

**A REPORT ON A GROUND INVESTIGATION
FOR A PROPOSED EXTENSION TO THE
LUTTERWORTH FIRE AND RESCUE STATION,
GILMORTON ROAD,
LUTTERWORTH, LE17 4DZ**

CLIENT: Leicestershire Fire and Rescue Service

ENGINEER: Michael Aubrey Partnership Limited

Date: 10 November 2017

Reference: MSH/17.387

A F Howland Associates
The Old Exchange
Newmarket Road
Cringleford
Norwich
NR4 6UF

Tel: 01603 250754

Fax: 01603 250749



A F Howland Associates

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1. INTRODUCTION

It is proposed to extend the existing Lutterworth Fire and Rescue Station, Gilmorton Road, Lutterworth, Leicestershire (Drawing 17.387/1).

At the instruction of Leicestershire Fire and Rescue Service, an investigation was carried out to provide information on the subsoil conditions and relevant geotechnical parameters relating to the proposed development.

This report provides the factual details of the fieldwork and laboratory testing undertaken during the investigation together with a consideration of the findings of the investigation with respect to the proposed works.



2. FIELDWORK

Fieldwork was carried out on the 3 October 2017 and comprised two window sample holes and a foundation inspection trial pit.

The positions were set out in general accordance with the requirements of the development as shown approximately on Drawing 17.387/2. The National Grid references and the elevation of the hole positions relative to Ordnance Datum were measured using a ProMark GPS system by A F Howland Associates. A starter pit was excavated by hand to a depth of 1.20 m at the window sample hole locations, while a cable avoidance tool (CAT) was used to sweep the pit and surrounding area to locate any services or buried obstructions. The latter was also used at the trial pit position.

Sampling, soil descriptions and *in situ* tests were carried out in accordance with BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015. Details of the strata encountered, the sampling, and *in situ* and subsequent laboratory testing are shown on records appended to this report.

The **window sample holes**, referenced WS01 and WS02, were carried out with a tracked window sampling rig to depths of 3.45 and 4.45 m below ground level (bgl). The sampling system utilises a 63.5 kg weight falling a distance of 750 mm to drive rods and sampling tubes into the ground, these are then extracted and the continuous samples described and subsampled for possible laboratory testing. Open drive samples (U70) were taken where possible in the more cohesive material to allow laboratory testing of undisturbed material. Standard penetration tests (SPT) were also carried out using a split barrel sampler. The SPT N value was taken as the number of blows for 300 mm of penetration, following a seating drive of 150 mm or 25 blows.

The **trial pit**, referenced TP01, was excavated by hand and taken to a depth of 0.65 m. The pit was excavated to inspect the foundations of the existing fire station. Once excavations were complete, the trial pit was backfilled with arisings.



The exploratory holes were monitored for **groundwater** inflow during fieldwork. Upon encountering groundwater, operations were temporarily stopped to allow the level to stabilise, recording the water level at five minute intervals for a period of twenty minutes.



3. LABORATORY TESTING

3.1 GENERAL

Subsequent to the fieldwork, a programme of laboratory testing was carried out to provide additional quantitative data on the materials encountered at the borehole position. The tests were completed in accordance with the procedures laid down in BS 1377: 1990 unless stated otherwise and consisted of:

- Natural moisture content
- Atterberg limits
- Undrained shear strength in triaxial compression without measurement of pore pressure
- Sulphate content and pH value
- Total sulphur content
- Waste acceptance criteria testing

3.2 TEST PROCEDURES

3.2.1 Natural Moisture Content

The natural moisture content is determined according to BS1377: Part 2: 1990: clause 3.2. This represents the mass of moisture content retained by the soil in its natural state as a percentage of its dry mass. For organic soils and peats care should be taken to avoid heating the sample above 50°C to prevent irreversible physical changes to the material.

3.2.2 Atterberg Limits

The Atterberg limits are determined in the laboratory by the procedures given in BS1377: Part 2: 1990. The liquid limit (LL) is the moisture content of the soil at the point that its behaviour passes from that of a plastic solid to that of a liquid. The test procedure given as clause 4.4 was used based on the cone penetrometer in which the penetration of a free-fall cone into moistened and cured samples of the soil is measured. The plastic limit (PL) is the moisture content of the soil at the point that its behaviour passes from a plastic solid to a brittle solid. This point is measured according to clause 5.3 and is the point at which a thread of the soil rolled to 3 mm diameter begins to crumble.

Together the Atterberg limits can be used to define the plastic range of the soil. The plasticity index (PI) is the difference between the liquid and plastic limit and is broadly



correlated to the engineering behaviour of the soil. When used with the natural moisture content of the soil they can also give an indication of its in situ condition.

3.2.3 Determination Of The Undrained Shear Strength In Triaxial Compression Without Measurement Of Pore Pressure

The undrained shear strength of the soil was measured, as stated in BS 1377: Part 7: 1990: clause 8, by axial compression of 70 mm diameter cylindrical specimens cut from the U70 undisturbed samples. The nature of the test is such that no change in moisture content of the specimen is allowed during shear.

The theory of behaviour of saturated clay materials in undrained shear failure gives that the strength will not be influenced by the confining pressure such that the measured angle of internal friction for the material will apparently be equal to zero. Experience has shown that this is true only for samples of unweathered heavily overconsolidated pure clays. Where the material is weathered or it contains a significant granular content a plastic rather than a brittle failure develops which produces a strain hardening during shear. In this situation measurable apparent undrained angle of internal friction is produced. A similar situation develops in partially saturated materials. The test results are also influenced by sample variation, and in particular the presence of natural fissures or inclusions within the sample.

The use of large diameter specimens is preferred as this compensates for the scale effects of random features in smaller specimens. One of two tests are carried out according to the soil characteristic. Unweathered specimens of heavily overconsolidated clays which have a brittle failure in shear are tested in a single stage. The confining pressure is taken as the total overburden pressure of the sample in situ. It is then failed by axial compression and the measured deviator stress reported as the apparent undrained cohesion. Specimens of weathered clay or the clays with granular contents are tested in a multistage manner according to BS 1377: Part 7: 1990: clause 9.

The test procedure is similar to the single stage but at the point that failure begins the confining pressure is increased and the specimen compressed for a further 2% of vertical strain at which point the confining pressure is again increased and held for a further 2% strain. The deviator stresses at each of the confining pressures are used to plot the Mohr



envelope and the apparent undrained cohesion and if appropriate the undrained angle of internal friction.

3.2.4 Sulphate content and pH value

In order to aid the evaluation of any aggressive tendency of the subsoil or groundwater to buried concrete the pH and soluble sulphate of a number of samples were determined using in-house procedures based on British Standard methods. The pH of a groundwater sample, or a soil suspension was determined electrometrically according to BS 1377: Part 3: 1990: clause 9.5. For the sulphate analysis, soil and groundwater samples were prepared in general accordance with BS 1377: Part 3: 1990: clause 5.3. The soil extract was analysed by optical emission spectrometry (ICP-OES), with the prepared water sample analysed by photometric analysis following precipitation with barium chloride. The total sulphate of a soil was measured on a filtrate following digestion of the soil by 10% hydrochloric acid, and tested according to clause 5.5.

3.2.5 Total Sulphur Content

To aid the evaluation of aggressive tendency of the subsoil to buried concrete as a result of its pyritic potential, the total potential sulphate content can be determined from the relationship between the total (acid soluble) sulphate content and the amount of total sulphur present. The total sulphur content is determined by a laboratory in-house method based on BS 1377: Part 3: 1990 and Methods for the Examination of Waters and Associated Materials (MEWAM) (Environment Agency, 2006).

A dried portion of the soil is extracted at 115 °C for 75 minutes using 100% aqua regia and potassium bromate/bromide oxidizing mixture. The principle of this digest is to oxidize all sulphur to sulphate, and use the aqua regia acid mixture to digest the sample. The resultant digest solution is then filtered and analysed by ICP-OES. The results are expressed as % S, and include water soluble and acid soluble sulphates and total reduced sulphur, as well as insoluble sulphates and organic sulphur.

3.2.6 Waste Acceptance Criteria testing

Waste Acceptance Criteria (WAC) assessment was undertaken to assist with waste characterisation and disposal of excavated materials. Waste materials fall into three categories, namely 'inert', 'non-hazardous' and 'hazardous', with each category defined by leaching limit values for acceptance at the relevant landfill site. Leaching is carried



out with a liquid/solid ratio of 2:1 and 8:1, where feasible, and then the 10:1 is determined. The components analysed are arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, lead, antimony, selenium, zinc, chloride, fluoride, sulphate, together with dissolved organic carbon and total dissolved solids; phenols are only relevant to the inert waste category.

Additionally, the inert classification requires the determination of BTEX (a combination of the volatile organic hydrocarbons defined above), polychlorinated biphenyls (total of the EC7 PCBs), mineral oil (in the C10 to C40 range), and polycyclic aromatic hydrocarbons. These suites of tests are not required for the non-hazardous and hazardous categories. pH is determined for non-hazardous waste acceptance and loss on ignition for the hazardous class, while the acid neutralisation capacity is measured for both, and total organic carbon for all three.



4. DISCUSSION

4.1 SITE DESCRIPTION

The site was accessed from Gilmorton Road, next to Lutterworth Medical Centre.

The existing fire station was a modern two-storey brick structure. The footprint of the proposed extension lay within a car park adjacent to the north-western wall of the existing fire station. The site was generally flat and level at around 123 m aOD.

A cursory examination of publicly available online historical Ordnance Survey mapping¹ reveals that the site was previously used for allotment gardens prior to the development of a fire station and ambulance station off Gilmorton Road during the latter part of the twentieth century. Aerial imagery² shows the existing fire station was built sometime between 2002 and 2006.

4.2 GENERAL GEOLOGY

Geological mapping for the area by the British Geological Survey (BGS, 2017) indicated a solid geology of Blue Lias Formation overlain by superficial deposits of Glacial Till.

The superficial deposits of **Glacial Till** are typically cohesive and comprise, in the unweathered state, a bluish grey variably sandy and silty clay containing abundant flint and chalk gravel. Other gravel lithologies may also be found and fine-grained sandstone may be present within the matrix of the till. At surface the till may be decalcified, weathering to yellowish brown or brownish grey with a noticeable absence of chalk.

The whole is generally stiff with apparent high degrees of overconsolidation, although it may contain or overlie other glacial materials which can be very much softer. Glacial materials are irregular in deposition so that extrapolation is not always reliable. Beds of sand and gravel may be found within or above the general sequence and can often be water bearing.

¹ www.old-maps.co.uk

² Google Earth



The **Blue Lias Formation** is a heavily overconsolidated clay of the Jurassic and Triassic Periods, laid down in a quiet marine environment. It is generally bluish grey in colour and comprises thinly interbedded limestones and calcareous mudstones or siltstones. It weathers to surface and becomes brown and grey mottled in colour and reduces in consistency to firm clay.

4.3 SITE GEOLOGY AND GEOTECHNICAL CONDITION

4.3.1 Soils

The investigation proved a differing sequence of deposits within the two exploratory holes but in general accordance with the BGS mapping and the natural soils are considered to represent a sequence of glacial deposits over clay of the Blue Lias Formation.

Made ground was found at both locations. At the location of WS01, made ground was found to 0.7 m bgl and comprised slightly gravelly sand with varying amounts of clay. At the location of WS02 and underlying a surface covering of tarmacadam, made ground was found to 2.3 m depth. This initially comprised dark brown slightly silty very gravelly sand with fragments of brick and clinker. From 0.6 m bgl, the made ground comprised dark brown slightly sandy granite gravel which was believed to be part of a soakaway. A single SPT within this gravel returned an N-value of 7, suggesting a loose condition.

Underlying the made ground at the location of WS01, was brown and black mottled slightly sandy clay with occasional flint gravel. The clay was assessed to be in a firm condition. Atterberg limit testing indicated the clay to be of intermediate plasticity, with a plasticity index of 21%. A single laboratory undrained shear strength test gave a result of 21 kNm⁻², which is less than the field strength assessment. The clay gave way to firm dark brown fibrous peat which was proved to 2.6 m depth. A band of slightly clayey slightly gravelly sand was encountered roughly mid-way within the sequence of peat. Peat deposits are not normally expected within glacial till but typically form within hollows left by the retreating ice sheet. A single SPT carried out across the band of sand but mostly within the peat returned an N-value of 21, suggesting a medium dense condition for the sand.



Cohesive soils, comprising greyish brown or grey clay with occasional flint and chalk gravel were found to underlie the made ground at the location of WS02 and were proved to the depth of the investigation at 4.45 m bgl. These are also considered to be glacial deposits. The clay was assessed to be in a firm condition, becoming stiff with depth. A single laboratory undrained shear strength test gave a result of 80 kNm^{-2} , which is consistent with the field strength assessment. A single SPT carried out wholly within this clay returned an N-value of 19. It is possible to roughly correlate the SPT N-value with undrained shear strength (C_u) based on work by Stroud (1989), who proposed the following relationship:

$$C_u = f_1 \cdot N$$

Where,

f_1 is a factor dependant on plasticity

The generic range for f_1 commonly adopted is 4.5 to 5.5 (Norbury, 2010). Adopting a conservative multiplication factor of 4.5, this estimates that the undrained shear strength of 82 kNm^{-2} is consistent with the field strength assessment and laboratory testing. However, this relationship should be used with caution given the limited data set on which it is based.

Underlying the peat, at the location of WS01, a thin layer of mudstone was found to overlie dark grey clay with occasional mudstone fragments. This is considered to represent the Blue Lias Formation. The clay was assessed to be in a stiff condition. A single laboratory undrained shear strength test gave a result of 57 kNm^{-2} , which is less than the field strength assessment.

4.3.2 Existing foundations

TP01 was excavated to examine the foundations of the existing building. Details are provided on drawing 17.387/TP01 which is appended.

TP01 was excavated adjacent to the brick wall. The brick wall was constructed upon a 0.25 m thick concrete foundation the top of which was recorded at 0.35 m depth and extended out from the wall by 0.40 m.



Made ground was initially recorded, overlying firm brown and grey mottled slightly sandy gravelly clay, extending below the foundation.

4.3.3 Chemical Considerations

Risks to construction materials can be assessed using the sulphate and pH results according to the recommendations of Building Research Establishment Special Digest 1 (BRE, 2005). These analyses were undertaken in order to evaluate any aggressive tendency of the soil and can be summarised as follows:

- pH values between 6.2 and 8.0
- water soluble sulphate (SO_3) concentrations from 0.02 to 2.64 g l^{-1} .
- acid soluble sulphate (SO_4) values of 0.13 and 0.78%
- total sulphur values of 0.59 and 1.3%.

The sulphur determinations were made to complement the sulphate testing according to the recommendations of Building Research Establishment Special Digest 1 (BRE, 2005). This establishes if a material is pyritic and uses a relationship between total sulphur, acid soluble and water soluble sulphate, and total potential sulphate (TPS), to determine whether it is necessary to increase the Design Sulphate (DS) class. The samples tested produced oxidisable sulphides above the 0.3% trigger concentration, suggesting that the materials contain pyrites.

4.3.4 Groundwater

A slow to moderate inflow of groundwater was recorded during fieldwork at 2.6 m bgl within WS01 at the base of the sequence of peat, this rose to 2.25 m bgl within twenty minutes. Seepages were also encountered within WS02 at 2.0 m.

However, any groundwater observations reported during fieldwork will have been affected by the permeability of the ground, the rate of progress of the hole and the techniques applied. The general procedures used during sampling do not allow precise measurements of the groundwater conditions, but give only a general guide to the overall situation. Fluctuations in any groundwater table will occur as a result of seasonal or climatic effects.



5. ENGINEERING INTERPRETATION

It is proposed to extend the existing Lutterworth Fire and Rescue Station. The proposed layout and sections are shown on a drawing supplied by the client (referenced DC/P/37/2016/101 and dated 13 February 2017), which is appended.

The comments and recommendations contained in the report are based on the data obtained from the relevant exploratory holes, field tests and associated laboratory testing. Extrapolation between and to other parts of the site is considered within the light of the geological setting as interpreted, but no responsibility can be accepted for varying geological and geotechnical conditions from those on which the report is based. It should be noted that the solutions are discussed in principle only based on the design requirements as understood.

5.1 FOUNDATIONS

5.1.1 General

The investigation proved a differing sequence of deposits within the two exploratory holes. Made ground was found to overlie a mixed sequence of glacial soils including peat, clay and sand overlying stiff clay of the Blue Lias Formation.

Groundwater seepages were noted within the made ground and inflow was encountered at 2.6 m bgl within WS01, coincident with the base of the peat.

5.1.2 Shallow foundations

It is understood that a shallow mass concrete foundation is preferred.

It is recommended that the structural loads are transferred through the made ground and peat and founded in stiff grey clay of the Blue Lias Formation or Glacial Till at least 2.6 m depth.

For a mass concrete foundation, general bearing capacity theory gives that for cohesive soils the allowable bearing stress increase over the overburden pressure at founding depth q_a is:



$$q_a = \frac{1}{F} (N_c \times C_u)$$

where;

- N_c is a bearing capacity factor related to footing geometry
- C_u is the undrained shear strength of the stressed soil
- F is a factor of safety against bearing capacity failure

Thus, for an undrained shear strength of 75 kNm⁻² taken for a borderline firm/stiff clay, the allowable bearing stress increase, with a factor of safety of 3 would be:

$$\begin{aligned} q_a &= \frac{1}{3} (6.1 \times 75) \\ &= 152.5 \text{ kNm}^{-2} \end{aligned}$$

It is generally accepted that in stiff clays, settlements are of an acceptable order of magnitude if bearing capacity is controlled by a suitable factor of safety. It should be noted that a conservative value for the bearing capacity factor N_c has been adopted in this approach.

5.1.1 Piled Foundations

Alternatively, the use of piled foundations would conveniently carry the structural loads to greater depth in order to mitigate the uncertainty of the upper soils. The ground conditions encountered lend themselves to the construction of either bored or driven pile systems, although it would be necessary to confirm the ground conditions to a depth greater than the finished depth of the piles.

Some guidance is presented on the most likely piling systems that may be considered, with the relative advantages and disadvantages discussed below.

Traditional **bored systems** would require temporary casing to be taken through the made ground and loose soils.

Driven systems would not be affected by the poor ground conditions and groundwater inflow, however, they can suffer restrictions imposed by increased amounts of associated



noise and vibration when piling through the denser granular material. Vibrations could affect nearby buildings, including any existing piles.

A number of the advantages of bored and driven methods are combined in **auger injected pile systems** in which the concrete or grout is placed down the hollow stem of a continuous flight auger (CFA). In particular, these do not require the use of temporary casing and do not develop excessive vibration. However, they are sensitive to construction technique and it would be essential to ensure that adequate supervision and control is employed to prevent defects developing in the pile.

5.2 EXCAVATIONS

Variable ground conditions were found, including made ground of 'loose' gravel. Excavations through the made ground are considered unlikely to remain freestanding for even limited periods and will require a suitable batter or sidewall support.

Excavations within natural soils are likely to remain stable in the short-term but for deeper excavations, positive support measures will be required for men to work in close proximity of the sidewalls. The nature of the peat and clay should provide temporary stability sufficient to allow the installation of the support after the formation levels are attained and it could be possible to use traditional open boarded support, or if land take allows this need for support could be reduced if the sidewalls are battered to improve their stability.

Groundwater seepages should be anticipated particularly where sandier soil or rock is encountered. Provision should be made to control seepages and surface run-off, in order to maintain adequately dry conditions for work.

5.3 FLOOR SLABS

Due to the presence of made ground and peat, ground floor slabs are recommended to be suspended with a ventilated void and damp proof membrane (DPM) provision.



5.4 BURIED CONCRETE

Specific chemical analyses were undertaken in order to evaluate any aggressive tendency of the subsoil to buried concrete.

The amount of oxidisable sulphides has been determined within the natural soil (see Section 4.3.3) and this indicates that pyrite is probably present.

For **undisturbed** soils, the pH results indicate acidic to slightly alkaline conditions, while the sulphate results correspond with a design sulphate class of **DS-3** according to Building Research Establishment Special Digest 1 (BRE, 2005). For concrete in contact with **disturbed ground** the design sulphate class takes into account the total potential sulphate (TPS) present. The samples tested had TPS in excess of 2.4 %, indicating a design sulphate class of DS-5. However, as the design sulphate class based on the water extract was much lower (DS-3), this can be limited to **DS-4**.

The Digest defines disturbed ground as soils substantially disturbed by cutting and filling or by excavation and backfilling. Simply cutting through the ground without opening up the ground beyond the cut face (e.g piling operations or excavations without backfill) is not considered to result in disturbed ground.

It is also necessary to take into account other factors related to the environment into which the concrete is placed i.e. the pH of the deposits and the mobility of the groundwater table. An ACEC (aggressive chemical environment for concrete) class can then be assigned. Groundwater was encountered during fieldwork, so groundwater seepages are possible. The pH values show that an ACEC classification of **AC-5** is appropriate for buried concrete in contact with disturbed soils. This may be reduced to **AC-4** where the ground is undisturbed.

5.5 WASTE MANAGEMENT AND DISPOSAL

The legislative regime on waste seeks to minimise the amount of material taken to landfill by actively requiring re-use, or improving it by further processing. However, if it is considered that there is no practical option for re-using the spoil, consideration needs to



be given to disposal. In these circumstances, the waste generator is required to establish the nature and character of the materials to the satisfaction of the waste receiver.

If the excavated arisings are to be removed from site and taken to landfill the waste receiver may require details of the waste classification, as well as waste acceptance criteria (WAC) to assist with the provision of the appropriate classification. The main categories for disposal are 'inert waste landfill', 'stable non-reactive hazardous waste in non-hazardous landfill', and 'hazardous waste landfill'.

The WAC analyses of the sample of **natural soil** show that the concentrations of all the determinands were below the leaching limits for waste acceptance at landfill for 'inert waste'. Total organic carbon, BTEX, polychlorinated biphenyls, mineral oil (as total petroleum hydrocarbons in the C10 to C40 range) and polycyclic aromatic hydrocarbons also fell into this category. pH is within the acceptable limit for 'non hazardous waste', while loss on ignition is within its acceptability range.

The sample of **made ground** reported a total petroleum hydrocarbon concentration of 2800 mg/kg which exceeds the criteria for inert waste of 500 mg/kg. Otherwise the analysis showed concentrations of all the determinands were below the leaching limits for waste acceptance at landfill for 'inert waste'. Total organic carbon, BTEX, polychlorinated biphenyls and polycyclic aromatic hydrocarbons also fell into this category. pH is within the acceptable limit for 'non hazardous waste', while loss on ignition is within its acceptability range.

The natural soils should be acceptable as inert waste but the made ground may not. Ultimately, it will be the decision of the landfill operator to make the judgement based on all the available data.



6. SUMMARY

1. A ground investigation was undertaken at Gilmorton Road, Lutterworth, where it is proposed to extend the existing Lutterworth Fire and Rescue Station.
2. The investigation proved a differing sequence of soils within the two exploratory holes. Made ground was found to overlie a mixed sequence of glacial soils including peat, clay and sand over stiff clay of the Blue Lias Formation.
3. Groundwater seepages were noted within the made ground and inflows were encountered at 2.6 m bgl within WS01, coincident with the base of the peat.
4. It is recommended that the structural loads are transferred through the made ground and peat and founded in stiff clay at least 2.6 m deep. An allowable bearing capacity of about 150 kNm^{-2} would be appropriate in the natural cohesive soils at this depth.
5. As an alternative to a shallow foundation and to mitigate the uncertainty of the upper soils, consideration could be given to the use of a piled foundation, although it would be necessary to confirm the ground conditions to a depth greater than the finished depth of the piles.
6. Excavations through the made ground are considered unlikely to remain freestanding for even limited periods and will require a suitable batter or sidewall support. Excavations within natural soils are likely to remain stable in the short-term. Groundwater should be anticipated particularly where sandier soil or rock is encountered.
7. Due to the presence of made ground and peat, ground floor slabs are recommended to be suspended with a ventilated void and damp proof membrane (DPM) provision.
8. A design sulphate class of DS-3 and an ACEC classification of AC-4 can be adopted for buried concrete within undisturbed soils. For disturbed soils, the design sulphate class should be increased to DS-4 with an ACEC classification of AC-5.
9. WAC analysis has shown that the natural soils should be acceptable as inert waste but the made ground may not. The concentration TPH within the made ground exceeded the criteria for inert waste. Ultimately, it will be the decision of the landfill operator to make the judgement based on all the available data.

M S Horne
BSc (Hons) MSc FGS

Dr A F Howland
MSc PhD DIC CEng FIMMM CGeol FGS

A F HOWLAND ASSOCIATES
10 November 2017



A F Howland Associates
Geotechnical Engineers

APPENDIX A: REFERENCES

BRITISH GEOLOGICAL SURVEY. 2017. OpenGeoscience web site. Geology of Britain Viewer. www.bgs.ac.uk/opengeoscience

BRITISH STANDARDS INSTITUTION.(BSI) 2015a. BS 5930:2015. Code of practice for ground investigation. British Standards Institution. London.

BRITISH STANDARD INSTITUTION (BSI). 2015b. BS 8002:2015 Code of practice for earth retaining structures. BSI. London

BRITISH STANDARDS INSTITUTION (BSI). 1990. BS 1377: Methods of test for Soils for engineering purposes. British Standards Institution, London.

BRITISH STANDARDS INSTITUTION (BSI). 2007. Eurocode 7 – Geotechnical Design. Part 2: Ground investigation and testing. British Standards Institution. London.

BUILDING RESEARCH ESTABLISHMENT. 2005. BRE Special Digest 1: 2005 Concrete in aggressive ground. Building Research Establishment, London.

ENVIRONMENT AGENCY. 2006. The determination of metals in solid environmental samples. Methods for the Examination of Waters and Associated Materials.

NORBURY, D. 2010. Soil and rock description in engineering practice. Whittles. Scotland.

STROUD, M. A. (1989) The standard penetration test - its application and interpretation. In Nixon, I. K. (Eds) Penetration testing in the UK: Proceedings of the geotechnology conference organised by the institution of civil engineers and held in Birmingham on 6-8 July 1988. Thomas Telford.



APPENDIX B: WINDOW SAMPLING RECORDS

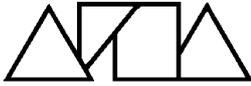
L	Plastic liner
B	Bulk disturbed sample
D	Small disturbed sample
U	Nominal 70 mm diameter undisturbed open tube sample
ES	Environmental sample
SPT	Standard penetration test using a split spoon sampler. N Value is uncorrected, but the hammer energy ratio is given in the remarks.
IP xx	Initial penetration during the SPT recorded in millimetres. If initial penetration equals or exceeds 450 mm the test is aborted.
S x,x	SPT seating drive blow count given by the summation of the blows 'X' required to drive the seating length
T x,x,x,x	SPT test drive blow count 'N' given by the summation of the blows 'X' required to drive the seating length (300 mm)
X*Y	Incomplete standard penetration test where the seating/test drive could not be completed. The blows 'X' represent the total blows for the given length of seating drive 'Y' (mm)
<u>dd/mm/yy: 1.0</u>	Date, water level at the window sample hole depth at the end of shift
dd/mm/yy: dry	and the start of the following shift

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions compiled by visual examination of liner samples obtained after BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015 and modified in accordance with laboratory test results where applicable





A F Howland Associates

Geotechnical Engineers

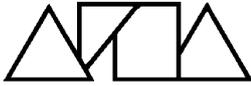
Site
Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Number
WS01

Excavation Method Tracked Window Sampling Rig, Dando Terrier 2002.	Dimensions 102mm to 2.00m 75mm to 3.00m	Ground Level (mOD) 123.46	Client Leicestershire Fire and Rescue Service	Job Number 17.387
	Location 454548 E 284691 N	Dates 03/10/2017	Engineer Michael Aubrey Partnership Limited	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water				
0.10-0.20	D1	DRY	10 blows	123.16	(0.30)	MADE GROUND (Dark brown clayey slightly gravelly fine sand. Gravel is rounded to subangular fine to medium flint. Frequent fragments of brick and ceramic)						
0.40-0.60	D2				(0.40)	MADE GROUND (Dark brown and brown mottled very clayey slightly gravelly sand. Gravel is rounded medium to coarse flint. Occasional fragments of brick)						
0.50	ES1				122.76	0.70	Firm brown and black mottled slightly sandy slightly gravelly CLAY. Gravel is rounded fine to coarse flint					
0.80	ES2				(0.75)	... becoming brown, black and off-white mottled sandy slightly gravelly CLAY. Gravel is rounded fine to coarse flint. With sand pockets.						
0.80-0.90	D3											
1.10-1.20	D4											
1.20-1.65	U1				DRY	IP 50/S 2,3	122.01	1.45	Firm dark brown fibrous PEAT			
1.20-2.00	L1							(0.55)	Firm dark brown fibrous PEAT. With sand pockets			
1.50-1.70	D5											
1.90-2.00	D6							121.46	2.00	Brown and grey mottled slightly clayey slightly gravelly medium SAND. Gravel is subangular fine to medium flint		
2.00-2.50	SPT	T 4,6,5,6	Moderate / Slow(1) at 2.60m, rose to 2.25m in 20 mins, not sealed.	121.31				(0.15)	Dark grey slightly sandy subangular to angular thinly laminated mudstone GRAVEL			
2.00-2.15	D8							2.15			Stiff dark grey CLAY. With occasional subangular gravel size fragments of mudstone	
2.00-2.45	D7							(0.45)			Complete at 3.45m	
2.00-3.00	L2											
2.20-2.30	D9	120.86	2.60	Complete at 3.45m								
2.50-2.60	D10	120.79	(0.07)									
2.60-2.67	D11	2.35	20 blows	120.01	(0.78)	Complete at 3.45m						
2.67-3.00	D12											
3.00-3.45	U2		03/10/2017:2.35m		3.45	Complete at 3.45m						

Remarks 1. Location CAT scanned prior to excavation. 2. Hand dug inspection pit to 1.20 m. 3. Groundwater struck at 2.60 m and rose to 2.33 m in 5 mins., 2.28 m in 10 mins., 2.26 m in 15 mins. and 2.25 m in 20 mins. 4. SPT Hammer Energy Ratio = 70.73%	Scale (approx)	Logged By
	1:25	TEB
	Figure No. 17.387.WS01	



A F Howland Associates Geotechnical Engineers

Site
Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Number
WS02

Excavation Method Tracked Window Sampling Rig, Dando Terrier 2002.	Dimensions 87mm to 3.00m 75mm to 4.00m	Ground Level (mOD) 123.29	Client Leicestershire Fire and Rescue Service	Job Number 17.387
	Location 454550 E 284702 N	Dates 03/10/2017	Engineer Michael Aubrey Partnership Limited	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.40 0.40-0.60	ES1 D1	DRY	IP 0/S 1,1 T 1,1,3,2	123.19	(0.10) 0.10	TARMACADAM		
						(0.50)		
1.00-1.20	D2	2.00	Slow(1) at 2.00m, rose to 1.98m in 20 mins, sealed at 3.00m. IP 0/S 5,5 T 3,3,3,3	122.69	0.60	MADE GROUND (Loose dark brown slightly sandy subangular to subrounded fine to coarse granite gravel) (possible soakaway)		
1.20-1.65 1.20-1.65 1.20-2.00	SPT N=7 D3 L1			(1.70)				
1.70-2.00	D4				... becoming brown			
2.00-2.30 2.00-3.00	D5 L2	2.00	Slow(1) at 2.00m, rose to 1.98m in 20 mins, sealed at 3.00m. IP 0/S 5,5 T 3,3,3,3	120.99	2.30	Firm greyish brown slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse flint		
2.45-2.60	D6			(1.10)	... becoming grey and dark grey mottled			
2.70 2.75-3.00	ES2 D7	DRY	24 blows			... becoming stiff		
3.00-3.45 3.00-4.00	U1 L3							
3.40-3.60	D8	DRY	IP 0/S 2,2 T 3,4,4,8	119.89	3.40	Stiff grey slightly gravelly CLAY. Gravel is subangular fine to medium flint and subrounded fine to medium chalk		
3.80-4.00	D9			(1.05)				
4.00-4.45 4.00-4.45	SPT N=19 D10		03/10/2017:DRY	118.84	4.45	Complete at 4.45m		

Remarks 1. Location CAT scanned prior to excavation. 2. Hand dug inspection pit to 1.20 m. 3. Groundwater struck at 2.00 m and rose to 1.98 m in 5 mins., 1.90 m in 10 mins., 1.98 m in 15 mins. and 20 mins. 4. SPT Hammer Energy Ratio = 70.73% 5. No sample recovery for SPT at 2.0 - 2.45 m	Scale (approx)	Logged By
	1:25	TEB
	Figure No. 17.387.WS02	

APPENDIX C: TRIAL PIT RECORD AND SECTION

KEY

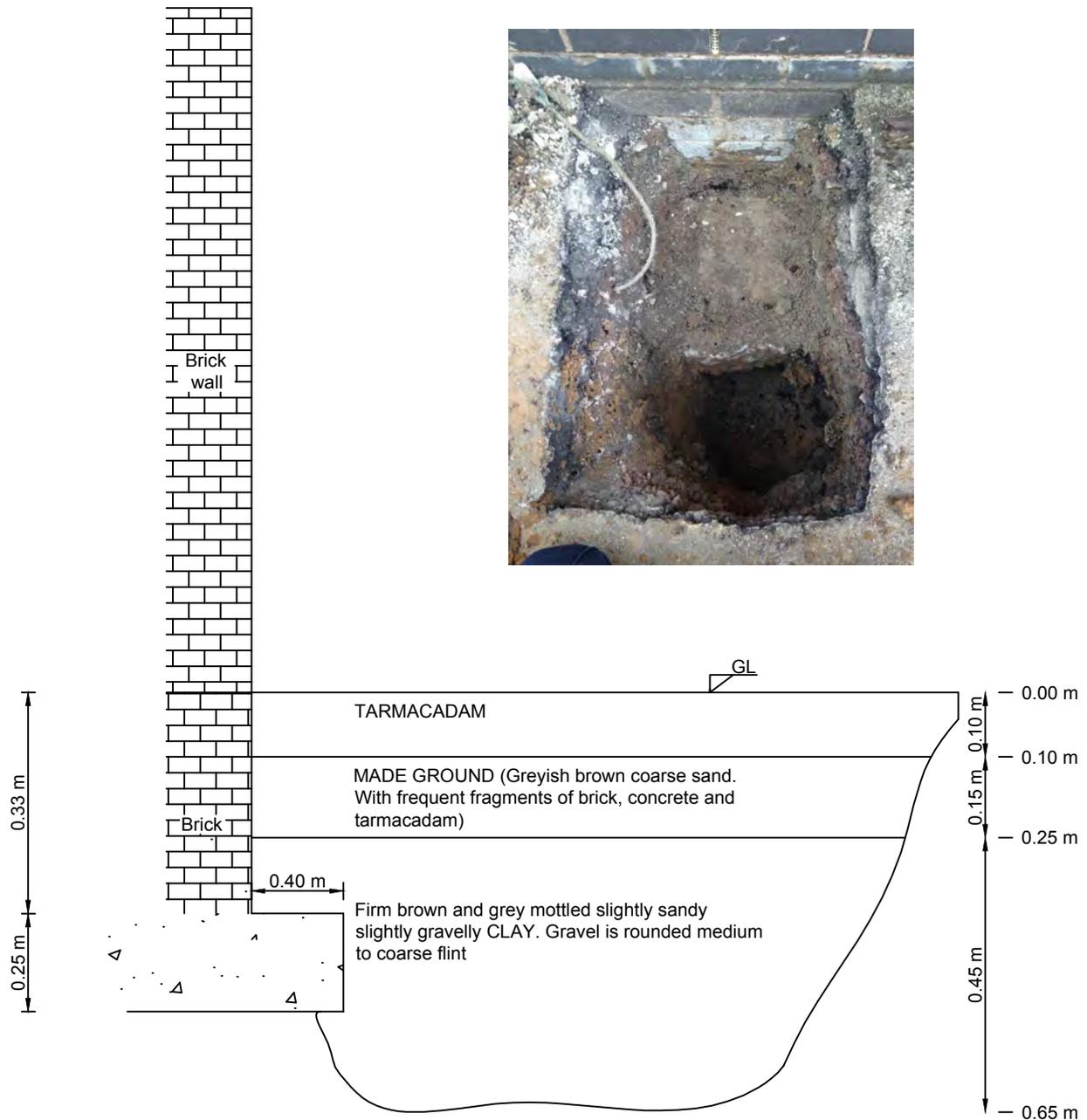
- B** Bulk disturbed sample
- D** Small disturbed sample
- ES** Environmental disturbed sample

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions compiled by visual examination of liner samples obtained after BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015 and modified in accordance with laboratory test results where applicable





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Geotechnical Engineers

Site: Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Diagrammatic Cross Section of Trial Pit (TP01)

Client : Leicestershire Fire and Rescue Service

Date : November 2017

Dwg : 17.387/TP01

Not to Scale

APPENDIX D: LABORATORY TESTING

Natural moisture content

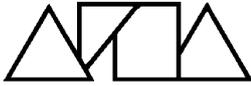
Atterberg limits

Undrained shear strength in triaxial compression without measurement of pore pressure

Sulphate content, total sulphur and pH value

Waste acceptance criteria testing





Site : Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Client : Leicestershire Fire and Rescue Service

Engineer : Michael Aubrey Partnership Limited

Job Number
17.387

Sheet
1 / 1

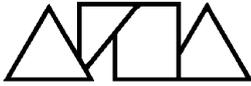
**DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT
AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX**

Borehole/ Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Group Symbol	Laboratory Description
				Percentage %	Moisture Content %						
WS01	0.80	D3	23	83	27	43	19	24	0.33	CI	Mottled orange brown and grey slightly sandy slightly gravelly CLAY with rare black staining.
WS01	2.60	D11	70	15	465		NP				Black silty GRAVEL (Carbon)

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3 Determination of moisture content 1990:4 Determination of the liquid limit BS 1377:PART 2:1990:5 Determination of the plastic limit and plasticity index

Remarks :



Site : Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Client : Leicestershire Fire and Rescue Service

Engineer : Michael Aubrey Partnership Limited

Job Number
17.387

Sheet
1 / 1

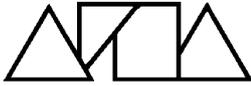
**DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH
IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE**

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kN/m ²)	Deviator Stress (kN/m ²)	Apparent Cohesion (kN/m ²)	Angle of Shearing Resistance (degrees)	Laboratory Description
WS01	1.20	U1	30	2.05	1.58	12 24 48	57 64 77	21	12.5	Soft black organic CLAY becoming light brown very sandy gravelly CLAY.
WS01	3.00	U2	39	1.84	1.32	60	115	57		Firm fissured black silty CLAY
WS02	3.00	U1	28	2.16	1.69	30 60 120	167 170 173	80	1.5	Stiff fissured dark grey silty CLAY with rare fine gravel

Method of Preparation : BS 1377:PART 1:1990:7.4.2 Moisture content 1990: Preparation of undisturbed samples for testing BS 1377:PART 2:1990:7.2

Method of Test : BS 1377:PART 2:1990:3 Determination of moisture content 1990:7 Determination of density BS 1377:PART 7:1990:8 Undrained shear strength 1990:9 Multistage loading

Remarks :



Site : Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

Job Number
17.387

Client : Leicestershire Fire and Rescue Service

Sheet
1 / 1

Engineer : Michael Aubrey Partnership Limited

DETERMINATION OF pH, SULPHATE CONTENT AND TOTAL SULPHUR OF SOIL AND GROUNDWATER

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Total Sulphur %	Percentage of sample passing 2mm Sieve %	pH	Classification	Laboratory Description
			Soil		Groundwater g / l					
			Total S04 %	S03 in 2:1 water:soil g / l						
WS01	1.10	D4		0.02			8.0	DS-1	Clay	
WS01	1.50	D5	0.13	0.25		0.59	6.9	DS-1	Peat	
WS01	2.20	D9	0.78	2.20		0.84	5.7	DS-3	Peat	
WS01	2.67	D12	0.35	2.03		1.30	6.2	DS-3	Clay	
WS02	2.70	ES2		0.19			7.5	DS-1	Clay	

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : Laboratory in-house methods based on BS1377: Part 3 for contents of water soluble sulphate, total sulphate and pH. Laboratory in-house method based on MEWAM (Environment Agency, 2006) for total sulphur

Remarks : Classification relates to Design Sulphate Class of BRE Special Digest 1 (2005)



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Certificate of Analysis

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 687593-1 WAC

Date of Report: 18-Oct-2017

Customer: A F Howland Associates
The Old Exchange
Newmarket Road
Cringleford
Norwich
NR4 6UF

Customer Contact: Ms Gill Bond

Customer Job Reference: GNB/17.387/00/02

Customer Purchase Order: GNB/17.387/00/02

Customer Site Reference: Site 2 - Lutterworth Fire and Rescue
Station, Lutterworth, LE17 4NG

Date Job Received at Concept: 06-Oct-2017

Date Analysis Started: 11-Oct-2017

Date Analysis Completed: 18-Oct-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



Report checked
and authorised by :
Aislinn Arthey
Customer Service Advisor

Issued by :
Aislinn Arthey
Customer Service Advisor

Waste Acceptance Criteria

Customer Sample Reference : WS01 ES2 @ 0.80m

SAL Sample Reference : 687593 001

Project Site : Site 2 - Lutterworth Fire and Rescue Station,
Lutterworth, LE17 4NG

Customer Reference : GNB/17.387/00/02

Test Portion Mass (g) : 175

Date Sampled : 03-OCT-2017

Matrix Class : Clay

Soil Summary						Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol					
pH	Probe			M		8.0		>6.0	
Loss on Ignition @450C	Ign @450C/Grav	0.1	%	M		4.1			10.0
Total Organic Carbon	OX/IR	0.1	%	N		0.7	3.0	5.0	6.0
Acid Neutralising Capacity (pH 7)	Titration	2.0	Mol/kg	N		<2.0			
BTEX (Sum)	Calc	0.040	mg/kg	U		<0.040	6.0		
Coronene	GC/MS (MCERTS)	0.1	mg/kg	N		<0.1			
PAH (Sum)	Calc	1.6	mg/kg	N		<1.6	100.0		
TPH (C10-C40)	GC/FID (SE)	10	mg/kg	M		(13) <10	500.0		
PCB EC7 (Sum)	Calc	0.00035	mg/kg	N		<0.14	1.0		
Moisture @105C	Grav (1 Dec) (105 C)	0.1	%	N		17			
Retained on 2mm	Grav	0.1	%	N		2.3			

10:1 Leachate							Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Units	2:1	8:1	LOD	Units	Symbol				
Antimony (Dissolved)	ug/l	1	2	0.010	mg/kg	N	0.017	0.06	0.7	5.0
Arsenic (Dissolved)	ug/l	1.3	4.6	0.0020	mg/kg	N	0.042	0.5	2.0	25.0
Barium (Dissolved)	ug/l	19	12	0.010	mg/kg	N	0.13	20.0	100.0	300.0
Cadmium (Dissolved)	ug/l	<0.02	0.03	0.00020	mg/kg	N	0.00026	0.04	1.0	5.0
Chloride	mg/l	3	2	10	mg/kg	N	24	800.0	15000.0	25000.0
Chromium (Dissolved)	ug/l	<1.0	<1.0	0.010	mg/kg	N	<0.010	0.5	10.0	70.0
Copper (Dissolved)	ug/l	1.7	2.7	0.0050	mg/kg	N	0.026	2.0	50.0	100.0
Dissolved Organic Carbon	mg/l	19	10	10	mg/kg	N	110	500.0	800.0	1000.0
Fluoride	mg/l	0.88	0.64	0.50	mg/kg	N	6.7	10.0	150.0	500.0
Lead (Dissolved)	ug/l	<0.3	1.3	0.0030	mg/kg	N	0.012	0.5	10.0	50.0
Mercury (Dissolved)	ug/l	<0.05	<0.05	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum (Dissolved)	ug/l	16	8	0.010	mg/kg	N	0.092	0.5	10.0	30.0
Nickel (Dissolved)	ug/l	<1.0	1	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Phenols(Mono)	mg/l	<0.02	<0.02	0.20	mg/kg	N	<0.20	1.0		
Selenium (Dissolved)	ug/l	1.4	0.7	0.0050	mg/kg	N	0.0081	0.1	0.5	7.0
SO4--	mg/l	4.0	0.8	5.0	mg/kg	N	11	1000.0	20000.0	50000.0
Total Dissolved Solids	mg/l	110	77	100	mg/kg	N	720	4000.0	60000.0	100000.0
Zinc (Dissolved)	ug/l	7	7	0.020	mg/kg	N	0.070	4.0	50.0	200.0

From: EC Directive 99/31/EC and Landfill Regulations 2002 (as amended)

Notes:- Cumulative release at L/S=10 (mg/kg of dry matter) in accordance with BS EN 12457. Soil leaching procedure is not covered by our UKAS accreditation

As detailed in- Waste Classification. Guidance on the classification and assessment of waste. Technical Guidance WM3:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427077/LIT_10121.pdf

Landfill WAC analysis (specifically leaching test results) should not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Waste Acceptance Criteria

Customer Sample Reference : WS02 ES1 @ 0.40m

SAL Sample Reference : 687593 006

Project Site : Site 2 - Lutterworth Fire and Rescue Station,
Lutterworth, LE17 4NG

Customer Reference : GNB/17.387/00/02

Test Portion Mass (g) : 175

Date Sampled : 03-OCT-2017

Matrix Class : Sandy Soil

Soil Summary						Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol					
pH	Probe			M		8.6		>6.0	
Loss on Ignition @450C	Ign @450C/Grav	0.1	%	M		4.4			10.0
Total Organic Carbon	OX/IR	0.1	%	N		2.7	3.0	5.0	6.0
Acid Neutralising Capacity (pH 7)	Titration	2.0	Mol/kg	N		<2.0			
BTEX (Sum)	Calc	0.040	mg/kg	U		<0.040	6.0		
Coronene	GC/MS (MCERTS)	0.1	mg/kg	N		(2) <0.3			
PAH (Sum)	Calc	1.6	mg/kg	N		<1.6	100.0		
TPH (C10-C40)	GC/FID (SE)	10	mg/kg	M		2800	500.0		
PCB EC7 (Sum)	Calc	0.00035	mg/kg	N		(2) <0.21	1.0		
Moisture @105C	Grav (1 Dec) (105 C)	0.1	%	N		5.6			
Retained on 2mm	Grav	0.1	%	N		54.9			

10:1 Leachate							Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Units	2:1	8:1	LOD	Units	Symbol				
Antimony (Dissolved)	ug/l	4	2	0.010	mg/kg	N	0.020	0.06	0.7	5.0
Arsenic (Dissolved)	ug/l	6.5	7.5	0.0020	mg/kg	N	0.074	0.5	2.0	25.0
Barium (Dissolved)	ug/l	22	13	0.010	mg/kg	N	0.15	20.0	100.0	300.0
Cadmium (Dissolved)	ug/l	<0.02	<0.02	0.00020	mg/kg	N	<0.00020	0.04	1.0	5.0
Chloride	mg/l	2	1	10	mg/kg	N	15	800.0	15000.0	25000.0
Chromium (Dissolved)	ug/l	<1.0	<1.0	0.010	mg/kg	N	<0.010	0.5	10.0	70.0
Copper (Dissolved)	ug/l	3.1	5.0	0.0050	mg/kg	N	0.046	2.0	50.0	100.0
Dissolved Organic Carbon	mg/l	14	10	10	mg/kg	N	110	500.0	800.0	1000.0
Fluoride	mg/l	0.23	0.15	0.50	mg/kg	N	1.7	10.0	150.0	500.0
Lead (Dissolved)	ug/l	4.1	3.5	0.0030	mg/kg	N	0.036	0.5	10.0	50.0
Mercury (Dissolved)	ug/l	<0.05	<0.05	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum (Dissolved)	ug/l	3	1	0.010	mg/kg	N	0.013	0.5	10.0	30.0
Nickel (Dissolved)	ug/l	<1.0	<1.0	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Phenols(Mono)	mg/l	<0.02	<0.02	0.20	mg/kg	N	<0.20	1.0		
Selenium (Dissolved)	ug/l	<0.5	<0.5	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
SO4--	mg/l	7.1	1.2	5.0	mg/kg	N	22	1000.0	20000.0	50000.0
Total Dissolved Solids	mg/l	82	48	100	mg/kg	N	480	4000.0	60000.0	100000.0
Zinc (Dissolved)	ug/l	5	4	0.020	mg/kg	N	0.039	4.0	50.0	200.0

From: EC Directive 99/31/EC and Landfill Regulations 2002 (as amended)

Notes:- Cumulative release at L/S=10 (mg/kg of dry matter) in accordance with BS EN 12457. Soil leaching procedure is not covered by our UKAS accreditation

As detailed in- Waste Classification. Guidance on the classification and assessment of waste. Technical Guidance WM3:

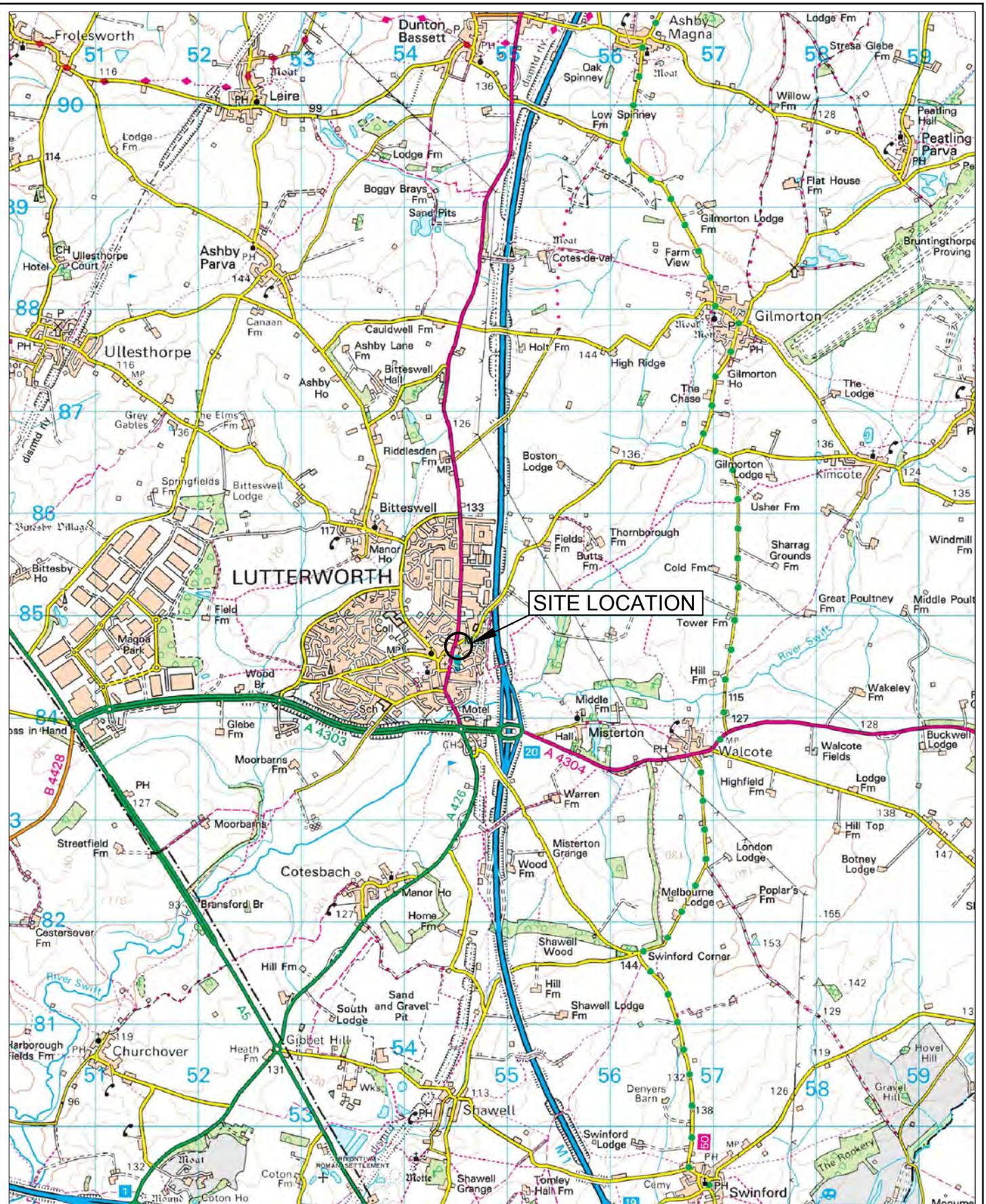
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427077/LIT_10121.pdf

Landfill WAC analysis (specifically leaching test results) should not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

APPENDIX E: DRAWINGS

Drawing 17.387/1	Site Location Plan
Drawing 17.387/2	Exploratory Hole Location Plan
Drawing 17.387/3	Nominal Section
Drawing DC/P/37/2016/101	Leicestershire Fire and Rescue Service Proposed Two Storey Extension





North



Circle indicates approximate location of site



A F Howland Associates
Geotechnical Engineers

Site: Lutterworth Fire and Rescue Station, Lutterworth, LE17 4NG

SITE LOCATION PLAN

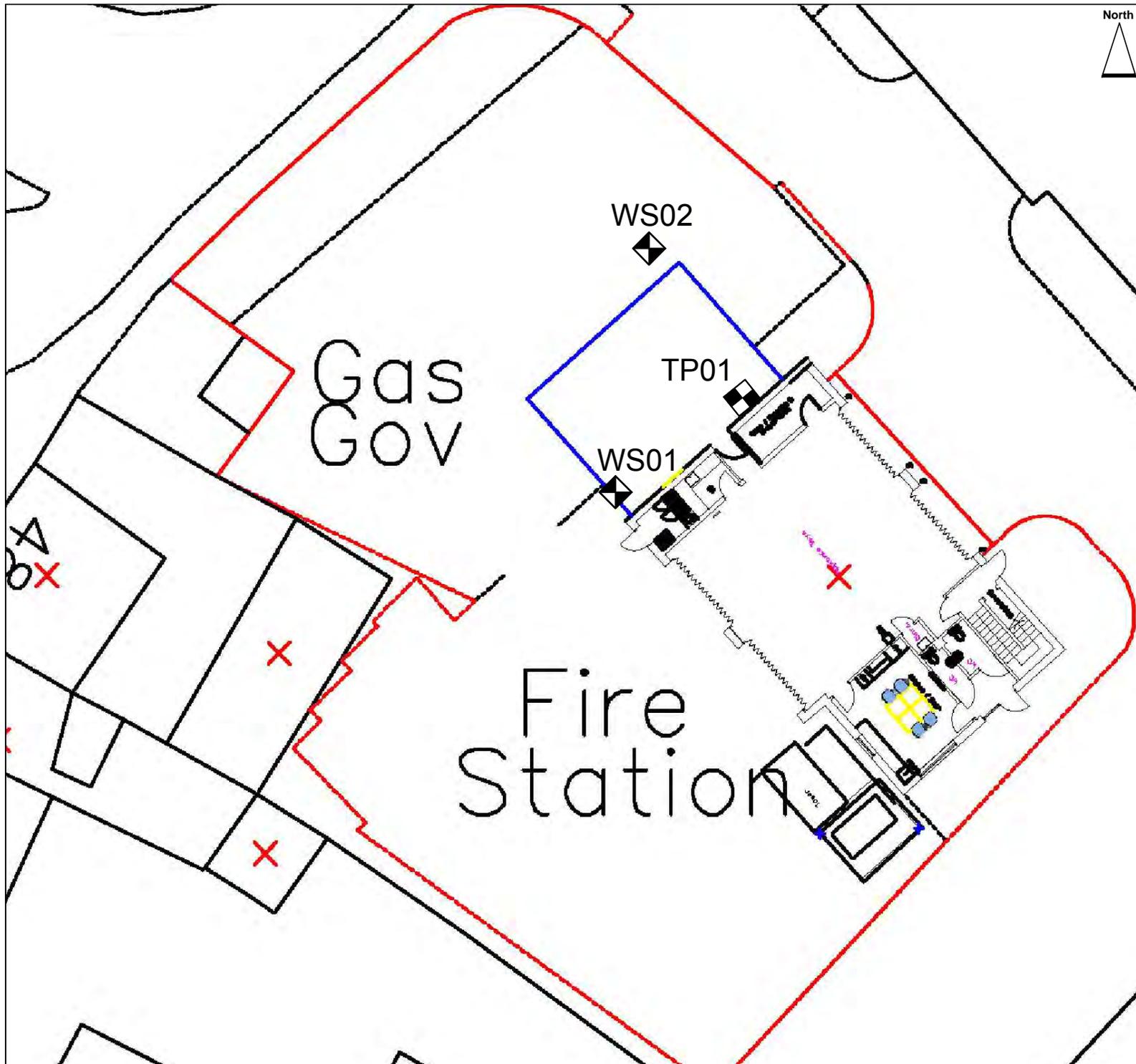
Client : Leicestershire Fire and Rescue Service

Date : November 2017

Dwg : 17.387/1

Scale 1: 50,000 @ A4

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North

Key:



Window sample location and reference



Trial pit location and reference

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Controller of Her Majesty's Stationery Office © Crown
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Rev	Date	Revision Description	Drwn	Chkd

Rev	Date	Revision Description	Drwn	Chkd

A F Howland Associates
Geotechnical Engineers

A F Howland Associates Ltd
The Old Exchange
Newmarket Road
Cringelford
Norwich
NR4 6UF

Tel: 01603 250754 Fax: 01603 250749

web: www.howland.co.uk

mail: admin@howland.co.uk

Client: Leicestershire Fire and Rescue Service

Site:

Lutterworth Fire and Rescue Station, Lutterworth, LE17
4NG

Job No.: 17.387

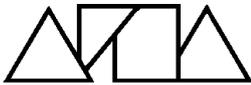
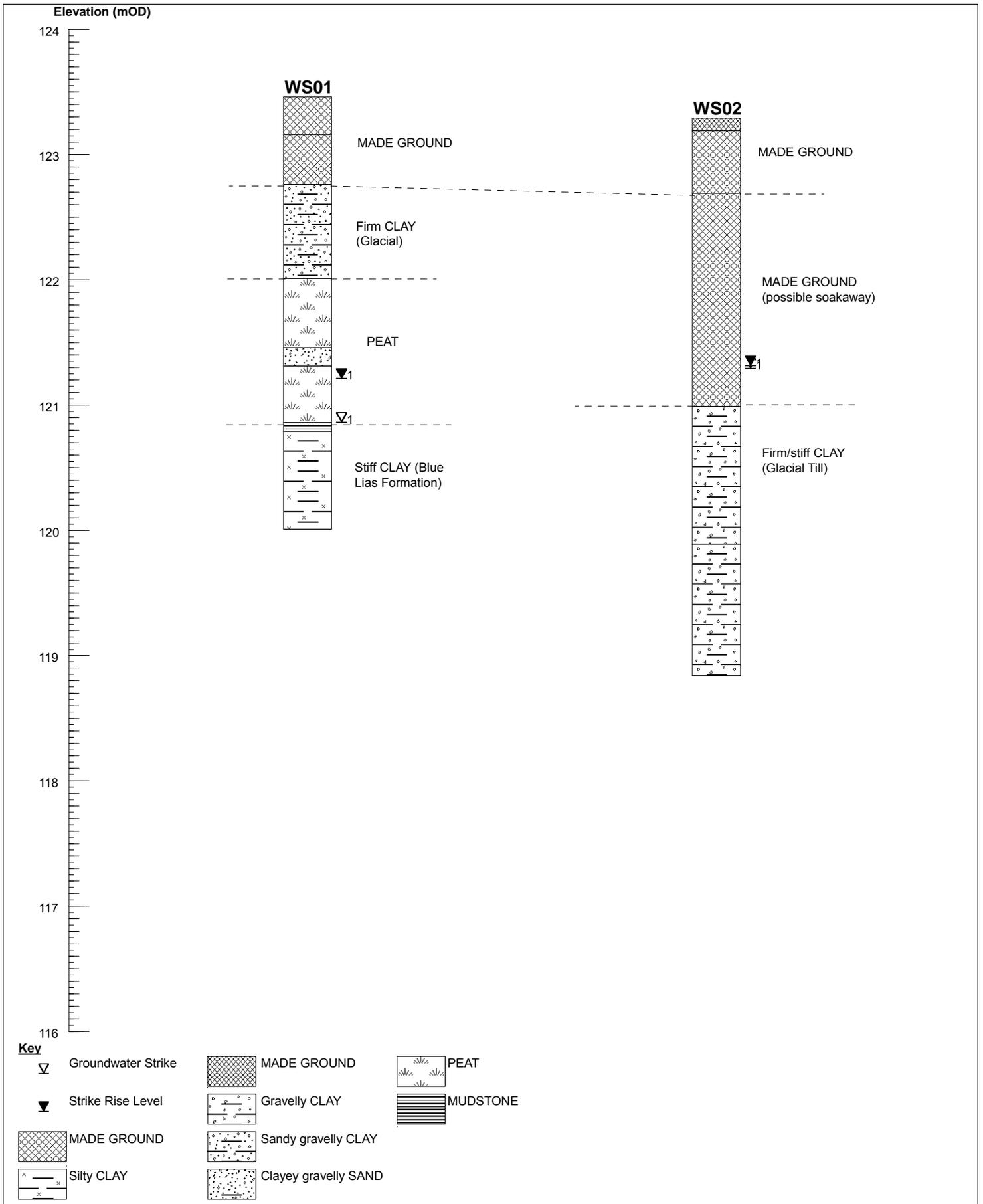
Drawing Title:

EXPLORATORY HOLE LOCATION PLAN

Date: November 2017

Drawing No: 17.387/2

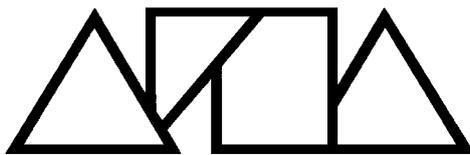
Scale: 1:250 @ A4



A F Howland Associates
Geotechnical Engineers

Nominal Section

Site Site 2 - Lutterworth Fire and Rescue Station, Lutterworth, LE1	Date Drawn 07/11/2017	Date Checked	Sheet 1/1	Job Number 17.387
Client Leicestershire Fire and Rescue Service	Drawn By MSH	Checked By	Scale 1:40[V]	Figure No. 17.387/3



A F Howland Associates

The Old Exchange
Newmarket Road
Cringleford
Norwich
NR4 6UF

Tel: 01603 250754

Fax: 01603 250749

Email: admin@howland.co.uk

www: <http://www.howland.co.uk>