gradient on site	Earthworks or retaining walls required to accommodate layout	Increased cost of development	VLk 5	H 4	Sv 20	Significant cut to fill earthworks will be required to develop the site to form the proposed development plateau, landscape bund and access roads. Therefore significant slopes may be created as part of the finished design. Drainage will be important in the design of these slopes. Ground Investigation confirms the expected ground model are consistent with the envisaged outline design assumptions. Ground modelling and slope stability assessments will be required to confirm designs at detailed design stages.	Sv
	As-dug cut material unsuitable as fill	Unstable earthworks	Surface deformation, structural damage	P 3	H 4	Md 12	Ground Investigation confirms that the ground model and that natural materials present within the cut areas which will be suitable for reuse, however these materials are expected to be sensitive to moisture content change and will need careful handling for reuse within structural fill areas. All materials should be suitable for use within landscape fill areas.	Md
	Embankment Stability	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways and adjoining property.	P 3	VH 5	Sb 15	Ground Investigation have been undertaken to confirm the underlying geology and this is in line with expectations. No particularly problematic ground conditions have been identified that would cause concern regarding foundation settlement or bearing failure. Embankments will need to be carefully designed and will need to accommodate suitable drainage systems and take account of the prevailing underlying ground conditions.	Mn
	Cutting Stability	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways and adjoining property.	P 3	VH 5	Sb 15	Ground Investigations have been undertaken to confirm the underlying geology and this is in line with expectations. No particularly problematic ground conditions have been identified that would cause concern regarding slope failure. However the overconsolidated clays are likley to eb suseptible to swelling and stress relief upon un loading and as such care must be taken with respecft to the design of cut slopes and designs will need to accomadate suitable drainage systems.	Sb
	Insufficient suitable fill	Import required to achieve design levels	Increased cost of development	VU 1	H 4	N 4	A careful cut to fill balalnce should be achieved to avoid the unecessary importation of fill materials. Ground Investigation has confirmed the site ground model and strata properties for reuse.	N

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Foundations & Substructures	Loose or soft, compressible soils at shallow depth	Ground unsuitable for conventional shallow footings	Excess settlement or alternative foundations	P 3	H 4	Md 12	Ground Investigation has confirmed that some areas of softer materials are present in the southern part of the site and these maybe suseptible to settlement.	Sb
	Adjacent Structures	Works on site affecting stability of adjacent structures	Alternative design or altered development layout.	P 3	H 4	Md 12	No buildings immediately adjacent to the site. However the design of cuttings and fill along the north east and south east will need to be suitabley robust and take account of the proximity and loading from the M1 and A508 respectivley. Ground Investigation has confirmed the ground model and e strata properties to assist in suitable design.	Mn
	Differential Settlement	Settlements / heave beneath buildings as a result fo cut to fill works.	Damage to floors and structures.	P 3	H 4	Md 12	Careful design has to be undertaken to smooth the transition from cut insitu materials to engineered fill materials. Foundation designs will need to take account of the transition and differing solutions may need to be adopted across the building footprint. Floor slabs and ground engineering solutions will need to be carefully designed to accomadate this risk. Design will need to take account of specification for earthworks. Ground Investigation has identified softer than expected materials in the southern area of the site and confirmed that upon unloading in cut areas (north) glacial clays are suseptible to swelling and heave which could exacerbate differential settlement if some form of treatment or stabilisation is not undertaken.	Sb
	Aggressive Ground Chemistry	Attack of buried concrete	Protection required	Lk 4	M 3	Md 12	Available information suggests that gypsum a naturally occurring sulphate could be present within several strata beneath the site and this will require more resistant concrete mix designs to be used to protect in ground concrete from attack. **Ground Investigation has confirmed that strata beneath the site are affected by above average sulphates and more resistant concrete mix designs will be reuired.**	Sb

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Floor slabs and Road Pavements	Soft and compressible near surface soil	Ground unsuitable for conventional ground bearing slab	Alternative floor design	U 2	M 3	Mn 6	Ground Investigation has identified softer than expected materials in the southern area of the site and confirmed that upon unloading in cut areas (north) glacial clays are suseptible to swelling and heave which could exacerbate differential settlement if some form of treatment or stabilisation is not undertaken.	Sb
	Soft and compressible near surface soil	Low CBR due to soft formation	Surface damage or alternative design	U 2	M 3	Mn 6	Ground Investigation has confirmed that only low CBR is achievable using the natural soils without treatment so hardstandings and highways should be designed for very low CBR, include capping or include stabilisation treatments to improve CBR.	Sb
	Frost susceptible soils	Frost Heave	Surface damage or alternative design	P 3	M 3	Mn 9	Final floor slabs and road pavement construction thickness design should incorporate this risk.	Mn
Drainage & Flooding	High permeability Strata	Ineffective storm water attenuation ponds/water & ecology features	Ponds need lining if required to retain water.	U 2	M 3	Mn 6	Shallow soils across the majority of the site are anticipated to be cohesive and are likely to retain water. Locally particularly in the north of the site granular soils are anticipated to be present and may allow groundwater to percolate away. Ground Investigation has confirmed the geology differential across the site. Cohesive soils cover most areas and are unlikely to be conducive to soakaway SUDS.	Mn
	Low Permeability Strata	Ineffective soakaways	Alternative drainage required	VLk 5	M 3	Sb 15	Ground Investigation has confirmed clay soils are present across the majorty of the site and that these are not conducive to soakaway SUDS.	Sb
	High groundwater	Effects planned plateau and cutting levels and foundation designs and in particular cutting depths.	Alternative vertical alignment/plataeu levels required affecting cut fill balance feasibility	Lk 4	H 4	Sb 16	Ground Investigations have confirmed that the site is underlain by low permeability, unproductive strata (Oadby Member and Whitby Mudstone Formation) with localised perched trapped groundwater tables at variable depths. A more continuous groundwater table has been identified to be present at levels of around 79 to 80m AOD within the underlieing granular Fluvio Glacial deposits. Trapped semi artesian groundwater is present within siltstone bands in the underlieing Whitby Mudstone Formation at depth. Drainage will need to be included in cut faces to pick up shallow perched water tables howeber the deper groundwater table appears to be below the propsoed development platform levels.	Md
	Embankment earthworks and cutting slopes will require drainage.	Insufficient attenuation soakaways and ponds to accommodate earthworks drainage	Flooding	Lk 4	M 3	Md 12		Mn
	Local watercourse	Flooding	Flood protection required	P 3	H 4	Md 12	The site is not located within an area at risk of flooding, however specialist flood risk assessment and drainage designs will be required.	Md

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Temporary Works & Construction Issues	Loose or unstable strata at shallow depth	Excavation Instability	Collapse or support required. Health and safety	P 3	H 4	Md 12	Ground Investigation has confirmed that where present cohesive soils are stable in the short term, however where granular Glacial Fluvial deposits are encountered and or groundwater is present collapse or even running sand can occur.Should man entry be required suitable support or battering back of excavation sides will be required and atmospheres will need to be tested. Groundwater dewatering may be required where excavations penetrate into granular deposits beneath the continuous water table.	Md
	Hard Strata / obstructions at shallow depth	Hard Digging / Hard driving	Increase cost and delay	VLk 5	M 3	Sb 15	Ground Investigation has confirmed the geological model and no hard digging was encountered in the depths and areas of cut. Hard strata in the form of bedrock mudstones, siltstones are present at depth within the southern area of the site at depth within the solid geology but are unlikely to be encountered as part of the major earthworks or foundation excavations.	Md
	Presence of UNRECORDED sensitive underground services.	Damage during works posing risk to H&S of personnel and public	Increased cost of delay and for unplanned diversions and protection or repair.	U 2	H 4	Mn 8	Vigilance throughout works. Ensure up to date service drawings are obtained and site is scanned before works commence. No unrecorded services identified during the intrusive investigations, land drains are present.	Mn
	Shallow Groundwater	Inundation of Excavations	Increase cost and delay. Health and safety	P 3	M 3	Mn 9	Shallow localised groundwater tables will be encounetred within the Glacial Till where granular pockets are present. A deeper continuous groundwater table appears to be present in the Glaciaofluvial deposits but it is unlikely that excavations and earthworks wioll breach this.	Mn
	Contaminated Ground	Precautions for Groundworkers	Increase cost and delay. Health and safety	U 2	M 3	Mn 6	Vigilance throughout works. Seek advice of Environmental Engineer if any identified unusual odourous or visually contaminated materials encountered. **Ground Investigation confirms no contamination has been identified.**	N
	Contaminated Ground	Increased Disposal Costs	Increase cost and delay. Health and safety	U 2	M 3	Mn 6		

Note: The register only considers geotechnical risk other risks may be present on site, including in-ground risks such as; ecology, archaeology, buried services, UXO etc., which are outside the scope of this assessment.

APPENDIX L
HAZARDOUS WASTE ASSESSMENT

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v5.2b. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

HASWASTE v5.2b. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

HASWASTE v5.2b. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

312598 - M1 Junction 15 West: Northampton

TP/WS/BH	CP1	WS1	WS8	WS9	WS10	WS11	WS14	TP6	TP7	TP8	TP8	TP9	TP14	TP16	TP24	TP25	CPBH2
Depth (m)	0.20	0.30	0.50	0.40	0.20	0.20	0.60	0.30	0.20	0.35	0.80	0.80	0.90	0.40	0.20	0.40	0.50
Envirolab reference	14/04743/1	14/04743/4	14/04743/11	14/04743/12	14/04743/13	14/04743/14	14/04743/17	14/04743/24	14/04743/25	14/04743/26	14/04743/27	14/04743/28	14/04743/33	14/04743/34	14/04743/40	14/04743/41	14/04743/48
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
% Moisture																	
pH (soil)	7.82	7.50	7.84	8.03	7.86	7.26	7.64	7.33	7.50	8.42	8.08	8.05	8.44		7.85	7.96	7.71
pH (leachate)																	
Arsenic	9	10	10	12	16	12	6	12	11	9	13	11	11		9	10	17
Cadmium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Copper	14	14	10	8	16	14	8	16	14	6	12	9	13		17	16	12
CrVI or Chromium																	
Lead	27	31	12	12	31	28	11	30	30	12	21	18	11		30	26	20
Mercury	0.18	0.29	0.17	0.17	0.20	0.17	0.18	0.18	0.17	0.17	0.17	0.23	0.67		0.17	0.26	0.17
Nickel	21	23	19	15	21	22	20	25	20	14	26	18	23		28	26	25
Selenium	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
Zinc	60	65	50	49	69	67	39	70	68	42	53	43	48		66	65	66
Barium																	
Beryllium																	
Cobalt																	
Manganese																	
Molybdenum																	
TPH																	
Petrol																	
Diesel																	
Lube Oil																	
White Spirit / Kerosene																	
Creosote																	
Unknown TPH with ID																	
Unknown TPHCWG	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1
Inseparable TPH Mixtures																	
Any																	
Any but No Petrol																	
White Spirit / Kerosene and Diesel																	
Total USEPA 16 PAHs	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1
Acenaphthene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Acenaphthylene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Anthracene	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		0.02	0.02	0.02
Benzo(a)anthracene	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04		0.04	0.04	0.04
Benzo(a)pyrene	0.04	0.04	0.04	0.04	0.05	0.07	0.04	0.04	0.04	0.04	0.04	0.04	0.04		0.04	0.04	0.04
Benzo(b)fluoranthene	0.05	0.05	0.05	0.05	0.07	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05
Benzo(ghi)perylene	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05
Benzo(k)fluoranthene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		0.07	0.07	0.07
Chrysene	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06		0.06	0.06	0.06
Dibenzo(ah)anthracene	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		0.04	0.04	0.04
Fluoranthene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08		0.08	0.08	0.08
Fluorene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Indeno(123cd)pyrene	0.03	0.03	0.03	0.03	0.03	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.03	0.03	0.03
Naphthalene	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.03	0.03	0.03
Phenanthrene	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.03	0.03	0.03
Pyrene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		0.07	0.07	0.07
Benzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Toluene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Ethylbenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Xylenes	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01	0.01
Trimethylbenzenes																	
Chlorobenzene																	
1,2-Dichlorobenzene																	
1,3-Dichlorobenzene																	
1,4-Dichlorobenzene																	
1,2,4-Trichlorobenzene																	
2-Chlorotoluene																	
4-Chlorotoluene																	
Trichloroethene (TCE)																	
Total Sulphide																	
Free Cyanide																	
Thiocyanate																	
Elemental/Free Sulphur																	
PCBs Total (eg EC7/WHO12)																	
Phenols Total by HPLC	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2
Phenol																	
Cresols																	
Xylenols																	
1-Naphthol																	
Resourcinol																	
2,3,5,6-Tetrachlorophenol																	
2,4,5-Trichlorophenol																	
2,4,6-Trichlorophenol																	
2,4-Dichlorophenol																	
4-Chloro-3-methylphenol																	
Pentachlorophenol																	
Bis(2-ethylhexyl)phthalate																	
Butylbenzylphthalate																	
Di-n-butylphthalate																	

Asbestos in Soil	Thresholds	CP1	WS1	WS8	WS9	WS10	WS11	WS14	TP6	TP7	TP8	TP8	TP9	TP14	TP16	TP24	TP25	CPBH2
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Asbestos detected in Soil (enter Y or N) (If Y: Hazardous Waste H6 and H7)	Y																	
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only) (If <0.1%, not Hazardous Waste)	see below																	
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N) (If Y: Hazardous Waste H6 and H7)	Y																	

Hazard Codes	Thresholds	CP1	WS1	WS8	WS9	WS10	WS11	WS14	TP6	TP7	TP8	TP8	TP9	TP14	TP16	TP24	TP25	CPBH2
Irritant H4	≥10%	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00000	0.00002	0.00002	0.00002
Irritant H4	≥20%	0.0043	0.0047	0.0039	0.0031	0.0043	0.0045	0.0041	0.0051	0.0041	0.0029	0.0053	0.0037	0.0047	0.0000	0.0057	0.0053	0.0051
Harmful H5	≥25%	0.0086	0.0094	0.0062	0.0052	0.0092	0.0089	0.0061	0.0099	0.0087	0.0048	0.0088	0.0065	0.0073	0.0000	0.0106	0.0097	0.0085
Toxic H6	≥0.1%	0.00008	0.00009	0.00007	0.00007	0.00008	0.00007	0.00008	0.00008	0.00007	0.00007	0.00007	0.00008	0.00012	0.00000	0.00007	0.00008	0.00007
Toxic H6	≥3%	0.00536	0.00587	0.00506	0.00445	0.00606	0.00586	0.00486	0.00647	0.00536	0.00395	0.00677	0.00496	0.00597	0.00000	0.00678	0.00647	0.00697
Carcinogenic H7	≥0.1%	0.00424	0.00465	0.00384	0.00303	0.00424	0.00444	0.00404	0.00505	0.00404	0.00283	0.00525	0.00364	0.00465	0.00000	0.00566	0.00525	0.00505
Carcinogenic H7	≥1%	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001	0.00001	0.00001
Carcinogenic H7 Unknown TPH with ID	≥1,000mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carcinogenic H7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Carcinogenic H7 % Asbestos in Soil (Fibres)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00000	0.00002	0.00002	0.00002
pH Corrosive H8 (Irritant H4) pH (soil or leachate)	H8 ≥11.5	7.82	7.50	7.84	8.03	7.86	7.26	7.64	7.33	7.50	8.42	8.08	8.05	8.44	0.00	7.85	7.96	7.71
pH Corrosive H8 (Irritant H4) pH (soil or leachate)	H8 ≤2	7.82	7.50	7.84	8.03	7.86	7.26	7.64	7.33	7.50	8.42	8.08	8.05	8.44	0.00	7.85	7.96	7.71
Toxic for Reproduction H10	≥0.5%	0.00424	0.00465	0.00384	0.00303	0.00424	0.00444	0.00404	0.00505	0.00404	0.00283	0.00525	0.00364	0.00465	0.00000	0.00566	0.00525	0.00505
Toxic for Reproduction H10	≥5%	0.00270	0.00310	0.00120	0.00120	0.00310	0.00280	0.00110	0.00300	0.00300	0.00120	0.00210	0.00180	0.00110	0.00000	0.00300	0.00260	0.00200
Mutagenic H11	≥0.1%	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001	0.00001	0.00001
Mutagenic H11 Unknown TPH with ID	≥1,000mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mutagenic H11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Mutagenic H11	≥1%	0.00424	0.00465	0.00384	0.00303	0.00424	0.00444	0.00404	0.00505	0.00404	0.00283	0.00525	0.00364	0.00465	0.00000	0.00566	0.00525	0.00505
Produces Toxic Gases H12 Sulphide	≥1,400mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Free Cyanide	≥1,200mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Thiocyanate	≥2,600mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H13 Sensitising	≥1%	0.00424	0.00465	0.00384	0.00303	0.00424	0.00444	0.00404	0.00505	0.00404	0.00283	0.00525	0.00364	0.00465	0.00000	0.00566	0.00525	0.00505
Ecotoxic H14	≥1.0	0.06872	0.07488	0.05469	0.05085	0.07860	0.07469	0.04710	0.08025	0.07390	0.04444	0.06755	0.05275	0.05848	0.00000	0.07992	0.07619	0.07444
Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.000008	0.000008	0.000008	0.000008	0.000024	0.000022	0.000008	0.000008	0.000008	0.000008	0.000008	0.000008	0.000008	0.000000	0.000008	0.000008	0.000008
Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

(columns 18–35)	col 18	col 19	col 20	col 21	col 22	col 23	col 24	col 25	col 26	col 27	col 28	col 29	col 30	col 31	col 32	col 33	col 34	col 35
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Asbestos in Soil	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Irritant H4 (≥10%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Irritant H4 (≥20%)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Harmful H5 (≥25%)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toxic H6 (≥0.1%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Toxic H6 (≥3%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7 (≥0.1%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7 (≥1%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7 Unknown TPH with ID	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carcinogenic H7 b(a)p marker test	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Carcinogenic H7 % Asbestos in Soil (Fibres)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Corrosive H8 (Irritant H4)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
pH Corrosive H8 (H8 ≥11.5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pH Corrosive H8 (H8 ≤2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toxic for Reproduction H10 (≥0.5%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Toxic for Reproduction H10 (≥5%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mutagenic H11 (≥0.1%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mutagenic H11 Unknown TPH with ID	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mutagenic H11 b(a)p marker test	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Mutagenic H11 (≥1%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Produces Toxic Gases H12 Sulphide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Free Cyanide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Thiocyanate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H13 Sensitising	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic H14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic H14 individual (≥0.0025%)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Ecotoxic H14 individual (≥0.025%)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 3rd ATP where applicable (sometimes called ATSP3).