INTERPRETATIVE REPORT ON GROUND INVESTIGATION FOR NEW EVAPORATORS AT KRAFT FOODS RUSCOTE AVENUE BANBURY

REPORT REF: 25186/01

AGS

Report No: 25186/01
Date: 28th March 2011
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Prepared on behalf of Kraft Foods UK Production Limited

GENERAL NOTES

1. The assessment made in this report is based on the information obtained during this investigation. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which, therefore, have not been taken into account in this report

2. It should be appreciated that any desk study information is not necessarily exhaustive and that further information relevant to the proposed site usage may be available.

3. The accuracy of any map extracts cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.

4. Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory holes or on the possible presence of features based on either visual, verbal or published evidence, this is for guidance only and no liability can be accepted for its accuracy.

5. It should also be noted, that any ground gases and contaminants monitored and analysed for are those most likely to give rise to the principal hazards for the proposed use of the site. However, no liability can be accepted for the presence of contaminants, explosive or toxic gases not analysed for.

6. The comments on ground conditions are based on observations made at the time of the investigation, unless otherwise stated. It should be noted, however, that groundwater levels vary due to seasonal or other effects.

7. Any qualitative risk assessment included in this report considers the significance of any contamination based on generic standards for the stated end use, together with an assessment of the presence of a pollutant linkage between sources, pathways and receptors. A qualitative assessment of low or insignificant risk does not imply that elevated concentrations of various determinands are not present compared to background or 'green field' conditions. A different assessment may apply if a different end use were proposed. It should also be acknowledged that institutional bodies may consider the presence of 'contaminants' in other ways regardless of whether an apparent risk is present based on defined sources, pathways and receptors.

REPORT STATUS SHEET

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INTERPRETATIVE REPORT ON GROUND INVESTIGATION FOR NEW EVAPORATORS AT KRAFT FOODS, RUSCOTE AVENUE, BANBURY

1.0 INTRODUCTION

1.1 It is proposed by the client, Kraft Foods UK Production Limited, to alter an existing large coffee production building within the Ruscote Avenue facility in Banbury, Oxfordshire. An approximately 25m high pair of industrial evaporators are to be built alongside the eastern elevation of the building with a large concrete base to be formed and extend beneath the footprint of the building to house internal equipment associated with the evaporator towers.

1.2 Geotechnical Engineering Ltd was instructed directly by the client, Kraft Foods UK Production Limited, to undertake a review of an existing Phase 1 Desk Study and investigation on site by others and conduct a borehole investigation at the location of the new structural alterations. The investigation on site was then to be used to give comments and recommendations on the findings with respect to the new evaporator installation. The scope of works included within this report is in general accordance with our Estimate Ref: T12878.

1.3 This report contains a description of the site at the time of the fieldwork, the fieldwork results and laboratory testing undertaken, strata encountered, engineering and contamination laboratory test results and an interpretative assessment of the ground conditions with regards to the proposed development.

1.4 This report is confidential and is written solely for the benefit of the Client and the Client's representatives and agents. Any comments given are based on the understanding that the proposed development will be as detailed above. This report has been prepared following an intrusive investigation, which took place on 24th February 2011 and Geotechnical Engineering Ltd warrants this report based on the conditions at the time of the investigation. Additional information, improved practices, new guidance, changes in legislation or provision of detailed layout and design proposals will necessitate this report having to be reviewed in whole or in part after that date.

2.0 THE SITE

2.1 General

2.1.1 The site is located within the existing Kraft Foods facility on the southeastern side of Ruscote Avenue, near opposite its junction with Lockheed Close approximately 1km north of Banbury town centre. The National Grid Reference for the centre of the site is approximately SP 453 415.

2.1.2 The Kraft Foods site is near oval shaped and the location of the proposed new

evaporators is near central within the facility on an area of land with dimensions of approximately 10m by 10m. The site lies at an elevation of approximately 97m Above Ordnance Datum (AOD) and is situated on the western flank of the Cherwell Valley with land sloping gently down towards the east.

2.1.3 The site is accessed via a security gatehouse and access road off the southern side of Ruscote Avenue, close to the junction with Beaumont Road.

2.1.4 At the time of the intrusive investigation (24th February 2011) the site of the proposed evaporators was covered by hardstanding and was located against the eastern elevation of an existing coffee production building. The site was split level with an elevated area adjacent to the existing building which was approximately 1.0m higher than the pavement level to the east. The pavement area was concrete surfaced and dropped down to the facilities roadway some 0.1m lower. A set of steps leading to an access door were present on the southern boundary of the proposed evaporator location. Numerous manhole covers were noted in the vicinity of the site, although a buried services search and location exercise conducted on site found the footprint of the proposed evaporators to be generally clear. The site and its immediate surrounds were devoid of any deep rooting vegetation.

2.1.5 See Drawing Ref. No 25186/01, Appendix A for an appreciation of the site layout.

2.1.6 The main identified land uses in the immediate area surrounding the site of the proposed evaporators are as follows;

- North – Pavement, Roadway and Coffee Production Buildings
- South – Roadway and Coffee Production Buildings
- East – Roadway, parking and contractors yard
- West – Coffee Production Buildings

3.0 DESK BASED RESEARCH

3.1 Ground Sense Limited Report Ref: 1042/D1/1 Overview

3.1.1 A copy of a previous site investigation conducted by Ground Sense Limited was provided by the Client for review and information purposes within this report. Report Ref: 1042/D1/1 was published in March 2006 and includes a desk study and borehole investigation for evaporator installation on site, some 80m west of the subject area for this investigation.

3.1.2 In summary the desk study indicated that the location of the new evaporators comprised undeveloped open fields used for agriculture with no features of note within an influencing distance. Several water courses were noted with land to the east noted to be liable to flooding. The 1965 Ordnance Survey map sheet shows the general site to have been developed with the construction of an industrial facility, presumably the existing Kraft Foods plant, with some earthworks indicated to create a level building platform. Subsequent map sheets indicate minor alterations on site but no further change of site usage.

3.2 Published Geology and Previous Findings

3.2.1 Reference to the 1:50,000 scale published British Geological Survey (BGS) Map Sheet 201 'Banbury' solid and drift edition indicates the site to be directly underlain by the solid geology of the Jurassic Lower Lias Formation. These strata typically comprise stiff fissured clay with occasional limestone bands. The desk study did not identify any previous uses for the site that would potentially generate significant thicknesses of Made Ground and hence any such material across the site could be expected to be relatively thin. Some ground disturbance could be expected in conjunction with the existing structures on site and services to the current buildings.

3.2.2 The previous investigation by Ground Sense Limited some 80m west of the new site consisted of two cable percussive boreholes to approximately 11.0m depth. The ground conditions encountered comprised a thin cover of Made Ground to a maximum depth of 0.60m underlain by the clay of the Lower Lias. The clay was found to be stiff, becoming very stiff and then hard and was proved to between 10.5m and 11.2m depth where a competent limestone layer was encountered. The previous boreholes were terminated within the limestone due to no further penetration after 30 minutes heavy chiselling.

3.2.3 It is understood that the existing evaporators, which are of a similar size and design to those proposed, located approximately 80m west of the site were constructed upon a 6.0m thick concrete base cast within the Lower Lias Clay. The large quantity of concrete and the depth of excavation was due to the tall slender structure installed and the need to anchor firmly in the ground.

4.0 FIELDWORK

4.1 General

4.1.1 A single exploratory position was included within the intrusive investigation comprising a combined dynamic sampled and rotary cored borehole through a diamond concrete cored hole and hand excavated starter pit taken down to 1.0m bgl. The location of the borehole was within the proposed footprint of the new evaporators in order to obtain the most representative ground profile for the project.

4.1.2 Fieldwork was generally carried out in accordance with BS5930 (1999) "Code of Practice for Site Investigations", BS10175 (2001) "Investigation of potentially contaminated sites - Code of practice", the Association of Geo-technical and Geo-environmental Specialist Guidelines for Good Practice in Site Investigations (August 1998), logged in accordance with BS EN ISO 14688-1:2004 and BS EN ISO 14688-2: 2004 and supervised by an experienced Geotechnical Engineer.

4.2 Surveying

4.2.1 The position of the borehole was defined by measuring from identifiable features on the site plan and correlation with the topographical survey conducted by Site Vision Surveys Ltd, upon instruction by Geotechnical Engineering Limited. The topographic survey was limited to the extent of the installation area and was

conducted on the 18th February 2011. The topographic information is presented on Drawing No: 25186/01, which is also marked with buried services information as determined on site using traditional methods and Ground Penetrating Radar to enable safe drilling.

4.2.2 Drawing No. 25186/01 is presented in Appendix A.

4.3 **GEL Pioneer Borehole**

4.3.1 Following the buried service clearance exercise a position for the proposed borehole by GEL Pioneer rig was identified and works commenced on 24th February 2011 within a coned and taped off work area. The drilling rig was moved onto position, a diamond tipped concrete coring barrel attached to the drill rods and the concrete hardstanding of the pavement cored at 225mm diameter.

4.3.2 On completion of coring and prior to drilling, a 1.0m deep service inspection pit was excavated utilising hand tools at the borehole locations to check further for the presence of buried services that may have otherwise been damaged by the investigation. A Cable Avoidance Tool (CAT) was used to check the base of the starter pit for any buried services beneath the base of the hand excavation.

4.3.3 The borehole was formed utilising a GEL Pioneer rig and was advanced using dynamic sampling equipment to a depth of 5.60m at initially 143mm diameter, reducing to 113mm diameter with depth. At 5.60m depth the dynamic sampling head was replaced with rotary equipment and the borehole continued at 116mm diameter using a water flush rotary core to 9.00m depth working within 140mm diameter steel casing installed to 3.90m depth.

4.3.4 Samples of the deposits encountered were recovered in 1.0m and 1.5m long clear plastic liners, which were sealed and transported back to GEL premises for subsequent logging and sub-sampling. Disturbed plastic pot, glass amber jar and 60ml glass vial samples were recovered from the various strata for chemical and engineering laboratory testing.

4.3.5 In situ Standard Penetration Tests, Split Spoon (SPT) were undertaken in the borehole at regular intervals to provide a measure of the relative in-situ strength of the cohesive deposits. The results are presented on the borehole record as SPT 'N' values and are an indicator of relative in-situ density of granular soils and shear strength in cohesive soils. These in-situ tests were alternated with 100mm diameter undisturbed (U100) samples taken using a sliding hammer with jarring link.

4.3.6 On completion of drilling, the borehole was backfilled with bentonite pellets to 8.0m bgl and then a 50mm standpipe was installed in the borehole and comprised UPVC casing from ground level to 1.0m bgl and slotted screen from 1.0m bgl to the base of the standpipe at 8.0m. An inert quartzitic gravel or recycled glass filter pack was placed around the slotted screen and a bentonite seal was placed above the filter pack. A push in rubber bung with gas valve was installed at the top of the standpipe with a flush stop-cock cover cemented at ground level such that no trip hazard exists within the concrete surfaced pavement.

4.3.7 Descriptions and depths of the various strata recovered are presented on the borehole records, reproduced in Appendix B, together with sample depths, comments on groundwater inflows and any other pertinent information.

4.4 Field Monitoring

4.4.1 Ground gas/groundwater level monitoring was carried out on three separate occasions commencing approximately one week after installation and with one week intervals between visits. The dates of the return visits were the 4th, 11th and 18th March 2011 from the standpipe installed within borehole BH01. The standpipe was monitored for methane, carbon dioxide, carbon monoxide, hydrogen sulphide, oxygen and atmospheric pressure using a Geotechnical Instruments Infra Red Gas Analyser 2000 and a GF60 flow meter.

4.4.2 Following measurement of soil gas concentrations and gas flow readings, the valve head assembly was removed to allow measurement of groundwater levels using a traditional dip meter.

4.4.3 The results of the gas concentration measurements, gas flow readings and groundwater level data obtained are reproduced in Appendix C.

5.0 LABORATORY TESTING

5.1 Engineering Laboratory Testing

5.1.1 Engineering laboratory testing was carried out in general accordance with BS1377 (1990) "Method of Test for Soils for Civil Engineering Purposes" at the UKAS accredited Geotechnical Engineering laboratory. The following tests were scheduled by Geotechnical Engineering Ltd:

- Natural Moisture Content
- Atterberg Limits – Liquid/Plastic Limits and Plasticity Index
- Water soluble sulphate content
- Acid soluble sulphate content
- Total sulphur
- pH value
- Quick undrained triaxial compression test (single stage)
- Consolidation test by Oedometer

5.1.2 The engineering laboratory test results are produced in Appendix D(i).

5.2 Chemical Contamination Testing

5.2.1 Laboratory testing of the shallow sub-soils was undertaken by a UKAS accredited laboratory, in accordance with MCERTS accreditation standards. No particular targets or 'hotspots' were identified during the desk study or on site during the visual assessment prior to the intrusive works being undertaken. The samples were analysed for some or all of the following determinands:-

- Arsenic, beryllium, boron, cadmium, chromium (total, trivalent, hexavalent), copper, cyanide, lead, mercury, nickel, selenium, vanadium and zinc
- pH
- USEPA 16 - Speciated Polycyclic Aromatic Hydrocarbons (PAHs)
- Phenols

5.2.2 The results are reproduced in Appendix D(ii) along with Table C1, which summarises the results and compares against current UK guidelines.

6.0 GROUND CONDITIONS

6.1 General

6.1.1 Based on former and current site use, published geological information and former intrusive investigations undertaken on site it was anticipated that the ground conditions across the site would comprise a variable thickness and composition of Made Ground overlying the solid geology of the Lower Lias at relatively shallow depth.

6.1.2 The above investigation agreed with the anticipated and published geological information.

6.2 Made Ground

6.2.1 The exploratory position on the Kraft Foods site in Banbury was covered by concrete and hence encountered 0.28m of concrete, which was noticed to be reinforced with steel. The concrete was cast upon a reddish brown slightly clayey, sandy granite gravel, which was found to extend down to 0.60m bgl and laid upon a geotextile membrane. Between 0.60m and 0.90m, the base of the fill material, the boreholes passed through a firm brown, grey and orange mottled slightly sandy, slightly gravelly clay, the gravel of which was sub-angular fine mudstone.

6.3 Superficial – Head Deposit

6.3.1 A superficial Head Deposit was met beneath the Made Ground within the borehole at a depth of 0.90m and was found to extend down to 1.90m bgl. This deposit generally consisted of a firm becoming stiff, friable, dark grey locally orange and brown slightly gravelly clay with occasional orange brown silt and fine sand lenses towards the base. The gravel fraction comprised sub-angular, fine and medium mudstone.

6.3.2 An SPT value for the Head Deposit of N=10 was obtained at a depth of 1.0m and is indicative of firm cohesive soils.

6.3.3 A plasticity index for the cohesive Head Deposit was recorded at 31% with 98% of the material tested passing the 425μm sieve. These results when modified in accordance with National House Building Council (NHBC) Standards Chapter 4.2 would indicate actual plasticity index for this stratum of 30%. Based on the NHBC document these deposits would be classed as having a medium volume change

potential. This stratum was determined as having a high plasticity and had results that plotted above the A-line hence representing cohesive soils.

6.4 **Solid Geology – Lower Lias**

6.4.1 The solid geology underlying the near surface soils and superficial deposits across the site comprises the Lower Lias Clay. This stratum, where weathered at near surface across the site, consisted of a generally stiff, friable, dark grey and brown mottled locally silty clay with rare selenite crystals, fossil shell and crinoids fragments. Occasional light brown lenses of fine sand were noted within the weathered zone between 3.50m and 3.90m depth. The less weathered Lower Lias Clay found below around 3.90m depth consisted of a stiff becoming very stiff, fissured, friable, dark grey silty clay with rare fossil shell and crinoids fragments, which were noted to be more prevalent at varying depths.

6.4.2 A medium strong, dark grey, argillaceous limestone was encountered within the borehole at a depth of 8.35m and was proved to at least 9.00m bgl, the completion depth of BH01. The limestone is thought to represent one of the competent limestone bands known to be present within the Lower Lias strata.

6.4.3 SPT values for the Lower Lias Clay ranging from N=23 to 48 were obtained at depths of 3.6m to 7.1m and were noted to increase with depth. These values are indicative of stiff becoming very stiff cohesive soils.

6.5 **Groundwater**

6.5.1 The borehole remained dry during and on completion of excavation of the starter pit and drilling of the borehole. However a slight seepage within the sub-base to the concrete and within the Lower Lias below 5.60m depth may have been masked by the water flush used during the coring process.

6.5.2 Three return visits were made to site on the 4th, 11th and 18th March 2011 in order to monitor the gas and groundwater levels within the standpipe installed within BH01. During the monitoring period allowed the standpipe within BH01 was found to have standing water levels ranging from 1.03m to 1.38m below ground level and were noted to be falling over the three week monitoring period.

6.6 **Visual/Olfactory Evidence of Contamination**

6.6.1 No obvious visual or olfactory evidence of TPH or solid phase contamination of the soils present on site was noted during the ground investigation.

6.7 **Live Roots**

6.7.1 No live or fibrous roots were noted within the soils revealed by BH01.

7.0 ENGINEERING CONSIDERATIONS

7.1 Introduction

7.1.1 It is understood that it is proposed to construct a new evaporator at the existing Kraft Foods site in Banbury with associated plant. The evaporators are approximately 25m tall and will be anchored in the ground by a considerable quantity of concrete, which is to be linked to the plant located internally within the existing coffee production building. Previous evaporators of a similar design on site were constructed upon a concrete base which was installed to a depth of 6.0m within the Lower Lias Clay. The Phase 1 desk study conducted by Ground Sense Limited for the Banbury site as a whole has not highlighted any significant potential for thickened deposits of worked or Made Ground and the intrusive investigation did not encounter any significant ground disturbance or cover of Made Ground other than that associated with the current occupation and ground levelling works.

7.1.2 A structural engineering specialist with experience in deep excavations and large mass concrete foundations should be appointed for all design and specification purposes.

7.2 Material Properties

7.2.1 The Made Ground found on site within BH01 to a depth of 0.90m below current site level at the location of the concrete pavement would not be suitable for use as a founding stratum due to its unknown history and compaction/strength characteristics and the potential for excessive total and differential settlements. Similarly the thin layer of superficial Head Deposits would not be considered suitable for use as a bearing stratum due to their locally potentially variable nature. The underlying Lower Lias Clay was noted to be stiff becoming very stiff with depth and the anticipated depth of excavation for the anchoring concrete would result in the very stiff clay being used as a founding stratum.

7.2.2 A single Atterberg Limit and Moisture Content test was undertaken on a sample of cohesive Head Deposit at a depth of 1.1m bgl. The results indicate a Moisture Content of 25%. The modified results indicate clays of a medium volume change potential and a high plasticity, the Head Deposit is derived from the underlying Lower Lias Clay and would possess similar volume change potential characteristics.

7.2.3 Geotechnical laboratory testing of the undisturbed 100mm diameter samples of Lower Lias Clay within the undrained triaxial compression apparatus determined estimates for shear strength ranging from 72kPa to 238kPa. These results are indicative of stiff and very fissured stiff clays, locally fissured to firm, and the results were noted to reduce with depth due to the increased fissuring of this stratum and the failure mode being fissure controlled.

7.2.4 The consolidation test within oedometer apparatus has indicated a low compressibility for the relatively less weathered Lower Lias Clay below 5.8m depth with a Coefficient of Compressibility (m_v) of 0.10m^2/MN.

7.3 Foundation Assessment

7.3.1 The Made Ground and Head Deposits found across the site within BH01 up to 1.9m deep are not considered to be suitable founding strata due to their bearing properties, thickness and variability in composition and therefore unacceptable total and differential settlements are likely under loaded conditions. However the anticipated depth of excavation required for the evaporators would rule these strata out as a founding medium in any case. The underlying Lower Lias Clay is considered suitable as a founding stratum for the proposed structures on site given the anticipated loads to be imposed and excavations required. Deepened traditional mass concrete or piled foundations could be considered for use on site both installed within the Lias Clay.

7.3.2 No live roots were noted within the starter pit to the borehole or the samples recovered and the site plus its surrounds was devoid of deep rooting vegetation that may have an impact on the proposed structures design and construction. However the superficial deposits and solid geology strata beneath the site would be classed as having a medium volume change potential and this characteristic should be taken into account should any planting be planned within proximity to the new structure, although this is highly unlikely given the setting.

7.3.3 All existing/former foundations to buildings and the on site retaining wall within the footprint of the new evaporator base should be grubbed out and removed from site and careful consideration taken with respect to interaction between the new concrete base and the existing building on site.

7.3.4 The proposed evaporators are of a similar design to those installed previously on site and it is known that previously the concrete base was cast at 6.0m depth within the Lower Lias Clay. Therefore it can be assumed that a similar build will be required for the new evaporators on site in order for sufficient concrete to be placed in the ground to anchor the structures soundly. The Lower Lias Clay within BH01 was found to be less weathered below 3.9m and become very stiff below 5.8m bgl. Therefore it is recommended that the new concrete base be cast at a formation level of 6.0m bgl within the very stiff Lower Lias Clay. Such a depth would be well below the deepest thickness of made ground, disturbed ground associated with the existing structure removal and superficial deposits and the potential zone of seasonal influence based on a medium volume change potential clay. Also this depth would provide a minimum 200mm to 300mm embedment for foundations within the founding stratum.

7.3.5 Foundations formed at 6.0m depth within the Lower Lias Clay would possess an allowable bearing pressure of 400kN/m² for total settlements not exceeding 25mm and minimal differential settlement. The above stated allowable bearing pressure is considered adequate for the proposed structures on site for tolerable immediate and long term consolidation settlement. However should higher bearing pressures be required to support the new evaporators or total settlement to be kept to a minimum, then foundations could be extended down to a greater depth via piles, installed within the limestone of the Lower Lias, although this is considered unlikely. Further advice should be sought if piled foundations are to be considered. The Lower Lias

Clay has a bulk density of approximately 2.20Mg/m^3 and the removal of 6.0m of overburden from the excavation should be considered in design in conjunction with typical bulk density for structural concrete in the order of 2.40Mg/m^3.

7.3.6 The plant associated with the evaporators that are to be located inside the existing coffee production building should be placed upon their own foundation, which is connected to the large external concrete base in order to reduce the potential for differential settlement. The two separate concrete bases should be provided with appropriately designed and installed steel reinforcement to further minimise potential differential settlement. The foundation for the internal plant should be taken through the existing floor and cast within the solid geology of the Lower Lias Clay at a minimum depth of 2.1m to provide a key into the founding strata. Such a concrete pad foundation would possess an allowable bearing pressure of 300kN/m^2 for total settlements not exceeding 25mm and minimal differential settlement.

7.3.7 For the allowable bearing pressures given above a Factor of Safety of 3.0 has been plied against shear failure.

7.3.8 Where foundation excavations are to be left open for any sustained period of time it is recommended that a blinding layer of concrete is placed within the base in order to prevent a deterioration in the founding strata and a reduction of the favourable bearing properties provided by the Lower Lias Clay.

7.3.9 The concrete base formation layer should be closely inspected for suitability and proof rolled with any 'soft spots' excavated and replaced with a suitable, compacted coarse granular material. Similarly any large limestone inclusions or lenses, which have not been considered in design, should be grubbed out and replaced as above, in order to remove any 'hard spots' from beneath the base area.

7.4 General Construction Advice

Exploratory Hole Positions

7.4.1 This borehole together with those from any previous investigations may represent soft spots and conduits/sumps for groundwater or surface water to migrate downwards or artesian water upwards. In excavations, such materials may also be loose and unstable. Unless specifically stated exploratory hole locations should be regarded as approximate. Consideration should be given to accurate location of such features where it is considered they may impact on the proposed development, although the GEL Pioneer borehole is of a minimal diameter and the Lower Lias Clay will prevent downward and lateral movement of waters beneath the site. However the limestone found beneath 8.30m depth within BH01 may introduce artesian water to the excavation. It is possible that the groundwater encountered within the standpipe installed in BH01 is derived from the limestone and that the bentonite seal placed at the base of the boreholes was not sufficient to contain the water pressure.

Excavation Plant

7.4.2 Conventional mechanical excavators should prove suitable for excavation through

the Made Ground and natural strata encountered at the site, although the access and size of the excavation may restrict the choice of such excavators for the ground works. A hydraulic breaker attachment will be required to break up the existing concrete and wall foundations on site prior to being grubbed out and removed from site.

Excavation Stability/Hazardous Gases

7.4.3 The borehole conducted during the site investigation was noted to remain stable during and on completion of its excavation and drilling, however it is likely that there will be some shallow spalling and partial collapse within excavations where the Made Ground is at a greater thickness, especially in the presence of perched water. The approximately 300mm thick layer of granite gravel hardcore beneath the concrete on site is likely to be unstable and prone to collapse once excavations commence on site. Beneath the Made Ground, foundation excavations are likely to stand well in the short term unsupported, however temporary support should be considered for all excavations where man entry is necessary, in compliance with statutory requirements to ensure safe working conditions. Some overbreak of pits and trenches is likely to occur in conjunction with existing foundations and within the Made Ground where larger fragments of concrete and other materials are encountered. The deep concrete base excavation for the evaporators will possibly require support during construction prior to the emplacement of the concrete due to the envisaged 6.0m depth.

7.4.4 It is unlikely that significant concentrations of landfill type gases such as carbon dioxide and methane are present on site at concentrations considered to be hazardous to human health. The gas monitoring exercise undertaken after the completion of the intrusive investigation identified slightly elevated levels of carbon dioxide, which is typical of inert Made Ground in the UK. Care should be taken when personnel enter excavations (or confined spaces), to ensure full ventilation is available and appropriate safety precautions taken, where necessary.

Dewatering/Soakaways

7.4.5 Significant groundwater issues are unlikely to occur within the proposed excavations on site based on the observations during the borehole exercise. However perched groundwater is likely to enter excavations during construction from within the Made Ground and sand/silt layers of the Head Deposits and Lower Lias Clay as was encountered during the standpipe monitoring visits. However as mentioned earlier, the water in the standpipe could be artesian water from within the limestone layer found below 8.3m depth, which has 'blown' through the bentonite seal at the base of the borehole. Slow groundwater ingresses from perched sources would be best dealt with by sump type pumping. It would be prudent to monitor standing water levels within the standpipe installed within BH01 prior to the commencement of ground works in order to determine any seasonal affect on the water table at the time of year of construction. If water is present within the standpipe during subsequent monitoring visits it may be prudent to bail or pump out the standpipe and observe recharge rates of groundwater to obtain an indication of recharge rates/flow rates for the perched groundwater.

7.4.6 No falling head tests were conducted on this site within the borehole during the investigation however it can be assumed that soakaway drainage would not be feasible within the relatively impermeable Lower Lias Clay. Any test results would fall within the poor soakaway potential range based on BS:8004 and would not be conducive to the use of soakaway drainage on this site.

Classification of Buried Concrete

7.4.7 The results of chemical analyses undertaken on soil samples recovered from the Made Ground and Oxford Clay indicate the Design Sulphate Class for the site to be "DS-3" based on the results of analytical testing and reference to BRE Special Digest 1 "Concrete in aggressive ground", Part I, in association with near neutral to slightly alkaline pH values. The BRE Digest suggests that buried concrete should be designed to an Aggressive Chemical Environment for Concrete (ACEC) site classification of "AC-3" based on mobile groundwater conditions and a 'Brownfield' site.

7.5 Ground Gas Assessment

7.5.1 Ground gas monitoring has been undertaken as part of this investigation on the 4th, 11th and 18th March 2011 with a total of three monitoring visits being undertaken, the results of which are included in Appendix C.

7.5.2 On all occasions, methane concentrations of <0.1% by volume were recorded in the standpipe installation. Carbon dioxide levels were recorded between 0.3% and 1.3% by volume and concentrations of oxygen were within the depleted to undepleted range (5.0% to 20.1%) for general atmospheric conditions. Minimal gas flow rates were detected during the return visits, recorded as between <0.1l/hr and 0.4l/hr. All three visits were undertaken at times of high atmospheric pressure (>1000mb).

7.5.3 In our experience, the gas concentrations recorded for the site are considered broadly typical of ground gas conditions recorded in generally inert Made Ground and variable natural strata.

7.5.4 In order to characterise the gas regime of the site, reference has been made to guidance given in British Standards document BS 8485:2007 'Code of Practice for the Characterisation and Remediation from ground gas in affected developments' which has evolved from previously published means of ground gas assessment published by CIRIA (C659/C665) and the NHBC (Report No 10627-R01 (04)). The methodology described in this document for determining whether methane and carbon dioxide could present a constraint to new development utilises a risk assessment based process in line with CLR11, taking into consideration the desk study findings, the data obtained during the phases of gas monitoring and the nature of the proposed development.

7.5.5 The data obtained during monitoring for gas concentrations and flow rates is utilised to calculate a 'site characteristic hazardous gas flow rate' (HGFR) based upon the data acquired for each monitoring point for each monitoring event. The maximum site characteristic hazardous gas flow rate recorded in the borehole together with the

range of gas concentrations recorded and typical flow rates are summarised in the following table.

Table 1 Characteristic Gas Situation Monitoring Results

Borehole	Max HGFR Q_{hgs}	Min of Peak CH_4	Max of Peak CH_4	Min of Steady CO_2	Max of Steady CO_2	Min of Average Flow	Max of Peak Flow	Characteristic Gas Situation
	l/hr	%	%	%	%	l/hr	l/hr	
BH01	0.005	<0.1	<0.1	0.3	1.3	<0.1	0.4	1

7.5.6 Assessment of these results is then undertaken to determine a 'characteristic gas situation' for the site, which is then utilised in establishing the likely level of gas protection measures required dependent upon the nature of the proposed development. The types of development listed are similar to those previously identified in the CIRIA and NHBC documents, i.e. commercial/industrial and public buildings and residential properties (high-rise or low-rise)

7.5.7 Based on the monitoring and risk assessment process the site is classified as a Characteristic Gas Situation 1 (Very Low Hazard Potential) due to the low concentrations of methane/carbon dioxide and associated flow rates recorded. Based upon the British Standards guidance, no gas protection measures are recommended for the new development with respect to either methane or carbon dioxide.

8.0 TIER 1 CHEMICAL ASSESSMENT

8.1 Published Guidelines

8.1.1 The following assessment summarises the results of the chemical analyses, compared to available and relevant published guidelines. At present in the United Kingdom there are no statutory limits for the presence of contaminants in the solid deposits (soils) or groundwater. There are a number of documents available, which provide guidelines on acceptability criteria. Those that are considered to be most relevant are discussed below.

Human Health

8.1.2 In January 2009, the Environment Agency issued an updated version of the Contaminated Land Exposure Assessment (CLEA) model used in assessing the chronic risks to human health from long-term exposure to chemicals in soil. The CLEA model is used to derive Soil Guideline Values, a series of generic assessment criteria (GACs) that may be used to simplify human health risk assessment from chronic exposure to contaminants in soils. At the time of preparation of this report generic Soil Guideline Values (SGVs) have been produced for the following contaminants: arsenic, cadmium, nickel, mercury, selenium, phenols, benzene,

ethylbenzene, toluene and xylenes. These SGVs have been produced for a series of standard land uses such as residential, commercial/industrial and allotments.

8.1.3 SGVs have been produced using Health Criteria Values (HCVs) which are intended to indicate the concentration of a substance in soil below which human exposure can be considered to represent a 'tolerable' or 'minimal' level of risk. SGVs are not intended to indicate the presence of an 'unacceptable intake or direct bodily contact with a contaminant' (ref. CLAN 2/05) and therefore exceedance of SGVs does not necessarily indicate the 'Significant Possibility of Significant Harm' (SPOSH) and that the site would meet the statutory definition of contaminated land as defined under Part IIA of the Environmental Protection Act 1990. Instead, the exceedance of SGVs simply indicates that further assessment or remedial action may be required. The non-exceedance of an SGV indicates the presence of an acceptable risk and that the land is suitable for its intended use.

8.1.4 In a number of instances where no published or draft SGVs are available then reference has been made to assessment criteria published by the Chartered Institute of Environmental Health and Land Quality Management Limited in their document "Generic Assessment Criteria for Human Health Risk Assessment 2nd Edition" dated 2009. The CLEA Model software (version 1.04), together with toxicological and parameter data obtained from published documents/sources in accordance with the hierarchy set out in Environment Agency guidance documents SR2-4 & 7, has been used to derive Generic Assessment Criteria (GACs).

8.1.5 It is understood that the current proposals are to make structural alterations to an existing coffee production building on site installing new evaporators externally and associated plant internally on site of the borehole conducted during this investigation. The industrial site is currently covered by concrete and asphalt hardstanding and when completed the site will be wholly covered by hardstanding. Therefore it is considered appropriate to compare all of the results to those generic SGVs and GACs applicable to a 'commercial/industrial' setting. The SGVs and GACs are intended to be used purely as a guide to whether further assessment is required or remedial action should be taken.

Controlled Waters

8.1.6 Controlled Waters are defined by Section 104 of Part III of the Water Resources Act, 1991, and amended by the Water Act 2003. This is interpreted to include:

'all rivers, canals, lakes, groundwater, estuaries and coastal waters to three nautical miles from the shore. Groundwaters are defined as water contained in underground strata within the saturation zone, and includes saturated perched water bodies.'

8.1.7 The site was found to be underlain by a cover of Made Ground and a thin layer of superficial Head Deposit with the solid geology of the Lower Lias Clay at relatively shallow depth. The Lower Lias Clay is classed as a non-aquifer and would act as an aquiclude protecting any groundwater within any underlying aquifers from vertical migration of any near surface contamination. The overlying Head Deposit was found to comprise a cohesive soil, which is likely to retard the migration of contaminants from the surface/near surface either laterally or downwards. Perched

groundwater was encountered within either the Made Ground or sand/silt lenses within the clay soils or as artesian water within the deeper limestone layer and are not thought to represent a significant pathway for any contaminants that may be present. Based on the above observations, the Phase 1 desk study information provided by the Client, former, existing and proposed site uses, no groundwater samples were submitted for chemical analysis due to the low risk posed to controlled waters.

8.2 Soil Chemical Test Results

8.2.1 Table C1 in Appendix D(ii) summarises all of the chemical tests carried out to date as part of this investigation and compares the results, where applicable, to published SGVs and other appropriate screening values as discussed above. Those determinands that exceed the identified screening values are assessed further below;

Arsenic, mercury, nickel, lead and selenium

8.2.2 A single sample of Made Ground and a single sample of Lower Lias Clay from the site were analysed for the above determinands. Concentrations were not recorded above generic commercial/industrial SGVs in either of the samples.

Beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, vanadium and zinc

8.2.3 The soils results have been compared to the CLEA 1.04 derived GAC for a commercial/industrial end use. Neither of the samples tested for beryllium, cadmium, chromium, copper, vanadium and zinc exceeded the GACs.

Phenols

8.2.4 An SGV for phenol of 31,000mg/kg has been derived using the CLEA 1.04 model for a commercial/industrial end use assuming 1% Soil Organic Matter (SOM). Neither of the samples tested exceeded this value.

Polycyclic Aromatic Hydrocarbons

8.2.5 Two soil samples were submitted for analysis of concentrations of PAHs, which were speciated into sixteen compounds in accordance with USEPA guidelines.

8.2.6 Currently, there are no published finalised SGVs for either individual PAH compounds or for total PAH, however CIEH and Land Quality Management Ltd in their document "Generic Assessment Criteria for Human Health Risk Assessments 2nd edition" (2009), have derived generic assessment criteria for sixteen of the main PAH compounds.

8.2.7 The results for the two samples of CLEA 1.04 and Lower Lias Clay tested for the sixteen individual PAH compounds show that none of the sixteen PAHs had concentrations above the GAC for the proposed commercial/industrial end use.

8.3 Summary of Chemical Contamination Assessment

8.3.1 In summary, the Made Ground and Lower Lias Clay across the site was not found to contain any concentrations of contaminants in excess of those SGVs and GAC derived using CLEA methodology with respect to a commercial/industrial land use. Therefore there is considered to be a low potential for the possibility of harm to the health of future users of the proposed site and a low risk posed to ground workers during construction.

9.0 QUALITATIVE RISK ASSESSMENT

9.1 Introduction

9.1.1 In carrying out this assessment, the potential targets of any contaminated soil/groundwater and potential pathways for contaminant migration to the targets have been taken into account. The following targets, therefore can either be excluded or require further assessment. These will be discussed in more detail below:

- End users of the site
- Construction workers
- Surrounding properties
- Groundwater
- Underground services

9.2 End Users

9.2.1 In order to undertake an assessment of the potential risk to human health the results have been compared against generic SGVs and LQM GAC assuming the proposed development will comprise an industrial end use.

9.2.2 On the basis of the chemical analysis carried out on soils recovered from the site, end users are considered to be at a low risk from the soils present, especially since the soils are to be capped by permanent hardstanding and building floors. Therefore no plausible pathway could exist between any contaminants (source) and the end users (receptors).

9.3 Construction workers

9.3.1 The potential health hazard imposed on construction workers engaged in site works by the near surface soils encountered over the site area is considered to be low on the basis of the chemical analyses carried out and visual inspection. Standard Health and Safety measures are considered adequate and as such high standards of personal hygiene should always be maintained amongst site personnel. Washing facilities should also be provided and used prior to eating/smoking to prevent any hand to mouth transfer of soils. Further advice should be sought where visual or olfactory evidence of contaminated materials is discovered during ground works.

9.4 Surrounding Properties

9.4.1 On the basis of the ground and groundwater conditions encountered and the results of analytical testing, the risk of off site migration of contaminants presenting a risk to nearby residents/property is considered to be low.

9.5 Groundwater

9.5.1 Based on the findings during this investigation and the Phase 1 desk study information provided by the Client there is considered to be a low risk to groundwater from the near surface soils identified across this site.

9.6 Underground Services/Structures

9.6.1 Underground services on the site can be affected by the presence of a range of contaminants in the soil. Reference has been made to the Water Regulations Advisory Services information and guidance note 'The Selection of Materials for Water Pipes to be Laid in Contaminated Land' (Ref. No 9-04-03) dated October 2002.

9.6.2 Whilst only a limited number of the potential contaminants that could affect water supply pipes have been reviewed as part of the soil testing undertaken as part of this assessment, it has been established that the Made Ground does not contain concentrations of PAHs that may represent a hazard to certain types of water supply pipes. The near neutral/slightly alkaline pH values do not signify potential risks of corrosion from particularly acidic or alkaline conditions. The proposed structural alterations and new evaporators on site are unlikely to have buried potable water supply pipes associated with them in any case.

9.6.3 The results of chemical analyses undertaken on samples of soil recovered from the made ground and naturally occurring deposits encountered at the site indicate the Design Sulphate Class for the site to be "DS-3". The BRE Digest suggests that buried concrete should be designed to an Aggressive Chemical Environment for Concrete (ACEC) site classification of "AC-3" based on mobile groundwater conditions, a Brownfield site and near neutral/slightly alkaline pH values.

9.7 Disposal of Materials

9.7.1 We recommend that if off-site disposal is required, that analytical results relevant to the materials being disposed of should be provided to landfill operators to confirm whether it meets their license agreements and to confirm disposal costs. Given the chemical results obtained from BH01 it is likely that any near surface Made Ground disposed of from site will meet the criteria required for disposal as inert waste.

9.7.2 The waste producer is responsible for ensuring that basic characterisation of the waste has taken place to establish its key characteristics.

9.7.3 All waste materials should be handled in accordance with the Duty of Care for waste or relevant Waste Management Licensing. Materials should be classified and disposed off according to the Landfill Directive. Correct testing (e.g. Waste

Acceptance Criteria testing) may need to be undertaken prior to disposal.

10.0 PROPOSED REMEDIAL ACTION/FURTHER WORKS

10.1.1 No specific remedial requirements have been identified as a result of the investigation undertaken, however further advice should be sought if visual or olfactory evidence of potentially contaminated material is discovered during ground works.

Appendix A

Appendix B

Geotechnical Engineering Limited

BOREHOLE LOG

BH01

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

Start Date 24 February 2011

End Date 24 February 2011

Sheet 1 of 2

Scale 1 : 50

Depth 9.00 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	test type & value	samp. /core range	instru -ment	description	depth (m)	reduced level (m)	legend
24/02/11 0945hrs	1D	0.30						Concrete (280mm) with metal re-enforcement bar.	0.28		
	2D*	0.30						Reddish brown slightly clayey sandy granite GRAVEL.	0.60		
	3B	0.50						Geotextile membrane over firm brown grey and orange slightly sandy slightly gravelly CLAY. Gravel is subangular fine mudstone. (MADE GROUND?)	0.90		
	4D	0.65									
	5D*	0.65									
	6B	1.00									
	7D	1.00	1.45	Nil	S 10			Firm becoming stiff friable dark grey locally orange and brown slightly gravelly CLAY. Gravel is subangular fine occasionally medium mudstone. (HEAD DEPOSITS)			
	8X	1.00	2.10					1.60m: With occasional lenses of orangish brown silt and fine sand.	1.90		
	9D	1.10									
	10D*	1.10									
	11D	2.00									
	12D*	2.00									
	13U	2.10	2.55	Nil				Stiff friable dark grey locally discoloured brown CLAY with rare fine gravel-sized selenite crystals and crinoid fossils. (LOWER LIAS CLAY)	2.65		
	14X	2.10	3.60								
	15D	3.50						Stiff friable dark grey silty CLAY. (LOWER LIAS CLAY)			
	16D*	3.50									
	17D	3.60	4.05	Nil	S 23			3.50m: With occasional light brown lenses of fine sand and rare fine gravel-sized selenite crystals.	3.90		
	18X	3.60	4.60								
	19D	4.50						Stiff fissured friable dark grey silty CLAY with rare fine and medium gravel-sized pinkish white shell fragments and rare crinoid fossils, locally abundant. (LOWER LIAS CLAY)			
	20U	4.60	5.05	Nil							
	21X	4.60	5.60								
	22D	5.50									
	23D	5.60	6.05	Nil	S 40	100			5.80		
	24C	5.60	7.10					Very stiff friable fissured locally finely laminated silty CLAY with rare off-white fine gravel-sized shell fragments. (LOWER LIAS CLAY)			
	25D	6.50									
	26D	7.10	7.55	Nil	S 45	100					
	27C	7.10	8.00								
	28D	7.50									
								Continued Next Page	(8.00)		

EQUIPMENT: Geotechnical Pioneer rig

METHOD: Hand dug inspection pit 0.00-1.00m. Dynamic sampled (143mm) 1.00-2.10m, (128mm) 2.10-4.60m, (113mm) 4.60-8.00m. Waterflush rotary core drilled (116mm) 8.00-9.00m.

CASING: 140mm diam to 3.90m.

BACKFILL: On completion, a slotted standpipe (50mm) was installed to 8.00m, granular response zone 1.00-8.00m, bentonite seal 8.00-9.00m and 0.20-1.00m, concrete and stopcock cover 0.20-0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered prior to use of water flush

AGS

CONTRACT	CHECKED
25186	JH

Geotechnical Engineering Limited

BOREHOLE LOG

BH01

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

Start Date 24 February 2011

End Date 24 February 2011

Sheet 2 of 2

Scale 1 : 50

Depth 9.00 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	test type & value	samp. /core range		Instru -ment	description	depth (m)	reduced level (m)	legend
	29C	8.00	9.00			80 85 85				8.35		
24/02/11 1715hrs 0.40m									Medium strong dark grey argillaceous LIMESTONE. (LOWER LIAS)	9.00		
									Borehole completed at 9.00m.			
										(18.00)		

water strike (m)	casing (m)	rose to (m)	time to rise (m)	remarks	CONTRACT	CHECKED
				Groundwater not encountered prior to use of water flush	25186	JH

Appendix C

Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

borehole /trial pit no.	date & time	barometric pressure (mb)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)
BH01	04/03/11 08:50							-0.3		
BH01	04/03/11 08:51							-0.1		
BH01	04/03/11 08:52							0.0		
BH01	04/03/11 08:53							0.0		
BH01	04/03/11 08:54							0.0		
BH01	04/03/11 08:57	1024	0.3	0.0	18.0	0.0	0.0		6	
BH01	04/03/11 08:58		0.3	0.0	18.0	0.0	0.0			
BH01	04/03/11 08:59		0.3	0.0	18.0	0.0	0.0			
BH01	04/03/11 09:00		0.3	0.0	15.6	0.0	0.0			
BH01	04/03/11 09:00		0.3	0.0	4.1	0.0	0.0			
BH01	04/03/11 09:00		0.3	0.0	6.3	0.0	0.0			
BH01	04/03/11 09:00		0.2	0.0	9.5	0.0	0.0			
BH01	04/03/11 09:01		0.3	0.0	8.7	0.0	0.0			
BH01	04/03/11 09:01		0.3	0.0	4.0	0.0	0.0			
BH01	04/03/11 09:01		0.3	0.0	7.6	0.0	0.0			
BH01	04/03/11 09:01		0.2	0.0	10.8	0.0	0.0			
BH01	04/03/11 09:02		0.3	0.0	5.6	0.0	0.0			
BH01	04/03/11 09:02		0.3	0.0	5.1	0.0	0.0			
BH01	04/03/11 09:02		0.2	0.0	8.4	0.0	0.0			
BH01	04/03/11 09:02		0.2	0.0	11.8	0.0	0.0			1.03
BH01	11/03/11 08:30							-0.5 to 0.4		
BH01	11/03/11 08:31							-0.5 to 0.4		
BH01	11/03/11 08:32							-0.5 to 0.4		
BH01	11/03/11 08:34	1004	0.5	0.0	19.2		0.0		6	1.28
BH01	11/03/11 08:34									
BH01	18/03/11 08:50							-0.1		

general remarks

# denotes result exceeding capacity of gas monitoring equipment

CONTRACT	CHECKED
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Geotechnical Engineering Limited

GAS AND GROUNDWATER LEVELS

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

borehole /trial pit no.	date & time	barometric pressure (mb)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)
BH01	18/03/11 08:51							0.0		
BH01	18/03/11 08:52							0.0		
BH01	18/03/11 08:53							-0.2		
BH01	18/03/11 08:54							0.0		
BH01	18/03/11 08:56	1010	1.3	0.0	5.7		0.0		7	
BH01	18/03/11 08:57		1.3	0.0	5.2		0.0			
BH01	18/03/11 08:58		1.3	0.0	5.2		0.0			
BH01	18/03/11 08:59		1.3	0.0	4.9		0.0			
BH01	18/03/11 09:00		1.3	0.0	4.7		0.0			1.38

general remarks

# denotes result exceeding capacity of gas monitoring equipment

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Appendix D(i)

2718

GEOTECHNICAL ENGINEERING LTD

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For the attention of John Higgins

Date of Issue 25 March 2011

TEST REPORT

PROJECT/SITE	PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY	Samples received	01/03/2011
GEL REPORT NUMBER	25186	Schedule received	01/03/2011
Your ref/PO:	**	Testing commenced	07/03/2011

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS1377: Part 2: 1990:3.2, Moisture Content	1	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid (Cone Penetrometer) & Plastic Limits	1	YES
BS1377: Part 5: 1990:3, Consolidation	1	NO
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	3	NO
BRE SD1 Reduced Suite: pH, Sulphate - water and acid soluble, sulphur (Subcontracted)	3	YES

Remarks

The report should not be reproduced except in full without written permission from this laboratory.

Approved Signatories:

W Jones (Client Manager) R Pratt (Client Manager)
J Hanson (Director) C Thomas (Consultant)

[redacted]

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Geotechnical Engineering Limited

LIQUID AND PLASTIC LIMITS

BS.1377 : Part 2 : 1990 : 4 and 5

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

borehole /trial pit no.	sample		specimen depth (m)	natural moisture content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
	no./type	depth (m)								
BH01	6X	1.00	1.10	25	BXE	2	55	24	31	Grey mottled brown slightly sandy CLAY with a little fine gravel

general remarks:
natural moisture content determined in accordance with BS1377 : Part 2 : 1990 : 3.2 (unless specified)
NP denotes non-plastic
# denotes sample tested is smaller than that which is recommended in accordance with BS1377

specimen preparation:		test method:	CONTRACT	CHECKED
A - as received	D - oven dried (60°C)	X - cone penetrometer (test 4.3)	25186	WJ
B - washed on 0.425mm sieve	E - oven dried (105°C)	Y - one point cone penetrometer (test 4.4)		
C - air dried	F - not known	Z - Casagrande apparatus (test 4.5)		

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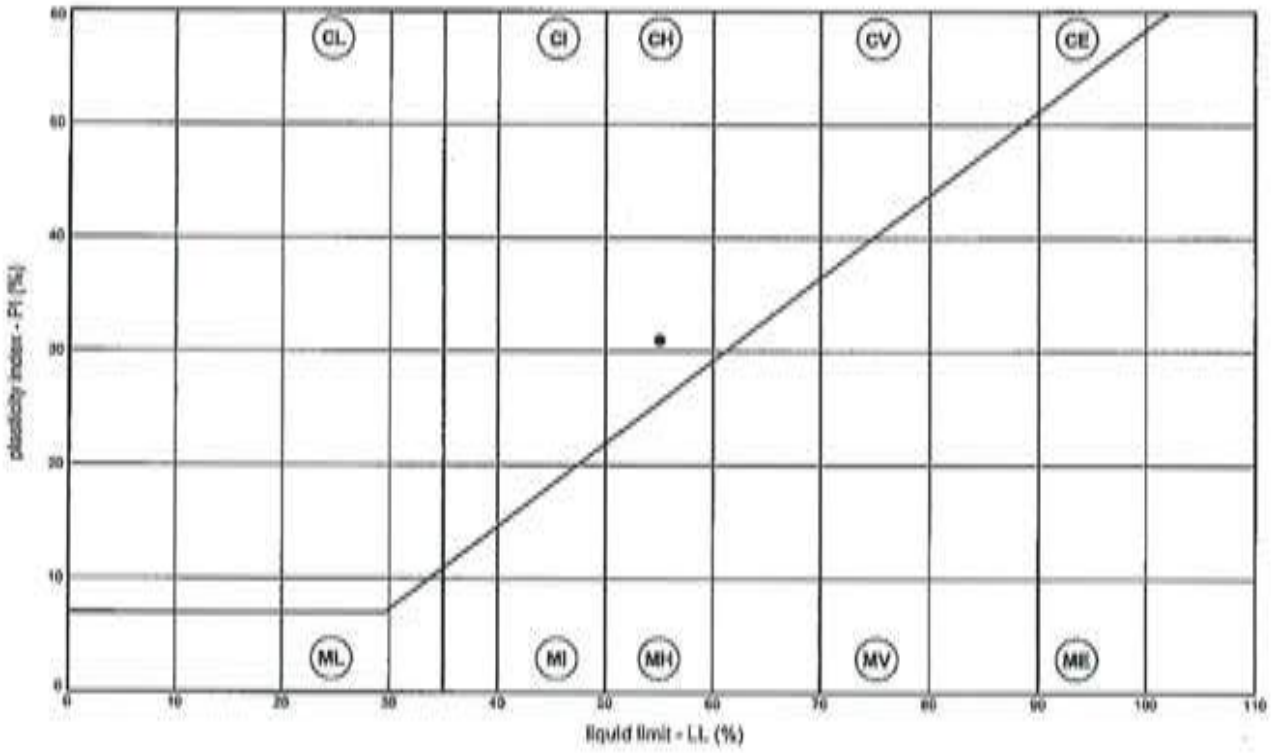
ATTERBERG LINE PLOT

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY



	BH/TP No.	depth (m)	LL	PL	PI	remarks
●	BH01	1.10	55	24	31	

CONTRACT	CHECKED
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UNDRAINED TRIAXIAL COMPRESSION

BS.1377 : Part 7 : 1990 : 8 and 9

CLIENT KRAFT FOODS LIMITED

SITE PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY

borehole / trial pit no.	sample no./type	sample depth (m)	specimen depth (m)	code	moisture content (%)	density bulk (Mg/m³)	density dry (Mg/m³)	cell pressure (kPa)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks
BH01	20U	4.60	4.60	UU70	17.6	2.20	1.87	60	475	5.7	S	238	Grey slightly sandy CLAY
BH01	24C	6.60	6.50	UU70	20.4	2.22	1.84	110	242	11.4	S	121	Grey slightly sandy CLAY
BH01	27C	7.10	7.60	UU38	24.2	2.01	1.62	150	143	15.8	I	72	Grey slightly sandy CLAY

general remarks: * shear strength taken as half deviator stress at failure for each stage.
# denotes sample unsuitable to test.

code:
CD - Consolidated drained
CU - Consolidated undrained
UU - Unconsolidated undrained
M - Multistage
S - Set of 3 specimens
R - Remoulded
38 - 38mm dia. x 76mm
70 - 69mm dia. x 140mm
100 - 106mm dia. x 200mm

failure mode:
B - barrelling (plastic failure)
S - shear (brittle failure)
I - intermediate
O - other (see remarks)

membrane correction applied
sample taken vertically (unless specified)
rate of strain = 2%/min (unless specified)

membrane thickness
38 - 0.2mm 70 - 0.4mm
100 - 0.4mm

CONTRACT	CHECKED
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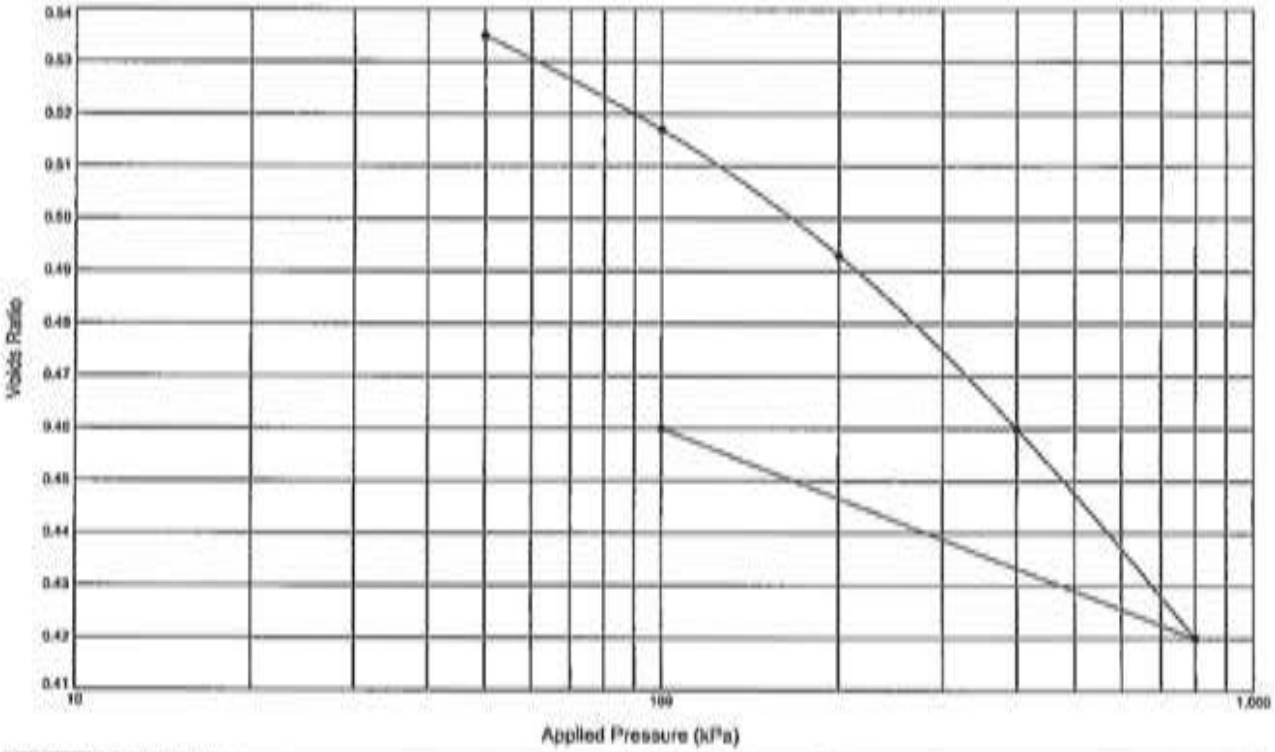
CONSOLIDATION TEST

BS.1377 : Part 5 : 1990 : 3

CLIENT	KRAFT FOODS LIMITED	BH/TP No.	BH01
SITE	PROPOSED EVAPORATORS, KRAFT FOODS, BANBURY	SAMPLE No./TYPE	24C
		SAMPLE DEPTH (m)	5.60
DESCRIPTION	Grey slightly sandy CLAY	SPECIMEN DEPTH (m)	6.80



Test and sample details			Test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility (m^2/MN)	laboratory coefficients of consolidation (m^2/year)
specimen diameter	(mm)	63.48				
specimen height	(mm)	19.04				
initial moisture content	(%)	19.1				
final moisture content	(%)	20.3				
initial bulk density	(Mg/m^3)	2.08	50	0.535		
initial dry density	(Mg/m^3)	1.74	100	0.517	0.238	7.23
initial voids ratio		0.548	200	0.493	0.161	4.80
initial degree of saturation	(%)	94	400	0.460	0.110	4.93
particle density	(Mg/m^3)	#2.70	800	0.420	0.069	4.05
swelling pressure	(kPa)	N/A	100	0.460	0.041	
P'o to P'o +100 kPa	(kPa)	*				
laboratory temperature	(°C)	21				
method of time fitting		root time				

remarks: # denotes particle density has been assigned an assumed value
Specimen swelled on first load stage at 50kPa

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25186	WJ

Chemtest
The right chemistry to deliver results

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Newmarket
CB8 0AL
Tel 01638 606070

Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester
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FAO Wendy Jones
14 March 2011

Dear Wendy Jones

Test Report Number **58679**
Your Project Reference **Proposed Evaporators, Kraft Foods, Banbury - 25186**

Please find enclosed the results of analysis for the samples received 4 March 2011.

All soil samples will be retained for a period of one month and all water samples will be retained for 7 days following the date of the test report. Should you require an extended retention period then please detail your requirements in an email to customerservices@chemtest.co.uk. Please be aware that charges may be applicable for extended sample storage.

If you require any further assistance, please do not hesitate to contact the Customer Services team.

Yours sincerely

[redacted]

Authorised Signatory

- ☐ Darrell Hall — Director
- ☐ Phil Hellier — Director
- ☑ Keith Jones — Technical Manager
- ☐ John Crawford — Quality Manager
- ☐ Malcolm Avis — Director

2183

ISO 14001 sira UKAS

Notes to accompany report:

- *The sign < means 'less than'*
- *Tests marked 'U' hold UKAS accreditation*
- *Tests marked 'M' hold MCertS (and UKAS) accreditation*
- *Tests marked 'N' do not currently hold UKAS accreditation*
- *Tests marked 'S' were subcontracted to an approved laboratory*
- *n/e means 'not evaluated'*
- *i/s means 'insufficient sample'*
- *u/s means 'unsuitable sample'*
- *Comments or interpretations are beyond the scope of UKAS accreditation*
- *The results relate only to the items tested*

Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester
GL2 4NF

FAO Wendy Jones

LABORATORY TEST REPORT

Results of analysis of 3 samples received 4 March 2011

Proposed Evaporators, Kraft Foods, Banbury - 25186

Chemtest
The right chemistry to deliver results

Report Date
14 March 2011

Login Batch No					58679		
Client's / UMS ID					AF81646	AF81647	AF81648
Sample ID					BH1	BH1	BH1
Sample No					2X	4X	8X
Sampling Date					03/03/2011	03/03/2011	03/03/2011
Depth					1.1m	2.1m	4.6m
Matrix					SOIL	SOIL	SOIL
SOP↓	Determinand↓	CAS No↓	Units↓	*			
2010	pH			M	7.9	7.2	7.2
2175	Sulfur (total TRL report 447)		%	M	0.25	1.49	2.0
2120	Sulfate (2:1 water soluble) as SO4	14808798	g l-1	M	0.05	1.6	1.1
2430	Sulfate (total) by BS1377 (HCl	14808798	%	M	0.05	1.84	0.32

All tests undertaken between 07/03/2011 and 14/03/2011

* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.

Appendix D(ii)

geotechnical

PROJECT: New Evaporators, Kraft Foods, Banbury
PROJECT NO: 25185

Determinand	No. of Tests	Soil Concentrations (mg/kg)		Soil Guideline Value [1] (mg/kg)		Generic Assessment [2] Criteria (mg/kg)	
		Min	Max	SGV	No. > SGV	GAC	No > GAC
pH	3	7.8	7.9				
INORGANICS							
Arsenic	3	10	18	640	0		
Boron	3	0.4	1.1			10000	0
Cadmium	3	0.2	0.58			340	0
Chromium (III)	2	58	60			30400	0
Chromium (VI)	2	<0.5	0.5			35	0
Lead	3	56	80	750	0		
Mercury	2	<0.1	<0.1	480	0		
Nickel	3	42	48	1800	0		
Selenium	3	<0.2	<0.2	13000	0		
Beryllium	2	1	1			430	0
Copper	3	18	22			71700	0
Vanadium	3	45	63			3160	0
Zinc	3	90	120			665000	0
ORGANICS							
Benzo(a)pyrene	2	<0.01	<0.01			14.00	0
Dibenz(a,h)anthracene	2	<0.01	<0.01			13.00	0
Fluorene	2	<0.01	<0.01			64000	0
Naphthalene	2	<0.01	<0.01			2000	0
Acenaphthene	2	<0.01	<0.01			84000	0
Acenaphthylene	2	<0.01	<0.01			84000	0
Anthracene	2	<0.01	<0.01			630000	0
Benz(a)anthracene	2	<0.01	<0.01			99.0	0
Benzo(b)fluoranthene	2	<0.01	<0.01			100.0	0
Benzo(ghi)perylene	2	<0.01	0.01			660	0
Benzo(k)fluoranthene	2	<0.01	<0.01			140.0	0
Chrysene	2	<0.01	<0.01			140.0	0
Dibenzofuran	2	<0.01	<0.01			2000	0
Indeno(123-cd)pyrene	2	<0.01	<0.01			99.0	0
Phenanthrene	2	<0.01	<0.01			22000	0
Pyrene	2	<0.01	<0.01			54000	0
Phenol	2	<0.3	<0.3	51000	0		

Footnotes

1. SGV and GAC based on an end-use of commercial/industrial
2. Figures in blue = published SGVs 2009
3. Figures in red = Generic Assessment Criteria (GAC) for Human Health Risk Assessment (2nd edition) published by Chartered Institute of Environmental Health/Land Quality Management Ltd dated 2009
4. Soil Organic Matter (SOM) calculated based on Total Organic Carbon analysis, assuming 58% carbon content. SOM mean is arithmetic mean.

Stratum : Made Ground/Lower Lias
Minimum Depth of Sample: 0.65m
Maximum Depth of Sample: 3.60m

Chemtest
The right chemistry to deliver results

Depot Road
Newmarket
CB8 0AL
Tel 01638 606070

Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester
GL2 4NF

FAO Sam Bevins
14 March 2011

Dear Sam Bevins

Test Report Number **58678**
Your Project Reference **Kraft Foods, Banbury - 25186/SB**

Please find enclosed the results of analysis for the samples received 4 March 2011.

All soil samples will be retained for a period of one month and all water samples will be retained for 7 days following the date of the test report. Should you require an extended retention period then please detail your requirements in an email to customerservices@chemtest.co.uk. Please be aware that charges may be applicable for extended sample storage.

If you require any further assistance, please do not hesitate to contact the Customer Services team.

Yours sincerely

[redacted]

Authorised Signatory

- ☐ Darrell Hall — Director
- ☐ Phil Heller — Director
- ☑ Keith Jones — Technical Manager
- ☐ John Crawford — Quality Manager
- ☐ Malcolm Avis — Director

2183

ISO 14001 sira UKAS

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Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester
GL2 4NF

FAO Sam Bevins

LABORATORY TEST REPORT

Results of analysis of 2 samples received 4 March 2011

Kraft Foods, Banbury - 25186/SB

Chemtest
The right chemistry to deliver results

Report Date
14 March 2011

Login Batch No					58578	
Chemtest LIMS ID					AF91637	AF91638
Sample ID					BH01	BH01
Sample No						
Sampling Date					03/03/2011	03/03/2011
Depth					0.65m	3.5m
Matrix					SOIL	SOIL
SOP↓	Determinand↓	CAS No↓	Units↓	*		
2010	pH			M	7.9	7.3
2300	Cyanide (total)	57125	mg kg^{-1}	M	<0.50	<0.50
2120	Boron (hot water soluble)	7440428	mg kg^{-1}	M	0.4	1.1
	Sulfate (2:1 water soluble) as SO4	14808798	g l^{-1}	M	0.04	0.93
2490	Chromium (hexavalent)	18540299	mg kg^{-1}	N	<0.5	<0.5
2450	Arsenic	7440382	mg kg^{-1}	M	16	10
	Beryllium	7440417	mg kg^{-1}	U	1.00	<1.00
	Cadmium	7440439	mg kg^{-1}	M	0.56	0.20
	Chromium	7440473	mg kg^{-1}	M	60	58
	Copper	7440508	mg kg^{-1}	M	22	18
	Mercury	7439976	mg kg^{-1}	M	<0.10	<0.10
	Nickel	7440020	mg kg^{-1}	M	49	42
	Lead	7439921	mg kg^{-1}	M	90	58
	Selenium	7782492	mg kg^{-1}	M	<0.20	<0.20
	Vanadium	7440622	mg kg^{-1}	M	53	46
	Zinc	7440666	mg kg^{-1}	M	130	96
2490	Chromium (trivalent)	7440473	mg kg^{-1}	N	60	58
2700	Naphthalene	91203	mg kg^{-1}	N	<0.01	<0.01
	Acenaphthylene	208968	mg kg^{-1}	N	<0.01	<0.01
	Acenaphthene	83329	mg kg^{-1}	N	<0.01	<0.01
	Fluorene	86737	mg kg^{-1}	N	<0.01	<0.01
	Phenanthrene	85018	mg kg^{-1}	N	<0.01	<0.01
	Anthracene	120127	mg kg^{-1}	N	<0.01	<0.01
	Fluoranthene	206440	mg kg^{-1}	N	<0.01	<0.01
	Pyrene	129000	mg kg^{-1}	N	<0.01	<0.01
	Benzo[a]anthracene	56553	mg kg^{-1}	N	<0.01	<0.01
	Chrysene	218019	mg kg^{-1}	N	<0.01	<0.01

All tests undertaken between 07/03/2011 and 14/03/2011

* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.

Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester
GL2 4NF

FAO Sam Bevins

LABORATORY TEST REPORT

Results of analysis of 2 samples received 4 March 2011

Kraft Foods, Banbury - 25186/SB

Chemtest
The right chemistry to deliver results

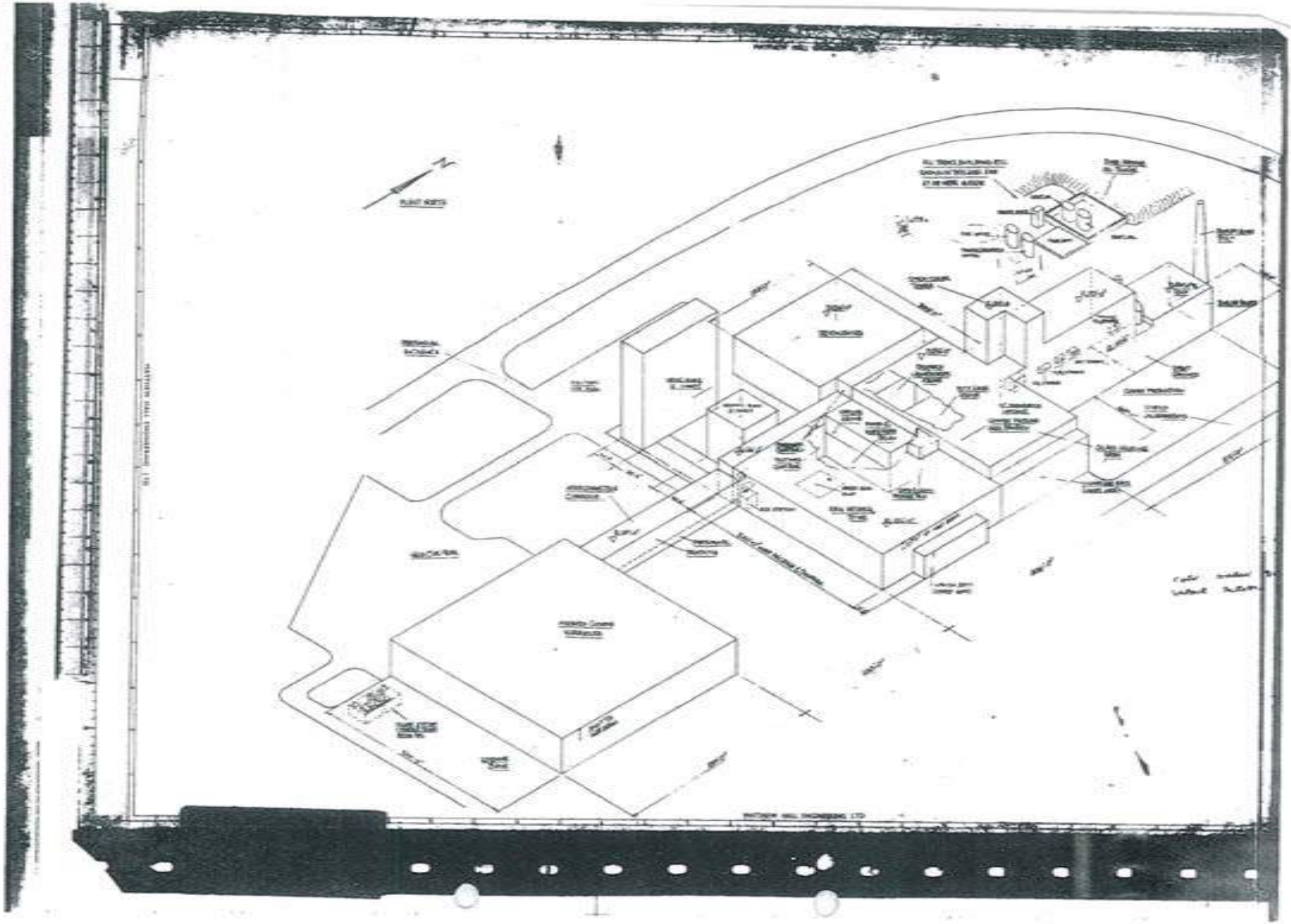
Report Date
14 March 2011

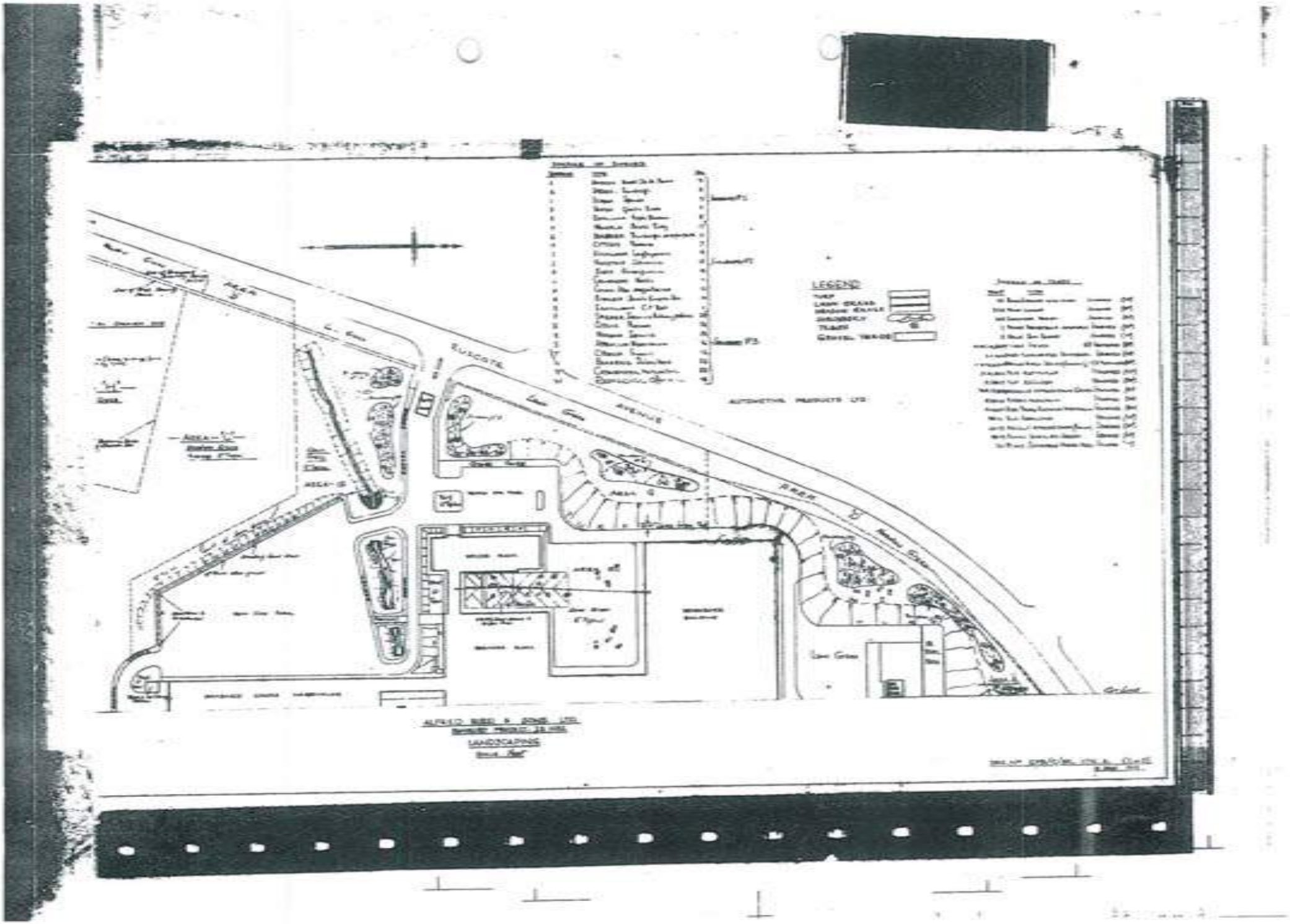
						58678	
						AF81637	AF81638
						BH01	BH01
						03/03/2011	03/03/2011
						0.65m	3.5m
						SOIL	SOIL
2709	Benzo[b]fluoranthene	205992	mg kg-1	N		<0.01	<0.01
	Benzo[k]fluoranthene	207089	mg kg-1	N		<0.01	<0.01
	Benzo[a]pyrene	50328	mg kg-1	N		<0.01	<0.01
	Dibenzo[a,h]anthracene	53703	mg kg-1	N		<0.01	<0.01
	Indeno[1,2,3-cd]pyrene	193395	mg kg-1	N		<0.01	<0.01
	Benzo[g,h,i]perylene	191242	mg kg-1	N		<0.01	<0.01
	Total (of 16) PAHs		mg kg-1	N		<0.2	<0.2
2920	Phenols (total)		mg kg-1	N		<0.3	<0.3

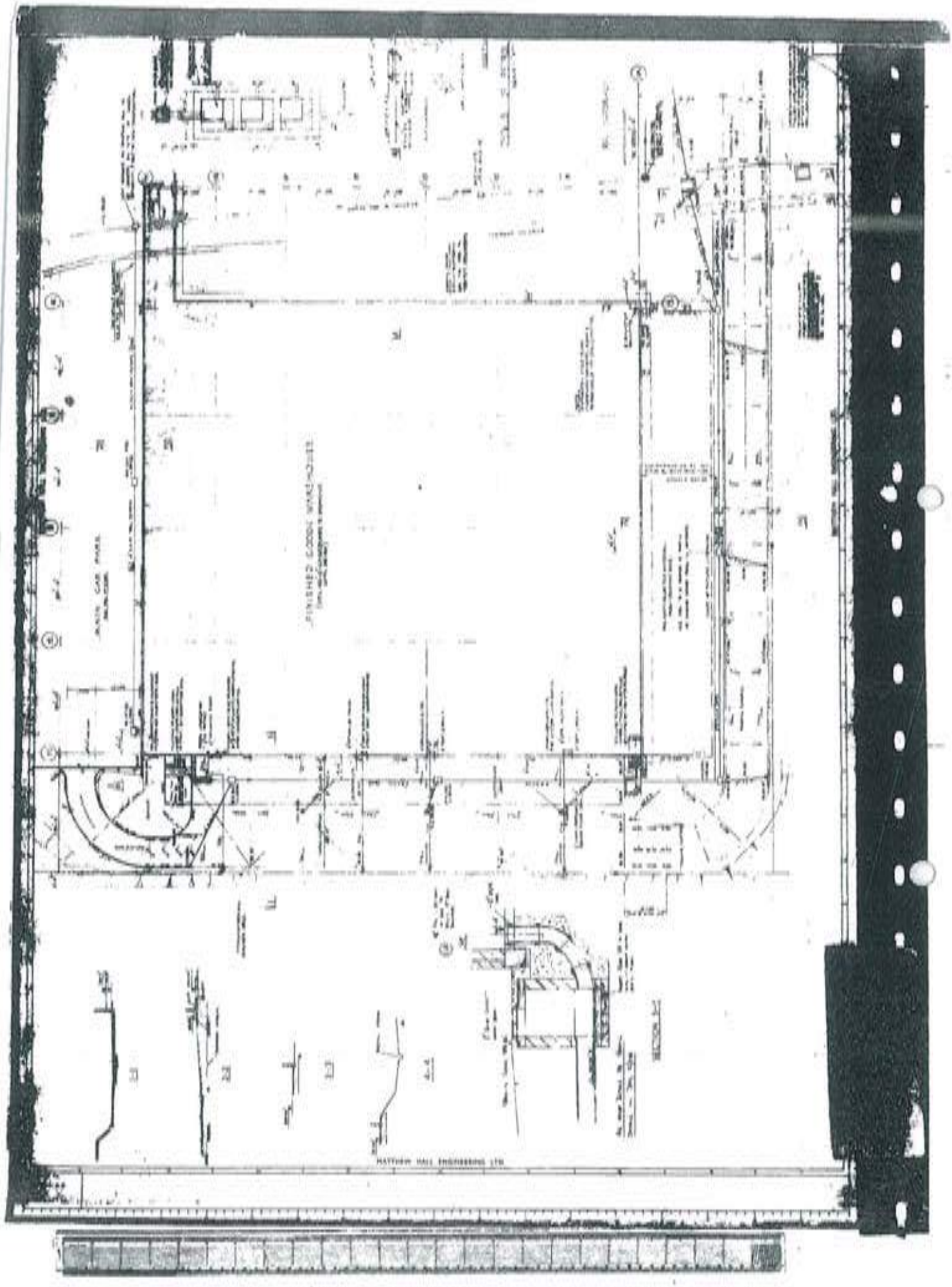
All tests undertaken between 07/03/2011 and 14/03/2011

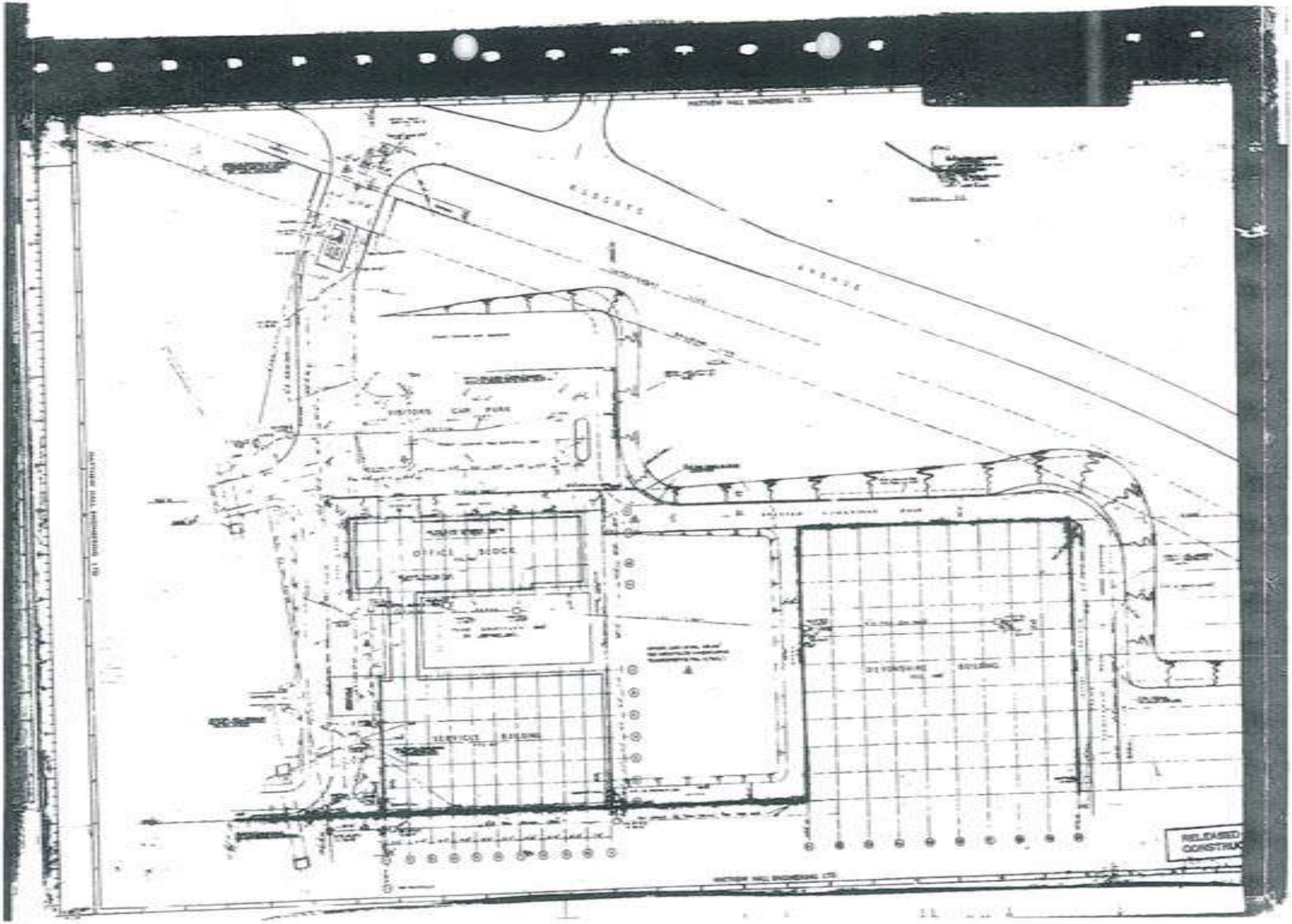
* Accreditation status

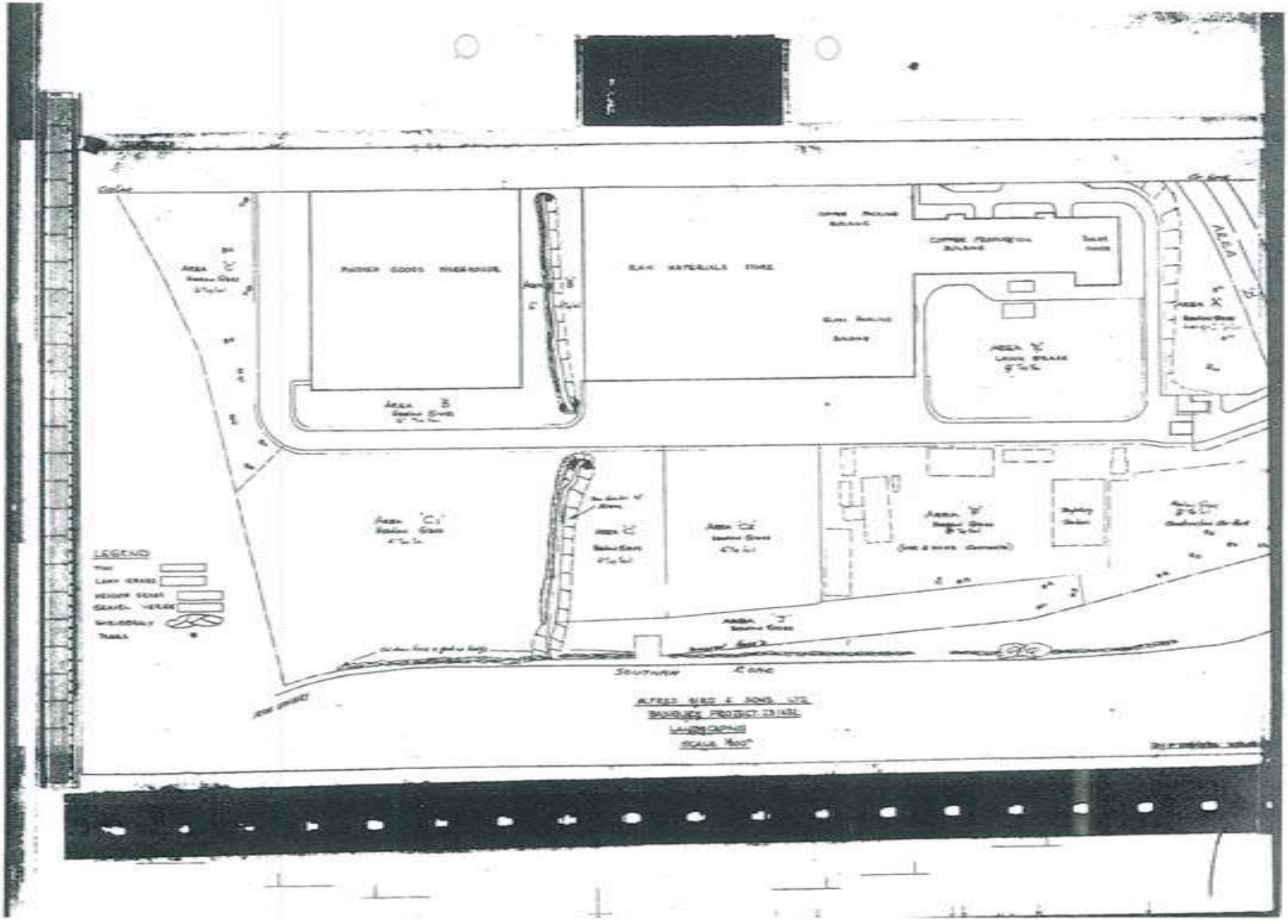
This report should be interpreted in conjuction with the notes on the accompanying cover page.

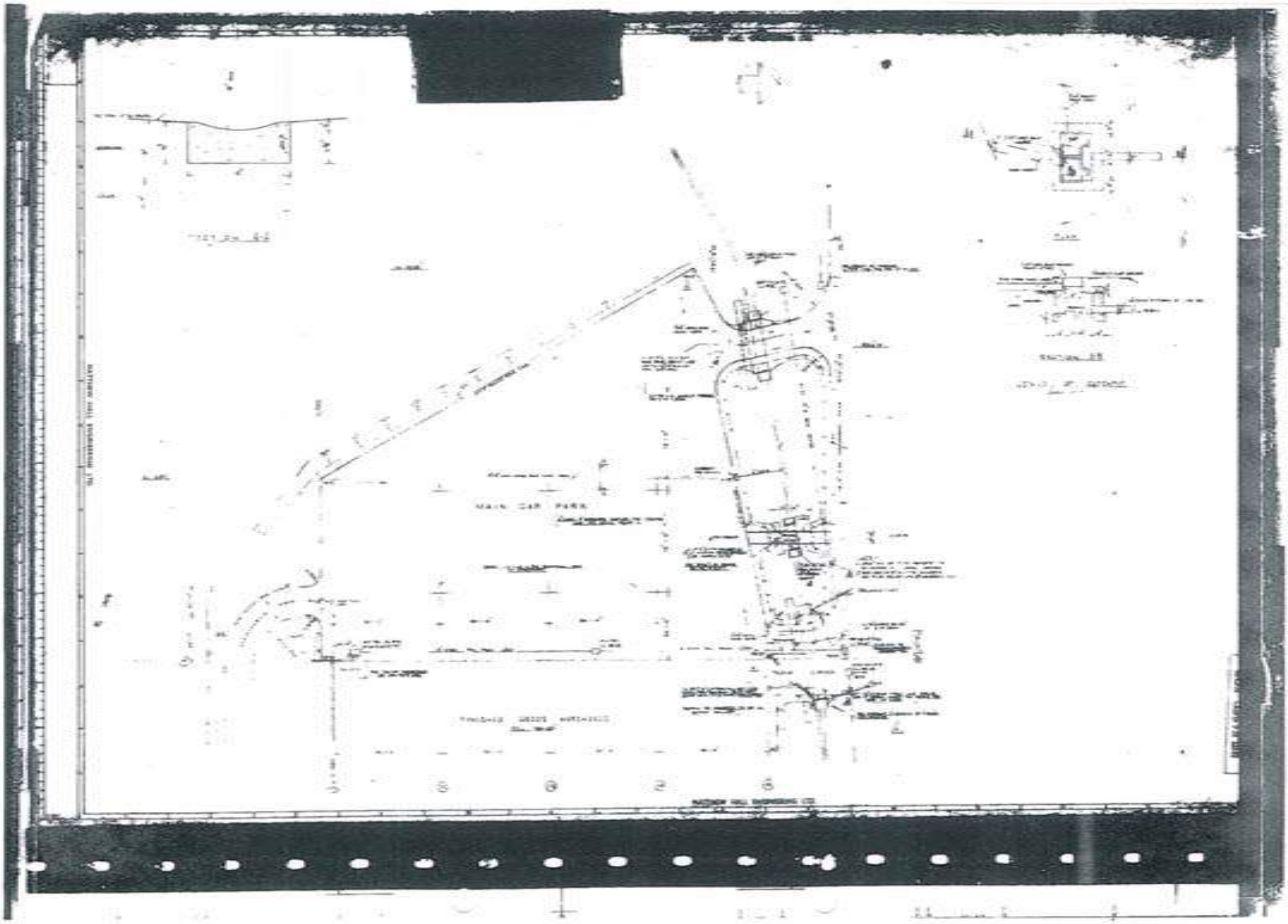



LEGEND
AUTOMOTIVE PRODUCTS LTD
LANDSCAPING




OFFICE BLOCK
SERVICE BUILDING
RELEASED
CONSTRUC


FINISHED GOODS WAREHOUSE
RAW MATERIALS STORE
AREA 'A'
AREA 'B'
AREA 'C'
AREA 'C1'
AREA 'C2'
AREA 'D'
AREA 'E'
AREA 'F'
AREA 'X'
LEGEND
SOUTHERN ZONE



Appendix 5 Responses to Requests for Public Register Environmental Information

Southam Road Retail Park, Banbury

Ground Stability and Phase 1 Contaminated Land Desk Study

Robert Foster

From: WT Enquiries [WTenquiries@environment-agency.gov.uk]
Sent: 23 January 2012 17:51
To: Robert Foster
Subject: FW: Southam Road, Banbury (our ref WT003495)
Attachments: Southam Road_EA.pdf; nirs report 1.htm; nirs report 2.htm; nirs report 3.htm; nirs report 4.htm; nirs report 5.htm; nirs report 6.htm; discharges.htm; Licence-PP3533KB.htm; new standard notice 2011.pdf

Dear Mr Foster

With reference to your request; please find attached reports of pollution incidents (nirs reports) and discharge consents,within the 250 metre radius of the site you are interested in.

I have checked thoroughly and can confirm that there are no records of water abstractions licences within this search radius;

We have no groundwater and surface water quality monitoring data within this search radius;

We have no records of any landfill sites within this search radius;

We have no record of waste transfer and waste treatment sites within this search radius;

" Details of all current licences including radiological sources in force for Part A processes"- licence PP3533KB attached.

Please do not hesitate to contact me if you have any questions.

Kind regards

Tristan

Tristan Hayden
External Relations Officer
01491 828439

External Relations
Planning & Corporate Services
Environment Agency
South East region
West Thames Area
Red Kite House
Howbery Park
Wallingford
Ox10 8BD

From: Robert Foster [mailto:RFoster@peterbrett.com]
Sent: 21 December 2011 10:35
To: WT Enquiries
Subject: Southam Road, Banbury

Dear EA,

Further to our earlier conversation, please find attached request for information for site at Southam Road, Banbury.

My direct dial is 0118 9520251

Regards,
Robert Foster
Engineer
For and on behalf of Peter Brett Associates LLP
Caversham Bridge House, Waterman Place, Reading, Berkshire, RG1 8DN
Tel: +44 (0)118 950 0761
Fax: +44 (0)118 959 7498
E-mail: rfoster@peterbrett.com
Website: www.peterbrett.com

Selection Results
NIRS2 Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting	No
857571	11-Feb-2011	Thames Region	West - Thames	Thames Region	West	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45232 41592	445232	24

Selection Results
NRS2 Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting	No
857571	11-Feb-2011	Thames Region	West - Thames	Thames Region	West	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45232 41592	445232	24

Selection Results
NRS2 Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting	No
951086	13-Oct-2011	South East Region	West Thames	South East Region	West Thames	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45024 41795	445024	24

Selection Results
NIRS2 Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting	No
214287	02-Feb-2004	Thames Region	West - Thames	Thames Region	West	Roscote Avenue, Banbury	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45036 41564	445036	24
942581	21-Nov-2011	South East Region	West Thames	South East Region	West Thames	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45036 41566	445036	24

Selection Results
NRSZ Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting	No
845730	23-Dec-2010	Thames Region	West - Thames	Thames Region	West	Hardwick	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45326 41878	445326	24

Selection Results
NIRS2 Pollution Incidents

Notification Identifier	Notification Date	EA Water Management Region	EA Water Management Area	EA Public Face Region	EA Public Face Area	Location	County	Unitary Authority	District Authority	National Grid Reference	Easting
87089	24-Jun-2002	Thames Region	West - Thames	Thames Region	West	Roscote Avenue, Banbury	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 4506 / 41360	44506
682378	28-May-2009	Thames Region	West - Thames	Thames Region	West	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45065 41358	44506
851461	19-Jan-2011	Thames Region	West - Thames	Thames Region	West	Spiceball Country Park	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45059 41358	44505
290881	10-Jul-2004	Thames Region	West - Thames	Thames Region	West	Banbury (Oxfordshire)	OXFORDSHIRE COUNTY		CHERWELL DISTRICT	SP 45051 41562	44505

Selection Results
WIMS Active Discharge Consents

Consent Number	Version Number	Previous Number	Date Issued	Date Effective	Date Reviewed	Date Revoked	Consent Comment	Short Name	Long Name	Address 1	Address 2	Address 3	Address 4	Post Code	Discharg
CAWM/0243	1		04-Sep-2000	10-Aug-2000	10-Aug-2004			KRAFT FOODS	KRAFT FOODS, OUTLET 2 NORTH SIDE	COFFEE OPERATIONS	RUSCOTE AVENUE	BANBURY	OXFORDSHIRE	OX16 2QU	SP45250
CNTM/0669	3		25-Sep-2009	01-Jan-2010	01-Jan-0014		OSM MODIFICATION	SETTLED DISC	SETTLED DISCHARGE, GRIMSBURY WATER	SETTLED DISCHARGE, GRIMSBURY WAT	ER WORKS, BANBURY, OXFORDSHIRE	-	-		SP45600
CNTM/1679	1		20-Dec-1994	20-Dec-1994			ConNo:WR1679 AppNo:7330 NoDis:1000000000 AbRef: AbNGR: PlcTP: Expir:	KRAFT JACOBS	KRAFT JACOBS SUCHARD, RUSCOTE AVENU	KRAFT JACOBS SUCHARD, RUSCOTE AV	ENUE, BANBURY, OXFORDSHIRE, OX16	7QU	-		SP45100
CNTM/1678	1		20-Dec-1994	20-Dec-1994			ConNo:WR1678 AppNo:7329 NoDis:1000000000 AbRef: AbNGR: PlcTP: Expir:	KRAFT JACOBS	KRAFT JACOBS SUCHARD, RUSCOTE AVENU	KRAFT JACOBS SUCHARD, RUSCOTE AV	ENUE, BANBURY, OXFORDSHIRE, OX16	7QU	-		SP45100
CTCR/2060	1		21-Nov-1983	21-Nov-1983			ConNo:2060 AppNo: NoDis:1 AbRef: AbNGR: PlcTP: Expir:	BATCHING PLA	BATCHING PLANT, SOUTHAM ROAD, BANBU	BATCHING PLANT, SOUTHAM ROAD, BA	NBURY, OXON, OX16 7SE	-	-		SP45400

Selection Results
PAS Active IPPC Authorisations

EA Region	EA Area	Original PAS Number	Current PAS Number	Operator Name	Permission Status	Local Authority	Installation Name	Address Line 1	Address Line 2	Address Street Name	Address Locality	Address Town	Address Post Town	Addre
SouthEast	West Thames	PP3533KB	PP3533KB	Kraft Foods UK Production Limited	Transfer Effective	CHERWELL DISTRICT COUNCIL	Combustion Plant, Banbury		Kraft Foods Uk Limited	Roscote Avenue		Banbury	Oxon	

Kraft, Phase 2, Banbury

Ground Conditions Desk Study

Final Report for

db symmetry ltd

April 2016

Hydrock Ref: R/161279/001

DOCUMENT CONTROL SHEET

Issued by: Hydrock Consultants Limited
3 Hawthorn Park
Holdenby Road
Spratton
Northampton
NN6 8LD

Tel: 01604 842888
Fax: 01604 842666
www.hydrock.com

Client: DB Symmetry ltd

Project: Kraft, Phase 2

Title: Ground Conditions Desk Study Report

Status: Final

Date: April 2016

Document Production Record

Issue number:	1	Name	Signature
Prepared		**Nathan Thompson** BSc FGS	[redacted]
Checked		**Simon Cook** BSc MSc C.Eng C.Geol MIMMM FGS	
Approved	P.p.	**Allan Bell** BSc MSc C.Geol RoGEP FGS	

Document Revision Record

Issue number	Date	Revision details
1	27th April 2016	Original issue.

Contents

Appendices

Executive Summary and Conceptual Site Model

SITE INFORMATION AND SETTING	
Report Purpose	Phase 1 desk study and preliminary risk assessment.
Client	DB Symmetry ltd
Site Name and Location	Kraft, Phase 2, Southam Road, Banbury, OX16 2EP. National Grid Reference of the approximate centre of the site is 445134E, 241431N.
Proposed Development	The proposed development is to be commercial/industrial. However, no specific development proposals have been provided to Hydrock.
PHASE 1 (DESK STUDY + WALK-OVER)	
Current Land Use and Description	The site is approximately 6.10ha and forms the southern part of the existing Kraft factory site. The site currently comprises a warehouse, part of the existing Kraft factory (in the centre and north), with a lorry park and lorry wash in the west, a large car park in the east and grassed areas in the south and northwest. There is an electricity sub-station in the southwest of the site. The warehouse was previously used as a storage area for Kraft but is currently vacant. There is a brook in the northwest of the site, which is then culverted (four pipes) below the warehouse, exiting on the eastern side of the warehouse (from two pipes) before flowing into the River Cherwell approximately 500m to the east. The site slopes slightly down from the west to the east with an approximate 4m drop from the car park to the warehouse.
Site History	The site was fields, with a brook in the northeast, since the earliest available mapping (1881). In 1965 the warehouse building is shown, as part of the larger Kraft factory. A car park is shown in the west of the site from 1984. Overhead power lines and a pylon are shown in the southeast of the site from 1965 until 1970.
Unexploded Ordnance	A non-specialist UXO assessment indicates a low bomb risk and no further consideration of UXO is required.
Geology	The available geological sources indicate the site to be underlain by the Charmouth Mudstone Formation. Alluvial deposits are shown to present approximately 20m east of the site. Made Ground is anticipated locally at least due to the current/former development of the site.
Hydrogeology	The alluvium is classified by the Environment Agency as a Secondary A Aquifer and the Charmouth Mudstone Formation as a Secondary (Undifferentiated) aquifer. The site is/ is not within a groundwater source protection zone (SPZ).
Hydrology	Bird Brook flows west to east in the northwest of the site before being culverted beneath the warehouse and exiting the site towards the east, to flow into the River Cherwell approximately 500m to the east. The Oxford Canal runs north to south 300m east of the site.
Flood Risk	The site is in Flood Zone 1. No further consideration is given to flood risk in this report.
Radon	• The site is in a Radon Affected Area, although no radon protective measures are necessary according to current guidance. However, consideration should be given to fitting basic protective measures to reduce risks to as low as reasonably practicable.

<table>
<tr><td>Natural Soil Chemistry (mg/kg)</td><td colspan="2">The recorded natural chemistry of the soil in the area is as follows (all values are in mg/kg): As 15 - 25; Cd <1.8, Cr 90 - 120, Pb <100 - 200, Ni 30 - 45.</td></tr>
<tr><td>Geotechnical Hazards Identified from Desk Study</td><td colspan="2">Uncontrolled Made Ground – excessive settlement (creep and inundation settlement or differential settlement) of foundations, roads and infrastructure elements.
Low strength compressible ground – excessive settlement of foundations, roads, infrastructure elements.
Attack of buried concrete by aggressive ground conditions, the Charmouth Mudstone Formation is known to be high in naturally occurring sulfates and potentially pyritic.
Shrinkage/swelling of clay – settlement/heave of foundations when located within the influence of trees and vegetation.
Slope instability – there is a steep unretained slope between the warehouse and the adjacent car park. Consideration of the long term stability of this slope will need to be given in the design of any new development.</td></tr>
<tr><td rowspan="5">Possible Contaminant Linkages of Moderate or Greater Risk Level - From Desk Study</td><td colspan="2">The possible pollutant linkages on an unremediated site determined by the desk study and walk-over are summarised below for risk levels of moderate or greater.</td></tr>
<tr><td>Source(s)</td><td>◄ potential Impact on ► Receptor(s)</td></tr>
<tr><td>Metals and other inorganics within Made Ground.</td><td>Future site users
Neighbours (during redevelopment works)</td></tr>
<tr><td>Ground Gases from bio-degradable matter in the alluvium and Made Ground</td><td>Future site users
Neighbours
Buildings</td></tr>
<tr><td>Asbestos fibres from insulation or asbestos containing materials in the Made Ground.</td><td>Future site users
Neighbours</td></tr>
<tr><td colspan="3">ASSESSMENT AND CONCLUSIONS</td></tr>
<tr><td>Conclusions</td><td colspan="2">Based on historical land uses and its current operational use, the overall risk from land contamination at the site is considered to be low for the current development, and low to moderate for a redeveloped site. However, this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.
It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.
Based on the available desk study and walk-over information, the following geotechnical issues need to be addressed by the exploratory investigation:
• depth of Made Ground across the site;
• strata and soil strength profile beneath the site; and
• sulfate concentration with depth.
• stability of the on-site slope.</td></tr>
</table>

FUTURE CONSIDERATIONS	
Further Work	In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, the following site investigation is proposed: • the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential and 'digability'; • dynamic sampling to allow collection of samples for geotechnical and chemical analysis of shallow soils and allow *in situ* testing (SPTs) to be undertaken for foundation design, and allow the installation of gas and groundwater monitoring wells; • cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils and allow *in situ* testing (SPTs) to be undertaken for foundation design, and allow the installation of gas and groundwater monitoring wells; • gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored; • gas concentration and groundwater level monitoring; • geotechnical testing of soils and rock; and • contamination analyses of soil and groundwater.

This Executive Summary forms part of Hydrock Consultants Limited report number R/161279/001 (Issue 1) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

In April 2016, Hydrock Consultants Limited (Hydrock) was commissioned by Savills working on behalf of DB Symmetry Limited to undertake a desk study for Kraft, Phase 2, Southam Road, Banbury, OX16 2EP.

The site currently comprises a warehouse, part of the existing Kraft factory (in the centre and north), with a lorry park and lorry wash in the west, a large car park in the east and grassed areas in the south and northwest.

The proposed development will be commercial/industrial, although no specific development proposals have been provided to Hydrock.

A site location plan (Hydrock Drawing 161279-D001), and a site survey plan (Hydrock Drawing 161279-D001) are presented in Appendix A.

1.2 Objectives

The objectives of this investigation are to assess the readily available information on the likely ground conditions at the site to determine potential geo-environmental (contamination) and geotechnical risks to possible future development.

1.3 Scope

The scope of work for this commission comprises a desk study and site walk-over reconnaissance to determine the nature of the site and its surroundings including current and former land uses, geology, hydrogeology, hydrology and geo-environmental data and reporting on the findings.

See Appendix E for detailed reporting methodology.

1.4 Provided Information

- Corstrophine and Wright's 'Proposed Site Plan, Southam Road Retail Park, Banbury', dated . February 2016 (Ref: 11619/0266) has been provided to Hydrock to assist in the preparation of this report.

1.5 Approach

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 M*odel Procedures* (Environment Agency 2004). The technical details of the approach and the methodologies adopted are given in Appendix E.

A recognised phased approach has been followed and this Phase 1 desk study and walk-over provides a preliminary assessment of the site conditions and the important factors that may require further investigation to reduce uncertainty. Recommendations for further work are listed at the end.

2.0 PRELIMINARY INVESTIGATION (PHASE 1 STUDY)

A number of desk study sources have been used to assemble the following information, including a proprietary environmental data report which has been obtained for the site (dated 15th April 2016) and is presented in Appendix D.

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	Kraft, Phase 2.
Site location and grid reference	Off the A361, Southam Road, Banbury, Oxfordshire, OX16 2EP. The National Grid Reference of the approximate centre of the site is 445134E 241431N.

A site location plan is provided in Appendix A (Hydrock Drawing 161279-D001).

2.2 Site Description and Walk-Over Survey

A walk-over survey was undertaken on 18th April 2016 to visually assess potential hazards and receptors. A basic site description is presented in Table 2.2 and selected walk-over photographs are presented in Appendix B.

Table 2.2: Site Description

Item	Brief Description
Site access	Off Ruscote Avenue.
Site area	Approximately 6.10 ha.
Elevation, topography and any geomorphic features	The northwest of the site (carpark) is at an elevation of approximately 100.5mOD and gently slopes towards the east. There is a steep slope between the car park and the adjacent warehouse, which is constructed on a platform at approximately 96.5mOD.
Present land use	The site currently comprises a warehouse, part of the existing Kraft factory (in the centre and north), with a lorry park and lorry wash in the west, a large car park in the east and grassed areas in the south and northwest. There is an electricity sub-station in the southwest of the site. The warehouse was previously used as a storage area for Kraft but is currently vacant. There is a brook in the northwest of the site, which is then culverted (four pipes) below the warehouse, exiting on the eastern side of the warehouse (from two pipes) before flowing into the River Cherwell approximately 500m to the east.
Vegetation	Sporadic trees and vegetation are present along the south and west of the site. Mature poplar trees are present just off site to the southeast.
General site sensitivity	The site is within a generally industrial/commercial setting in the north of Banbury. However, there are houses immediately to the southwest.

Item	Brief Description
Site boundaries and surrounding land	The site is bounded by industrial buildings (other parts of the Kraft factory) to the north, Southam Road and a grassed area to the east, a graveyard to the southeast, residential properties to the southwest and by Ruscote Avenue to the west.

2.3 Site History

A study of historical Ordnance Survey maps (Appendix C) has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development and is summarised in Table 2.3.

Table 2.3: Key Features from Historical Mapping

Map Edition and Scale	Key Features on Site	Key Features off Site
1881: 1:10,560 1882 1:1,250	The site comprises five irregular shaped fields Bird brook is shown flowing through the northwest corner of the site.	A road borders the southwest of the site. A building is shown 50m to the west of the site. A nursery is shown 250m to the south. A cemetery is shown 300m to the southeast. The northern outskirts of Banbury is shown approximately 400m to the south. An Iron Foundry is shown 480m to the south. Oxford canal is shown flowing north to south 300m to the east. The River Cherwell is shown flowing north to south 500m to the east.
1899 – 1900 1:10,560 1:1,250	No significant change.	Banbury Water Works are shown 550m to the northeast. A spring is shown 450m to the northeast.
1920 – 1938 1:10,560 1922 1:2,500	No significant change.	Allotment gardens are shown 100m to the southeast. The iron foundry is no longer shown.
1955 1:10,560	No significant change.	An industrial building has been constructed 120m to the east of the site.
1965 – 1984 1:1,250 1968 1:10,560	An industrial building (food processing plant) has been constructed in the centre of the site within a cutting. A power line crosses the site from west to east and there is an electricity pylon in the southeast of the site.	An industrial building (food processing plant) has been constructed 20m to the north and a second industrial building is shown 200m to the north. Tanks are shown 500m to the north.
1970 1:2,500	The power lines and pylon are no longer shown.	No significant change.

1984 – 1988 1:1,250 1978 – 1980 1:10,000	A car park is shown in the west of the site.	A cemetery is shown 20m to the southeast of the site with a small area of allotment land shown up to the southern boundary. A number of industrial warehouses are shown 50m to the northwest. A tank is shown 270m to the north. Residential housing has been constructed up to the southwestern boundary.
1990 – 1993 1:1,250 1994 – 2010 1:10,000	No significant change.	The allotments are no longer shown. A depot is shown bordering the southeast corner of the site. An electricity sub-station is shown just off the southeast corner of the site.

2.4 Unexploded Ordnance/Bombs

In general accordance with CIRIA Report C681 (Stone *et al* 2009) non-specialist UXO screening exercise has been carried out for the site. There is no indication of former military use and screening against the Zetica regional bomb risk map (Oxfordshire) indicates the site to be in an area where the bomb risk is low. A copy of the map is presented in Appendix D.

Since the available records of aerial bombing are interpreted by Zetica as showing a low bomb risk no further consideration of UXO is required.

2.5 Geology

The general geology of the site area is shown on the 1:50,000 geological map of Banbury (Sheet 201) and is summarised in Table 2.4.

Table 2.4: Geology

Location	Age	Stratigraphic Name	Description
20m east	Quaternary	Alluvium	Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.
On site.	Jurassic.	Charmouth Mudstone Formation	Dark grey laminated shales and dark, pale and bluish grey mudstones.

Some Made Ground is anticipated across the site area associated with the current development.

2.6 Hydrogeology

The aquifer designations given in Table 2.5 are based on the Environment Agency interactive aquifer designation map.

Table 2.5: Hydraulic Characteristics of Strata

Stratum	Aquifer Designation	Hydraulic Characteristics
Alluvium	Secondary (A) aquifer	High water content due to organic nature of material but low permeability due to presence of clay and silts.
Charmouth Mudstone Formation	Secondary undifferentiated aquifer	Lower permeability in mudstone but possibly higher horizontal permeability in shale members.

The site is not within a groundwater Source Protection Zone (SPZ) and there are no licensed groundwater abstractions within 1km of it.

Reference to the Environment Agency web site shows the following groundwater body beneath the site and its current chemical status (Table 2.6).

Table 2.6: Groundwater Body

Category	Label / Status
Waterbody ID	GB40602G600200
Waterbody name	Banbury Jurassic
River basin district	Cherwell
Current quantitative quality	Good
Current chemical quality	Poor
2027 predicted quantitative quality	Good
2027 predicted chemical quality	Good
Protected area	Yes.

2.7 Hydrology and Flooding

The surface water features in the vicinity of the site are listed in Table 2.7.

Table 2.7: Surface Water Features

Feature	Location Relative to Site
Bird Brook (partially culverted	On site in the north and culverted below the warehouse. Flows into the River Cherwell 500m to the east.
Oxford Canal	Runs north to south 300m to the east of the site.
River Cherwell	Flows north to south 500m to the east of the site.

There is one discharge consent on site and one 12m to the north of it, both for trade discharges – site drainage into Bird Brook.

The chemical quality of the River Cherwell was recorded as Grade B (good) in 2009, based on the General Quality Assessment Headline indicators scheme.

The desk study information indicates the proposed development is in Flood Zone 1 (with a low probability of flooding). However, the area is greater than 1 ha so consultation with the Environment Agency is required with a Flood Risk Assessment (FRA).

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

2.8 Waste Management and Hazardous Substances

There are no waste management sites recorded within 250m of the site.

A cemetery is present along the southeast boundary of the site.

There are no records relating to the storage of radioactive materials within 1km of the site.

There are no Local Authority Pollution Prevention and Controls, COMAH sites, NIHHS sites, or Planning Hazardous Substance consents or enforcements within 500m of the site.

There are a number of industrial processes operating on site and in the surrounding area. However, as long as these have been operated in accordance with any applicable permit, no impact on the site is envisaged.

2.9 Previous Evidence of Known Contamination Events

A category 3 (minor) water impact event occurred in the north of the site in June 2002 relating to a discharge of unidentified oil.

2.10 Natural Soil Chemistry

Information contained within the environmental data report (Appendix D) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.8 below.

Table 2.8: Natural Soil Chemistry

Element	Arsenic	Cadmium	Chromium	Lead	Nickel
Concentration (mg/kg)	15 - 25	<1.8	90 - 120	<100 - 200	30 - 45

2.11 Radon

The site is in a Radon Affected Area with recorded radon levels in 1-3% of homes above the action level. Whilst no radon protection measures are required for new buildings at this location in line with current guidance, consideration should be given to fitting basic protection measures on the 'as low as reasonably practicable' principle in view of the legal responsibilities of rental landlords and employers with commercial properties (see Appendix E for further details).

3.0 PRELIMINARY CONCEPTUAL SITE MODEL

3.1 Physical Setting

The preliminary ground model of the site is the basis of the understanding of the ground conditions that will inform the geo-environmental exposure model and the geotechnical hazard assessment.

The site is located off the A361, Southam Road, Banbury. It is currently a vacant industrial unit, a car park, a lorry park and soft landscaping. Bird Brook flows from the west to the east in the northwest corner of the site before being culverted across the remainder of the site.

The underlying bedrock comprises the Charmouth Mudstone Formation, comprising dark grey laminated shales and bluish grey mudstone.

Superficial Alluvial deposits comprising soft to firm compressible silty clay are recorded to the south of the site, and may be present below it.

The alluvial deposits are classified as a Secondary (A Aquifer) and the Charmouth Mudstone Formation as a (Secondary undifferentiated Aquifer). The site is not within a groundwater Source Protection Zone (SPZ).

A category 3 (minor) water impact event occurred in the north of the site (Bird Brook) in June 2002 relating to a discharge of unidentified oil.

There is one on site discharge consent for trade discharges (surface water) into Bird Brook.

3.2 Geo-environmental Exposure Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages based on the contaminant-pathway-receptor approach.

3.2.1 Potential Contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.

- PCBs associated with the electricity sub-station in the southeast of the site.
- Hydrocarbon fuels, lubricant and chlorinated solvents associated with the industrial building.
- Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons.
- Ground gases (carbon dioxide and methane) from alluvial soils.

Potential Off-Site Sources of Contamination

Tanks associated with the Kraft Factory to the north.

3.2.2 Potential Receptors

The following potential receptors are identified.

- Humans (site end users, neighbours).
- Development (buildings, utilities and landscaping).
- Groundwater: Secondary A aquifer (Alluvium) and Secondary (Undifferentiated) aquifer (Charmouth Mudstone Formation).
- Surface water: Bird Brook flowing into the River Cherwell 500m to the east.

It should be noted that health and safety risks to site contractors and maintenance workers have not been assessed during these works and will need to be considered separately.

3.2.3 Potential Pathways

The following potential pathways are identified.

- Humans: ingestion, skin contact, inhalation of dust and indoor air.
- Buildings: methane ingress via permeable soils and/or construction gaps.
- Plant life: root uptake.
- Plant uptake: methane ingress to the root zone.
- Underlying groundwater: migration of contaminants via leachate dispersion through the unsaturated zone in the Alluvium.
- Underlying groundwater: migration of contaminants into the Alluvium and/or Charmouth Mudstone Formation.
- Surface water: overland flow.
- Surface water: drainage discharge.
- Surface water: base flow from groundwater.

3.2.4 Summary of Potential Contaminant Linkages

Table 3.1 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in CLR 11 for which additional risk assessment is required.

Linkages have been assessed in general accordance with guidance in CIRIA Report C552 (Rudland *et al* 2001) but with the addition of a 'no linkage' category. More details are given in Appendix E including descriptions of typical examples of probability and consequences.

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to site demolition and redevelopment workers, consideration of occupational health and safety issues is beyond the scope of this report and need to be considered separately in the Construction Phase Health and Safety Plan.

Table 3.1: Exposure Model – Preliminary Risk Assessment of Source-Pathway-Receptor Contaminant Linkages

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Made Ground: Elevated metals, PAH and petroleum hydrocarbons.	Dermal contact	End users of the site	Likely	Medium	Moderate	There may be elevated Chemicals of Potential Concern in the Made Ground soils which will require assessment to determine the risk.
	Ingestion					
	Inhalation of fugitive dust	Neighbours	Likely	Medium	Moderate	
		End users of the site				
PCBs associated with the electricity sub-station in the southeast of the site.	Dermal contact	End users of the site.	Unlikely	Medium	Low	Electricity sub-station in the southeast of the site. Any PCB's will be localised in this area.
	Ingestion					
Hydrocarbon fuels, lubricants and chlorinated solvents associated with the industrial building.	Ingestion	End users of the site	Low likelihood	Medium	Moderate/Low	Industrial building used for storing products. Concrete slab across warehouse with no visible cracking or signs of wear.
	Dermal Contact					
	Inhalation					
	Leaching through unsaturated zone	Groundwater and possible abstractions	Unlikely	Mild	Very low	
Asbestos fibres from insulation or asbestos-containing materials in the Made Ground	Fugitive dust.	End users of the site.	Low likelihood	Severe	Moderate	Asbestos likely to be present in the Made Ground due to the age of the construction.
		Neighbours.				

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Elevated concentrations of ground gases (methane) from biodegradable matter in the alluvium and Made Ground.	Migration through soils or groundwater to indoor air.	End users of new buildings (asphyxiation or explosion).	Low likelihood	Severe	Moderate	There may be elevated ground gases in the natural Alluvial soils and Made Ground.
		Users of off-site properties (asphyxiation or explosion).				
		New buildings (damage by explosion).				
		Neighbouring properties (damage by explosion).				
Elevated concentrations of ground gases (methane and carbon dioxide) from biodegradable matter in the alluvium and Made Ground.	Migration through soils or groundwater to indoor air.	End users of new buildings (asphyxiation).	Low likelihood	Severe	Moderate	There may be elevated ground gases in the natural Alluvial soils and Made Ground.
		Users of off-site properties (asphyxiation).	Unlikely	Severe	Moderate/Low	

3.3 Geotechnical Hazard Identification

Potential geotechnical hazards based on the expected ground conditions are listed below.

- Uncontrolled Made Ground – excessive settlement (creep and inundation settlement or differential settlement) of foundations, roads and infrastructure elements.
- Low strength compressible ground – excessive settlement of foundations, roads, infrastructure elements.
- Attack of buried concrete by aggressive ground conditions, the Charmouth Mudstone Formation is known to be high in naturally occurring sulfates and potentially pyritic.
- Shrinkage/swelling of clay – settlement/heave of foundations when located within the influence of trees and vegetation.
- Slope instability – there is a steep unretained slope between the warehouse and the adjacent car park. Consideration of the long term stability of this slope will need to be given in the design of any new development.

4.0 DESK STUDY CONCLUSIONS

Table 3.1 is a summary of the geo-environmental risks identified and the overall risk associated with the site has been designated using qualitative judgement according to the risk categories given in Table 4.1.

Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be low to moderate for the current development, and low to moderate for a redeveloped site. However, this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.

It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.

Table 4.1: Assessed Overall Risk Categories for the Site from Land Contamination

Risk Category	Definition
Very High Risk	A significant contaminant linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A contaminant linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Realisation of the risk is likely to present a substantial liability to the site owner or other Responsible Person. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A contaminant linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. It is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low Risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of possibility of harm. It is unlikely that the site owner or other Responsible Person would face substantial liabilities from such a risk. Precautionary investigations and risk assessment advisable on change of use. Any subsequent remedial works are likely to be relatively limited.
Very Low Risk	No contaminant linkage likely to exist under current or future conditions, but this cannot be completely discounted. If harm is realised, it is likely at worst to be mild or minor. Site not capable of being determined under Part 2A where the Local Authority inspects the site. Precautionary investigations and risk assessment advisable on change of use. Otherwise no further action recommended.
No Risk	No contaminant linkage exists.

5.0 UNRESOLVED ISSUES, UNCERTAINTIES AND LIMITATIONS

5.1 Site-Specific Comments

The Phase 1 investigation has highlighted a number of issues that require intrusive investigation and assessment to inform the design of the proposed development.

5.2 General Comments

This report details the findings of work carried out in April 2016. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of DB Symmetry Ltd and those parties designated by them for the purpose of providing geotechnical and geo-environmental recommendations for the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness. It is assumed that previous reports provided have been assigned to the Client and can be relied upon. Should this not be the case Hydrock should be informed immediately as additional work may be required.

The work has been carried out in general accordance with recognised best practice. The various methodologies used are explained in Appendix E. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase 'suitable for use' is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The preliminary risk assessment process may identify potential risks to site demolition and redevelopment workers. However, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds such as Japanese knotweed, this report does not constitute a formal survey of these potential hazards.

Any site boundary line depicted on plans does not imply legal ownership of land.

6.0 RECOMMENDATIONS FOR FURTHER WORK

In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise:

- the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential and 'digability';
- dynamic sampling to allow collection of samples for geotechnical and chemical analysis of shallow soils and allow in situ testing (SPTs) to be undertaken for foundation design, and allow the installation of gas and groundwater monitoring wells;
- cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils and allow in situ testing (SPTs) to be undertaken for foundation design, and allow the installation of gas and groundwater monitoring wells;
- gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored;
- gas concentration and groundwater level monitoring;
- geotechnical testing of soils and rock; an
- contamination analysis of soil and groundwater.

Hydrock

Kraft Phase 2, Banbury

Ground Investigation

Final Report for

db symmetry Limited

July 2016

Hydrock Ref: R/161279/002

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Issue Number	Date	Revision Details
1	15th July 2016	Original issue.
2	26th July 2016	Updated following Comments
3	26th July	Updated following additional Comments.

Contents

Appendices

Executive Summary and Conceptual Site Model

SITE INFORMATION AND SETTING	
Report Purpose	Phase 2 interpretative ground investigation and risk assessment.
Client	db symmetry Limited.
Site Name and Location	Kraft Phase 2, Southam Road, Banbury, OX16 2EP.
Proposed Development	Commercial / industrial development.
PHASE 1 (DESK STUDY AND WALK-OVER)	
Current Land Use and Description	The site comprises a vacant industrial unit, a car park, a lorry park and soft landscaping. Bird brook flows from the west to the east in the northwest corner of the site before being culverted across the remainder of the site. The northwest of the site comprises a car park at an elevation of approximately 100.5m OD and gently slopes towards the east. There is a steep slope between the car park and the adjacent warehouse, which is constructed on a platform at approximately 96.5mOD.
Site History	Historically the site has been fields with Bird Brook in the northwest corner of the site from the earliest available mapping (1881). From 1965 an industrial building (food processing plant) is shown in the centre of the site. A car park is shown in the west of the site from 1984.
Geology	The available geological sources indicate the site to be underlain by Made Ground associated with the development of the site, over Charmouth Mudstone. Alluvium is recorded approximately 20m to the south of the site, and may underlie parts of it.
Hydrogeology	The Alluvium is classed as a Secondary (A) aquifer. The Charmouth Mudstone Formation is classified as a Secondary (Undifferentiated) aquifer.
Hydrology	Bird Brook is present in the northwest of the site flowing west to east, and is culverted beneath the warehouse buildings across the northern extent of the site. Bird Brook flows into the River Cherwell, approximately 500m to the east of the site. Hydrock understand the site storm drainage discharge directly into Bird Brook at numerous locations across the site.
Previous Site Data	A Phase 1 desk study was prepared for the site by Hydrock and issued in April 2016. The data from this desk study have been used alongside the ground investigation data in the preparation this report.
PHASE 2 – GROUND INVESTIGATION	
Hydrock Site Works	The Hydrock ground investigation comprised: • 4 rotary cored boreholes to a maximum depth of 20.14m below ground level (bgl); • 26 window sample boreholes to a maximum depth of 5.45m bgl; • 9 installations of gas/groundwater monitoring boreholes; • 6 rounds of monitoring of gas concentrations and groundwater levels; • chemical analysis of soils and groundwater; and • geotechnical testing of soils and rocks.

Ground Conditions Encountered	The ground conditions as proven by investigation comprise: • Topsoil - to between 0.30m and 0.40m bgl, comprising orange brown sandy slightly gravelly clay; or • Made Ground – to between 0.30m and 2.60m bgl, comprising asphalt or concrete over sandy gravel or clay comprising flint, concrete, ironstone, sandstone; over • Alluvium, present in the east to depths of between 1.20m and 4.60m bgl, comprising soft to firm greenish grey slightly sandy clay with some rootlets and rare reeds. Mild organic odour; over • River Terrace Deposits – to between 0.90m – 8.00m bgl, comprising loose to medium dense orange clayey gravel or firm (occasionally soft) gravelly clay of sandstone, ironstone and flint; over • Charmouth Mudstone Formation – to the full depth of investigation at >20.14m bgl, comprising stiff grey thinly laminated clay becoming a very weak thinly laminated grey mudstone with some shell fragments and bands of limestone.
Groundwater	Groundwater was encountered at between 0.90m bgl and 5.00m bgl during the investigation. Water levels recorded post-fieldwork range from 0.32m bgl to 3.76m bgl.
GEO-ENVIRONMENTAL ASSESSMENT AND CONCLUSIONS	
Conclusions of Contamination Generic Risk Assessment	**Human health:** Subject to agreement with the regulators, Hydrock does not believe the site poses a significant risk to Site users. Asbestos noted in a small number of samples (2 out of 23 Made ground samples). **Plant growth:** Recorded US_{95} value for nickel in soil slightly in excess of the GAC. However, Hydrock considers that and no further assessment of this contaminant is required. **Controlled Waters:** Low risk, subject to agreement with the regulators. **Ground gases or vapours:** Low risk from ground gases and CS 1 conditions apply. **Water Supply Pipework:** Brownfield site and the presumption in the guidance is that barrier pipe will be used.
Proposed Mitigation Measures	Subject to approval, the following remedial strategy is considered necessary. • Capping of soft landscaping with clean soil cover and appropriate materials handling and materials management (there are suitable soils present on site to be used as the cover system). • Protectaline pipework for potable water supplies.
GEOTECHNICAL CONCLUSIONS	
Obstructions	There is existing development on the site comprising an existing warehouse building and associated car parking. Obstructions were encountered at shallow depth in two locations and further obstructions associated with this development, including foundations, floor slabs and services, should be anticipated. Heavy duty excavation plant/breaking equipment may be required to excavate the existing construction.
Groundworks and Earthworks	Excavation to proposed founding depth generally should be readily achievable with standard excavation plant. Some collapse of the near surface soils was noted during drilling, requiring casing of all future boreholes. Groundwater levels are generally shallow and dewatering may be required. Excavated soils should be reusable as follows: • Made Ground - General Fill; • Alluvium - landscaping material only; • River Terrace Deposits - General and Structural Fill; and • Charmouth Mudstone - General and Structural Fill.

Foundations	Pad foundations in the western part of the site. Ground improvement with pad foundations or piled foundations, in the eastern part of the site. Suitable dewatering will be required. Allowable net bearing pressure of 125 kN/m^2 should be available for pad foundations on the firm and stiffer natural fine soils, medium dense and denser coarse soils, or vibro-treated soils, keeping total and differential settlement within acceptable limits. Deepening of foundations/heave protection maybe required to allow for the effects of trees where present.
Ground Floor Slabs	The construction of a ground bearing floor slab will require the over-excavation and replacement of the Made Ground. In the eastern part of the site, due to the poor and variable strength of the Made Ground and the Alluvium the floor slab should be founded on VSCs.
Road Pavement Design (CBR)	Following earthworks, undertaken to a suitable specification, a design CBR of 2.5% should be assumed. A geo-grid will be required in the eastern part of the site.
Soakaways	Soakaway drainage is considered unsuitable for this site.
Buried Concrete	Design Sulfate Class - DS-1 and ACEC Class AC-1 for shallow soils, which equates to a Design Chemical Class DC-1 for a 50 year design life. Design Sulfate Class - DS-2 and ACEC Class AC-3z for piles, which equates to a Design Chemical Class DC-1 for a 50 year design life.
Waste Management	Based on the results of the testing it is anticipated that the natural Alluvium and River Terrace Deposits may be classified as inert for off-site disposal purposes. Excavated Made Ground and Charmouth Mudstone Formation soils may be classified as non-hazardous.
FUTURE CONSIDERATIONS	
Uncertainties and Limitations	Investigation techniques were restricted to boreholes and window samples and the footprint of the buildings has not been fully investigated and further investigation is suggested as part of the detailed design process to establish if pad foundations can be used across a higher proportion of the site then currently available.
Further Work	The following further works will be required during design and construction: • Discussions with regulatory bodies and water authority as required; • detailed design works; • the use of barrier pipework for potable water supplies; and • soft landscape to be completed with clean, validated, site won material. No further investigation work is required outside that which would be required for detailed design and construction.

This Executive Summary forms part of Hydrock Consultants Limited report number R/161279/002 (Issue 3) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

In May 2016, Hydrock Consultants Limited (Hydrock) was commissioned by Savills working on behalf of DB Symmetry limited to undertake a ground investigation for Kraft, Phase 2, Southam Road, Banbury, OX16 2EP.

The site currently comprises a warehouse, part of the existing Kraft factory (in the centre and north), with a lorry park and lorry wash in the west, a large car park is present in the east and grassed areas are present in the south and northwest.

The proposed development will be commercial/industrial, although no specific development proposals have been provided to Hydrock.

A site location plan (Hydrock Drawing 161279-D001) and a site survey plan (Hydrock Drawing 161279-D002) are presented in Appendix A.

1.2 Objectives

The objectives of this investigation are to assess the ground and groundwater conditions to provide initial geotechnical design recommendations and to carry out a risk assessment of potential chemical contaminants to establish 'suitability for use' to assist with the sale of the land.

1.3 Scope

The scope of work for this commission comprises:

- an initial ground investigation including window sampling, rotary drilling, gas and groundwater monitoring, laboratory chemical and geotechnical testing; and
- reporting ground investigation, geo-environmental assessment of the site conditions and geotechnical interpretation of the ground and groundwater conditions.

See Appendix E for detailed reporting methodology.

1.4 Provided Information

The following has been provided to Hydrock by Savills for use in the preparation of this report:

- Corstrophine and Wright. February 2016. 'Proposed Site Plan - Southam Road Retail Park, Banbury'. Ref:11619/0266; and
- Kraft Foods. 9th June 2015. 'Site Plan Indicating Known Underground Services'. Drawing Ref: CD022-01.

1.5 Approach

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 M*odel Procedures* (Environment Agency 2004), the AGS (2006) *Good Practice Guidelines for Site Investigations*, BS 5930:2015 and BS 10175:2011+A1: 2013. The technical details of the approach and the methodologies adopted are given in Appendix E.

A recognised phased approach has been followed, starting with a desk study and walk-over to produce a preliminary assessment of the site conditions and the important factors that require further investigation to reduce uncertainty (issued previously).

Phase 2 comprises intrusive investigation work and testing. The factual data from Phases 1 and 2 are used to develop a conceptual site model (CSM). This comprises a ground model (of the physical conditions) and an exposure model (of the possible contaminant linkages). The CSM forms the basis for a number of risk assessments in accordance with current guidelines. Professional judgement is then used to evaluate the findings of the risk assessments and to provide recommendations for the project.

By convention, the geo-environmental and the geotechnical aspects are discussed in separate sections, but in instances where interaction is required to produce a holistic design, this is discussed at the end of the geotechnical recommendations section.

Remaining uncertainties and recommendations for further work are listed at the end of the report.

2.0 PRELIMINARY CONCEPTUAL SITE MODEL

Hydrock have previously undertaken a Desk Study for the site. This was reported in Hydrock's 'Kraft, Phase 2, Banbury - Ground Conditions Desk Study', reference C161279/001 dated April 2016.

The preliminary conceptual site model from that report is summarised below.

2.1 Physical Setting

The preliminary ground model of the site is the basis of the understanding of the ground conditions which informs the geo-environmental exposure model and the geotechnical hazard assessment.

2.1.1 Location and Site History

The site is located off the A361, Southam road, Banbury. It is currently a vacant industrial unit, a car park, a lorry park and soft landscaping. Bird Brook flows from the west to the east in the northwest corner of the site before being culverted across the northern boundary of the remainder of the site.

Historically the site has been fields with Bird Brook in the northwest corner of the site from the earliest available mapping (1881). From 1965 an industrial building (food processing plant) is shown in the centre of the site. A car park is shown in the west of the site from 1984.

2.1.2 Landscape and Topography

The northwest of the site (car park) is at an elevation of approximately 100.5m OD and gently slopes towards the east. There is a steep slope between the car park and the adjacent warehouse, which is constructed on a platform at approximately 96.5mOD.

2.1.3 Geology

The site is presumed to be underlain by Made Ground associated with the development of the site.

The British Geological Survey mapping indicates the geology to comprise Charmouth Mudstone Formation (Jurassic), comprising dark grey laminated shales and dark, pale and blueish grey mudstones with occasional limestone beds and local concretions.

Alluvium (clay with some gravel) is recorded 20m to the east of the site.

2.1.4 Hydrology and Drainage

Bird Brook is present in the northwest of the site flowing west to east, and is culverted beneath the warehouse buildings. Bird Brook flows into the River Cherwell 500m to the east of the site.

The site storm drainage discharges directly into Bird Brook at numerous locations across the site.

There is one discharge consent on site and one 12m to the north, for trade discharges into Bird Brook.

2.1.5 Hydrogeology

The Alluvium is classed as a Secondary (A) aquifer. The Charmouth Mudstone Formation is classified as a Secondary (Undifferentiated) aquifer.

2.2 Geo-environmental Exposure Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages based on the contaminant-pathway-receptor approach.

2.2.1 Potential Contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.

Potential On-Site Sources of Contamination

- PCBs associated with the electricity sub-station in the southeast of the site.
- Hydrocarbon fuels, lubricant and chlorinated solvents associated with the industrial building.
- Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons.
- Ground gases (carbon dioxide and methane) from alluvial soils.

Potential Off-Site Sources of Contamination

- Tanks associated with the Kraft factory to the north.

2.2.2 Potential Receptors

The following potential receptors have been identified.

- Humans (neighbours, site end users).
- Development (buildings, utilities and landscaping).
- Groundwater: Secondary A aquifer (Alluvium) and Secondary (Undifferentiated) aquifer (Charmouth Mudstone Formation).
- Surface water: Bird Brook flowing into the River Cherwell 500m to the east.
- It should be noted that health and safety risks to site contractors and maintenance workers have not been assessed during these works and will need to be considered separately.

2.2.3 Potential Pathways

The following potential pathways have been identified.

- Humans: ingestion, skin contact, inhalation of dust and outdoor air.
- Buildings: methane ingress via permeable soils and/or construction gaps.
- Plant life: root uptake.
- Plant uptake: methane ingress to the root zone.
- Underlying groundwater: migration of contaminant via leachate dispersion through the unsaturated zone in the Alluvium.
- Underlying groundwater: migration of contaminants into the Alluvium and/or Charmouth Mudstone Formation.
- Surface water: overland flow.
- Surface water: drainage discharge.
- Surface water: base flow from groundwater.

2.3 Geotechnical Hazard Identification

Potential geotechnical hazards based on the expected ground conditions are listed below.

- Uncontrolled Made Ground – excessive settlement (creep and inundation settlement or differential settlement of foundations, roads and infrastructure elements.
- Low strength, compressible ground – excessive settlement of foundations, roads and infrastructure elements.
- Attack of buried concrete by aggressive ground conditions – the development site is underlain by Made Ground and the Charmouth Mudstone Formation is known to be high in naturally occurring sulfates and is potentially pyritic.
- Shrinkage/swelling of clay – settlement/heave of foundations when located within the influence of trees and vegetation.
- Slope instability – there is a slope halfway across the site. Typical instability causes are inappropriate cutting at the toe or loading at the crest of marginally stable slopes or reactivation of relict slip surfaces.

3.0 GROUND INVESTIGATION

3.1 Investigation Rationale

The ground investigation rationale based on the findings of the preliminary risk assessment is summarised in Table 3.1.

Table 3.1: Investigation Rationale

Exploratory Holes	Purpose
BH01 – BH04	To assess deeper ground conditions including undertaking SPTs. To allow collection of samples for geotechnical characterisation. To allow collection of samples for contamination analysis. To allow the installation of gas and leachate wells.
WS01 – WS26	To assess shallower ground conditions including undertaking SPTs. To allow collection of samples for geotechnical characterisation. To allow collection of samples for contamination analysis. To allow the installation of gas and leachate wells.

3.2 Ground Gas Regime

It is judged from the available evidence that the gas generation potential at the site is moderate on account of the potential for Made Ground and alluvial soils. The sensitivity of the development is assumed to be low (commercial / industrial). Consequently, an appropriate minimum monitoring regime is 6 readings over 3 months, provided other monitoring requirements are also met, such as prevailing atmospheric pressure conditions (for example, BS 8485:2015 suggests monitoring shall include a period of falling atmospheric pressure).

3.3 Site Works

The fieldwork took place between 26/05/16 and 07/05/16 and is summarised in Table 3.2. The approximate site investigation locations (surveyed in using a tape measure from landmarks) are shown on the Ground Investigation Plan in Appendix B.

The logs, including details of ground conditions, soil sampling, *in situ* testing and any installations, are presented in Appendix B.

Table 3.2: Summary of Site Works

Activity	Method	No.	Depth Range	*In Situ* Tests	Notes (e.g. Installations)
Boreholes	Rotary cored	4	19.61 – 20.14	Standard Penetration Test (SPT)	-
	Dynamic percussive (windowless) sampling	21	0.50 – 5.45	Standard Penetration Test (SPT)	Groundwater and gas monitoring installations in nine holes.

3.4 Geo-Environmental Testing

3.4.1 Sampling Strategy and Protocols

Investigatory hole locations were determined by reference to the conditions identified in the preliminary risk assessment. Certain specific features such as the sub-station and lorry wash area were targeted for specific investigation, but a reasonably even spacing was used for the remainder of the site. Specific sampling statistics or grids were not utilised in this instance.

Samples were taken stored and transported in general accordance with BS 10175:2011+A1: 2013.

3.4.2 Geo-environmental Monitoring

Gas monitoring boreholes have been monitored on six occasions. The results are presented in Appendix D.

3.4.3 Geo-environmental Laboratory Analyses

The tests undertaken are summarised in Table 3.3 and the geo-environmental analysis certificates are presented in Appendix C. Wherever possible, UKAS accredited procedures have been used.

Table 3.3: Summary of Sample Numbers for Geo-environmental Analyses of Soils

Determinand Suite (see Appendix E for Details of Suites)	Made Ground	Topsoil	Alluvium	River Terrace Deposits	Charmouth Mudstone Formation
Hydrock default suite of determinands for solids	23	1	2	10	2
Volatile organic compounds (VOC target list plus TIC by GC-MS	10	-	-	-	-
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	13	-	-	5	1
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	13	-	-	5	1
Polychlorinated biphenyls (PCB)	4	-	-	-	-
Waste Acceptance Criteria (WAC)	2	-	1	-	1

The geo-environmental analyses undertaken on groundwater samples are summarised in Table 3.4.

Table 3.4: Summary of Sample Numbers for Geo-environmental Analyses of Groundwater

Determinand Suite (see Appendix E for Details of Suites)	Groundwater
Hydrock default suite of determinands for waters	5
Volatile organic compounds (VOC target list plus TIC by GC-MS	5
Benzene, toluene, ethylbenzene and xylene (BTEX) by GC-MS)	5
Total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite)	5

3.5 Geotechnical Testing

3.5.1 Geotechnical Laboratory Testing

The tests undertaken are summarised in Table 3.3 and the geo-environmental analysis certificates are presented in Appendix C. Wherever possible, UKAS accredited procedures have been used.

Table 3.5: Summary of Sample Numbers for Geotechnical Tests

Test	Made Ground	Alluvium	River Terrace Deposits	Charmouth Mudstone Formation
Natural moisture content	2	13	10	16
Atterberg limit determination	2	7	4	6
Particle size distribution (sieve/sedimentation)	1	3	5	2
Remoulded CBR	2	2	4	1
Single stage triaxial compressive strength	-	1	2	2
Dry density moisture content tests	-	2	2	1
Sulfate and aggressive chemical environment classification for buried concrete classification (full BRE SD1 suite)	1	3	4	4
Point Load Index	-	-	-	15

4.0 GROUND INVESTIGATION RECORDS AND DATA

4.1 Physical Ground Conditions

4.1.1 Introduction

The following presents a summary of the properties of the ground and groundwater conditions encountered, based on field observations, interpretation of the field data and laboratory test results, taking into account drilling, sampling methods, transport, handling and specimen preparation.

All relevant data from the Hydrock investigation detailed in Section 3.0 are used from this point forward. Derived[1] geotechnical parameters are presented also.

For the purposes of property designation, soils are divided into fine soils (clays and silts) and coarse soils (sands, gravels, cobbles and boulders) in accordance with BS 5930.

Soil plasticity class for fine soils is based on the classification system of BS 5930, adopting modified plasticity index values (based on percentage passing 425 µm sieve). Volume change potential of fine soils on change of moisture content has been assessed using guidance provided in NHBC Standards/BRE Digest 240 - Part 1.

Equivalent approximate undrained shear strengths (c_u) and equivalent approximate coefficients of volume compressibility (m_v) have been calculated from recorded SPT N values, adopting f_1 and f_2 values respectively (based on CIRIA Report 143 (Clayton 1995)) appropriate to the recorded plasticity.

The angle of shearing resistance (ϕ') of the coarse soils has been derived from the uncorrected standard penetration resistance N-value using the relationship published by Hatanaka and Uchida (1996).

4.1.2 Summary of Strata Encountered

Details of the strata encountered are provided in the logs in Appendix E, a summary is presented in Table 4.1 and the individual strata are described in the sections below. Relevant cross-sections/contour plans/isopachyte diagrams are presented in Appendix A.

Table 4.1: Strata Encountered

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Topsoil	Orange brown sandy slightly gravelly clay.	0.00	0.30 – 0.40	0.30 – 0.40
Made Ground	Asphalt or concrete over sandy gravel or clay comprising flint, concrete, ironstone, sandstone.	0.00	0.30 – 2.60	0.30 – 2.60
Alluvium	Greenish grey slightly sandy clay with some rootlets and rare reeds. Mild organic odour.	0.30 – 2.60	1.20 – 4.60	0.50 – 3.30

[1] **Derived values** of geotechnical parameters and/or coefficients are obtained from test results, by theory, correlation or empiricism in line with BS EN 1997-2:2007, Section 1.6.

Stratum	Brief Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
River Terrace Deposits	Orange clayey gravel or gravelly clay of sandstone, ironstone and flint.	0.30 – 4.60	0.90 – 8.00	0.20 – 7.50
Charmouth Mudstone Formation	Stiff grey thinly laminated clay becoming a very weak thinly laminated grey mudstone with some shell fragments and bands of limestone.	0.55 – 8.00	>19.70 - >20.14	>18.27

4.1.3 Topsoil

For the purposes of this report, Topsoil is defined as the upper layer of an *in situ* soil profile, usually darker in colour and more fertile than the layer below (subsoil), and which is a product of natural chemical, physical, biological and environmental processes, but does not imply compliance with BS 3882:2015.

Topsoil was encountered along Brid Brook and in soft landscaping areas.

4.1.4 Made Ground

Made Ground was encountered across the majority of the site to depths of between 0.30m and 2.60m bgl. In general there are three main types:

- surfacing including asphalt, concrete and 'hard-core' across the external hardstanding areas (car park, lorry park and roadways);
- concrete slab across the footprint of the vacant warehouse; and
- 'general' Made Ground comprising interbedded clayey gravel and gravelly clay with fragments of brick, sandstone, ironstone, ash and concrete.

The Made Ground is inherently variable and as such representative values of geotechnical properties are impracticable to determine. On this basis, no laboratory geotechnical testing has been undertaken on it. *In situ* SPT testing suggests that the 'general' Made Ground ranges from relatively uncompact to compact (N values range from 6 to 35).

The depth or level to the base of the Made Ground is shown on Hydrock Drawings KRF-HYD-02-XX-DR-G-010 (depth) and KRF-HYD-02-XX-DR-G-011 (level).

4.1.5 Alluvium

Alluvium was encountered underlying the Made Ground or Topsoil in the north and east of the site as shown on Hydrock Drawings KRF-HYD-02-XX-DR-G-005 and KRF-HYD-02-XX-DR-G-008. It generally consisted of a soft to firm greenish grey sandy clay with some remnant rootlets, flint gravel and a mild organic odour.

Particle size distribution tests undertaken on the Alluvium indicate it to generally comprise a sandy, gravelly clay/silt.

Natural moisture contents in these fine materials range from 16% to 37%, and modified plasticity indices range from 9% to 35%. On this basis these soils are classified as of intermediate and high plasticity (CI/CH soils) and of low to medium volume change potential.

Undrained shear strength parameters of these materials based on *in situ* and laboratory testing are presented in Table 4.2.

Table 4.2: Soil Strength Results and Derived Values

SPT (N-Value) (Range)	Shear Strength (Range)	Method	No. of Results
	c_u (kPa)		
3 - 37	15 - 180	Correlation with Stroud (1975) based on 'average' plasticity	19
-	76	Laboratory triaxial test	1

Approximate coefficients of volume compressibility (m_v) derived from the *in situ* SPT testing within the cohesive units of these materials range from 0.06 m^2/MN to 0.74 m^2/MN adopting an f_2 value of 0.45 (based on the 'average' plasticity).

4.1.6 River Terrace Deposits

River Terrace Deposits was encountered underlying the Made Ground and/or Alluvium across the majority of the site. This generally consisted of loose to medium dense orange brown gravelly sand/sandy gravel or soft to firm gravelly clay.

Particle Size Distribution tests undertaken on the River Terrace Deposits indicate them to comprise sandy silt/clay to clayey sandy gravel.

SPT N-values within the coarse units of these materials range from 4 to 24, showing them to be of loose to medium relative density. Angles of shearing resistance based on these results range from 33° to 39° based on the correlation of Hatanaka and Uchida (1996).

Natural moisture contents in the fine units of these materials range from 17% to 36%, and modified plasticity indices range from 8.5% to 24.5%. On this basis these soils are classified as of low to high plasticity (CL, CI and CH soils) and as non-shrinkable to medium volume change potential.

Undrained shear strength parameters of the cohesive units of these materials based on *in situ* and laboratory testing are presented in Table 4.3.

Table 4.3: Soil Strength Results and Derived Values

SPT (N-Value) (Range)	Shear Strength (Range)	Method	No. of Results
	c_u (kPa)		
0 - 22	15 - 110	Correlation with Stroud (1975) based on 'average' plasticity	19
-	37 - 84	Laboratory triaxial test	2

Approximate coefficients of volume compressibility (m_v) derived from the *in situ* SPT testing within the cohesive units of these materials range from 0.05 m^2/MN to 0.7 m^2/MN adopting an f_2 value of 0.5 (based on the 'average' plasticity).

4.1.1 Charmouth Mudstone

The Charmouth Mudstone Formation was encountered underlying the Made Ground, Alluvium or River Terrace Deposits across the majority of the site. The depth and level to the Charmouth Mudstone is shown on Hydrock Drawings KRF-HYD-02-XX-DR-G-006 and KRF-HYD-02-XX-DR-G-007 respectively.

Particle Size Distribution tests undertaken on the Charmouth Mudstone Formation indicate the soils to comprise silt/clay.

Natural moisture contents in these fine materials range from 13% to 27%, and modified plasticity indices range from 24% to 28%. On this basis these soils are classified as of high plasticity (CH soils) and of medium volume change potential.

SPT N-values below 20 were only recorded within the upper 1m of the Charmouth Mudstone Formation and are assessed as a softening of the clay due to groundwater resting at the interface of the Charmouth Mudstone Formation and overlying soils.

Undrained shear strength parameters of the cohesive units of these materials based on *in situ* and laboratory testing are presented in Table 4.4.

Table 4.4: Soil Strength Results and Derived Values

SPT (N-Value) (Range)	Shear Strength (Range) c_u (kPa)	Method	No. of Results
7 - 50	35 - 250	Correlation with Stroud (1975) based on 'average' plasticity	93
-	85 - 100	Laboratory triaxial test	2

Approximate coefficients of volume compressibility (m_v) derived from the *in situ* SPT testing within the cohesive units of these materials range from 0.04 m^2/MN to 0.29 m^2/MN adopting an f_2 value of 0.5 (based on the 'average' plasticity).

Rock Characterisation

Table 4.4 summarises information pertaining to the strength of the intact rock material (not rock mass) according to geological stratum and, if applicable, weathering zones or other variations within the particular stratum. Factual results are summarised for laboratory and field tests. Where point load index tests are used to infer unconfined compressive strength (UCS), this is also tabulated. Rock strength terms follow the method of BS EN ISO 14689-1:2003.

Rock strength is quoted as its unconfined compressive strength, which is twice the shear strength value. This is particularly important in the intermediate range between very stiff/hard soils classified in terms of shear strength and very weak rocks, described in terms of compressive strength.

Care should be exercised in using these assumed rock strength parameters for any purpose beyond the scope of this report because it may be that additional sampling and testing is required for certain purposes. The reader should refer to the original test results in Appendix C.

Rock mass properties, rather than intact rock material properties, may be more suitable for design purposes.

Table 4.4: Intact Rock Strength Results and Derived Values

Stratum	Point Load Index (Range)		UCS (MPa) (Range)	Method	No. of Results
	Is	$Is_{(50)}$			
Charmouth Mudstone Formation	0.03 – 0.11	0.04 – 0.15	0.72 – 2.7	Axial point load	14
Limestone bands within the Charmouth Mudstone Formation	1.26	1.6	32		1

4.2 Obstructions

Obstructions were encountered in a number of the boreholes as summarised in Table 4.5.

Table 4.5: Obstructions Encountered During Hydrock Investigations

Exploratory Hole	Depth	Description	Stratum
WS04	0.90	Terminated on concrete.	Made Ground
WS08	0.50	Terminated in hand pit due to refusal	Made Ground

4.3 California Bearing Ratio (CBR)

The CBR results are summarised in Table 4.5.

Table 4.5: CBR Results and Derived Values

Stratum	Method	No. Tests	CBR (%) (Range)
Made ground	Laboratory remoulded sample	3	1.4 – 3.7
Alluvium		2	2.0
River Terrace Deposits		4	0.9 – 2.1
Charmouth Mudstone Formation		1	5.6

4.4 Dry Density/Moisture Content Relationship

The results of the dry density/moisture content relationship testing are presented in Table 4.6.

Table 4.6: Dry Density/Moisture Content Relationship

Stratum	Maximum Dry density Mg/m^3	Optimum Moisture Content Mg/m^3
Made Ground	1.53	25
Alluvium	1.53 - 1.86	16 - 24
River Terrace Deposits (fine)	1.52 - 1.72	19 - 25
Charmouth Mudstone Formation	1.69	17

4.5 Sulfate Content

In accordance with BRE (Special Digest 1), the Design Sulfate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in Table 4.7. The assessment summary sheets are presented in Appendix C.

Table 4.7: Aggressive Chemical Environment Concrete Classification

Stratum	No. Tests	DS	ACEC
Made Ground	1	DS-1	AC-1
Alluvium	3	DS-1	AC-1
River Terrace Deposits	4	DS-1	AC- 1
Charmouth Mudstone Formation	4	DS-2	AC-3z

4.6 Groundwater

Groundwater strikes encountered during the investigation and subsequent monitoring are summarised in Table 4.8.

Table 4.8: Groundwater Data

Stratum	Date Range	Exploratory Hole	Fieldwork		Post-Fieldwork Monitoring	
			Depth Groundwater Encountered (Rose to after 20 mins) (m bgl)	Groundwater Elevation (Reduced Level) (mOD)	Depth to Groundwater (Range) (m bgl)	Groundwater Elevation (Reduced Level) (Range) (mOD)
Made Ground	08/06/16 – 07/07/16	WS09	0.90	95.60	0.32 – 0.39	96.11 – 96.18
Alluvium	16/06/16 – 07/07/16	WS01	-	-	1.10 – 1.67	94.08 – 94.65
	03/06/16	WS12	3.94	92.92	-	-
	26/05/16	BH01	2.00	93.83	-	-
River terrace deposits	02/06/16	WS13	4.60	94.26	3.48 – 3.51	95.35 – 95.38
	16/06/16 – 07/07/16	WS03	-	-	2.94 – 3.02	92.61 - 92.69
	16/06/16 – 07/07/16	WS18	-	-	1.27 – 1.70	94.99 – 95.42
	16/06/16 – 07/07/16	WS25	-	-	0.78 – 1.17	101.51 – 101.9
	16/06/16 – 07/07/16	WS26	-	-	1.24 – 1.70	98.45 – 98.91

Stratum	Date Range	Exploratory Hole	Fieldwork		Post-Fieldwork Monitoring	
			Depth Groundwater Encountered (Rose to after 20 mins) (m bgl)	Groundwater Elevation (Reduced Level) (mOD)	Depth to Groundwater (Range) (m bgl)	Groundwater Elevation (Reduced Level) (Range) (mOD)
Charmouth Mudstone Formation	06/06/16	WS22	4.00	95.72	-	-
	09/06/16 – 07/07/16	WS19	5.00	92.32	1.66 – 2.07	95.25 – 95.66
	16/06/16 – 07/07/16	WS14	-	-	2.16 – 3.76	95.1 – 96.7

4.7 Geo-Environmental Results

The chemical test results for soil, leachate and groundwater are presented in Appendix F which also includes summary tables of the data.

4.8 Ground Gases (Carbon Dioxide and Methane)

Records from the gas monitoring are presented in Appendix G and summarised in Table 4.9. Six monitoring visits have been undertaken.

Table 4.9: Range of Ground Gas Data

Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Flow Rate (l/hr)
0.1	0.1 – 5.4	15.2 – 20.7	<0.1

4.9 Asbestos

Asbestos has been identified in two of the 38 samples analysed. Quantification has been undertaken on the two identifications. These are listed below in table 5.14.

Table 4.14: Asbestos Identification.

Sample Location/Depth	Strata	Material Detected	Asbestos Type	Quantification
BH02/0.5	Made Ground	Loose fibres	Amosite	<0.1
WS03/0.6	Made Ground	Hard/cement type material, loose fibres and insulation lagging	Chrysotile/Amosite	0.076

4.10 Updated Ground Model

The preliminary conceptual site model initially developed from the desk study and walk-over survey (Section 2.0) has been updated using the findings of the ground investigation.

The ground investigation has confirmed ground conditions below the site to comprise:

- Made Ground – to between 0.3m and 2.6m below ground level (bgl), comprising asphalt and/or concrete hardstanding over clayey gravel of ironstone, sandstone, brick and concrete or gravelly clay; over
- Alluvium – to between 1.2 and 4.6m bgl, comprising sandy gravelly clay/silt with some rootlets and mild organic odour; or
- River Terrace Deposits – to between 0.90m and 8.0m bgl, comprising loose to medium dense sandy gravel, loose to medium dense gravelly sand or gravelly clay; over
- Charmouth Mudstone Formation (encountered underlying variously the Made Ground, Alluvium and River Terrace Deposits) to a maximum proven depth of 20.14m bgl.

Groundwater was generally encountered at the interface between the superficial deposits and the Charmouth Mudstone Formation. Groundwater was recorded post-fieldwork at levels between 0.36m bgl and 3.76m bgl.

5.0 GEO-ENVIRONMENTAL ASSESSMENT

5.1 Approach

A number of generic risk assessments have been undertaken in accordance with the principles of CLR 11 (Environment Agency 2004) using the CSM that has been updated following the ground investigation. Firstly, the risks associated with the identified potential contaminant linkages have been estimated using standardised methods (typically involving comparison of site data with published 'screening values'. Secondly, where screening values are exceeded, the risks have been evaluated in an authoritative review of the findings with other pertinent information to determine if exceedance may be acceptable in the particular circumstances. For details please refer to Appendix E.

The data sets used comprise the appropriate analytical results obtained by Hydrock and listed in Section 3.4.

In cases where unacceptable risks are indicated, mitigation measures such as more advanced stages of risk assessment or remediation are proposed in Section 5.9.

5.2 Updated Exposure Model

Following the site investigation, the plausible contaminant sources, receptors and pathways identified in Section 2.0 have been updated or confirmed as follows. No potential sources, receptor or pathways have been removed from, or added to, the exposure model.

With reference to the updated ground model and updated exposure model reported above, generic risk assessment is undertaken in Section 5.0. Geotechnical recommendations made in Section 6.0.

5.3 Human Health Risk Assessment

The final development use is unknown, however, it is understood it is likely to be commercial/industrial end use. On this basis, a Tier 2 assessment using soil screening values for the CLEA land use scenario commercial/industrial end use, has been undertaken.

The soil screening values used are generic assessment criteria (GAC) and results are given in Appendix F. Note that the Category 4 Screening Levels (C4SL) for lead have been used as there are no recognised GACs and the use of the term 'GAC' in this report includes this.

Statistical testing is used where data sets are suitable. For data sets with low sample numbers and/or a non-random spatial distribution (e.g. where sampling is targeted at specific areas) individual sample test results are compared directly with the screening values.

It should be noted that the phrase 'further assessment required' is used to denote soil concentrations that are equal to, or exceed, a GAC. This does not necessarily mean that the soil is 'contaminated' or not fit for use.

5.3.1 Risk Estimation (Including Statistical Testing)

The data set for each chemical determinand in the Hydrock Suite has been assessed for the presence of potential outliers (based on the conceptual model). No outliers have been removed.

In line with the guidance provided by the CIEH (May 2008) the 95th upper confidence level on the true mean (US_{95}) has been calculated from the sample data. Data have been assessed using the one-sample t-test or the one-sided Chebychev Theorem, as appropriate to the distribution and number of samples.

Based on a US_{95} exceedance of the GAC, no substances are above the GAC and no further assessment of these contaminants is required.

5.3.2 Risk Estimation (Without Statistical Testing)

Asbestos

Asbestos has been identified in two of the thirty eight samples tested. Quantification of the samples has identified loose fibres of chrysotile at <0.001 and chrysotile/amosite, hard cement type material, loose fibres and insulation lagging at 0.076%

It is understood that the proposed development is likely to be for a commercial/industrial end use, although no further details are known. Based on this end use it is assessed that the site will mostly be covered by buildings and hardstanding, with only limited soft landscaping.

Mitigation by appropriate materials management will be required in order to protect site users. Mitigation should also be undertaken to protect groundworkers, for example protective clothing and suitable dust suppression.

Petroleum Hydrocarbons (PHC)

A single exceedance with regards to petroleum hydrocarbons is present at WS03, 0.3m bgl. This is a marginal exceedance of the Aliphatics >EC12-EC16 banding 59mg/kg vs a GAC of 24mg/kg.

Given the nature of the proposed development and the proposed hardstanding, Hydrock do not believe this represents a significant risk to site users.

Volatile Organic Substances (VOC)

Recorded concentrations of VOCs in all samples submitted for testing are below the limit of detection and no further assessment of these contaminants is required.

5.4 Plant Life Risk Assessment

5.4.1 Risk Estimation

Priority phytotoxic chemical concentrations have been screened against published values to determine the likely risk to plant growth and the findings presented in Appendix F. As with human health, statistical testing is used where data sets are suitable, otherwise individual sample test results are compared directly with the screening values.

Based on a US_{95} exceedance of the GAC, the pervasive chemicals of potential concern which require further assessment are summarised in Table 5.1.

Table 5.1: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	US_{95} (mg/kg)	No. Samples Exceeding Generic Criterion
Nickel	75	BS338882 2015	23	4.8	130	81.58	5

5.4.2 Risk Evaluation

Detriment to plant life is hard to quantify and many of the GACs are based on agricultural crop yields rather than serious harm of death of a species. As the recorded US_{95} value for nickel in the soil is only slightly in excess of the GAC and the vegetation on site did not show any signs of physical distress, Hydrock considers that and no further assessment of these contaminants is required.

5.5 Pollution of Controlled Waters Risk Assessment

5.5.1 Risk Estimation

The risks to groundwater and surface water from contaminants on site have been assessed according to the Environment Agency (2006) Remedial Targets Methodology (RTM).

Under the European Water Framework Directive (2000/60/EC) pollutants from contaminated land sites are considered as passive inputs. Inputs to surface waters and inputs of non-hazardous pollutants to groundwater and are regulated under the Agency's 'limit' pollution objective. As such, site contaminant loadings are compared with relevant threshold values (Water Quality Targets (WQT)) which are linked to the conceptual site model. Acceptable WQT are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)).

The approach for hazardous substances in groundwater is to use the 'prevent' pollution objective. Acceptable WQT are listed by UKTAG (November 2013, amended January 2014) and are minimum reporting values (MRV), referred to in this report as HAZ-MRV.

For the purposes of this report, the site data are compared with the various targets as set out according to the Hydrock scenario in Table 5.2 (see Appendix E for details), on the basis of the following:

- Groundwater is present in the Alluvium and River Terrace Deposits and is likely to provide base flow to Bird Brook.
- Bird Brook flows into the River Cherwell 500m east of the site.
- The surface water abstraction is upstream of Bird Brook.

Table 5.2: Summary of Water Quality Risk Assessment Protocol

Hydrock Scenario	Water Body Receptors	Secondary Receptors	Example Contaminant Linkages	RTM Level and Data Used	Water Quality Targets
B	Groundwater. Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be an aquatic ecosystem.	RTM Level 2 - Groundwater.	EQS (inland) HAZ-MRV
Notes: Some EQS are water hardness dependent. This is measured either in the receiving water or in groundwater (if it is part of the pathway), or is estimated from national maps. Inland waters EQS applicable to freshwater, other waters EQS applicable to marine or transitional waters. Where both DWS and EQS are applicable, it is assumed that the EQS is for inland waters. This table and the results of the assessment are considered as a first screening for potential risks of pollution of Controlled Waters. More specific requirements may be stipulated by the relevant Agency.					

The results of the Remedial Targets Methodology assessment are presented in Appendix F and are summarised in Table 5.3.

It should be noted that in some instances the reporting limit (or detection limit) quoted by the laboratory may be greater than the WQT that it is being assessed against. As the current exercise is an initial screening assessment, further assessment of these elements has not been undertaken.

Table 5.3: Chemicals of Potential Concern for Which Further Assessment is Required (Controlled Waters)

Chemical of Potential Concern	Water Quality Target (ug/l)	Basis for Water Quality Target	No. of Samples Analyzed	Min. (ug/l)	Max. (ug/l)	No. Samples Exceeding Target
Copper	1	EQS	5	0.5	4.6	3
Manganese	123			6.3	270	1
Nickel	4			1.5	8.2	2
Note: the maximum recorded value is compared with the water quality target.						

Recorded concentrations of petroleum hydrocarbons and VOCs in the groundwater samples are all below the limit of detection.

5.5.2 Risk Evaluation

Recorded concentrations of copper, manganese and nickel are above the relevant EQS Inland Waters WQT.

The inland waters EQSs for these metals are based on the bioavailable fraction. Because bioavailability has not been calculated for these metals the above assessment is conservative, as it is based on the assumption of 100% bioavailability. It is likely that if the bioavailability was calculated for these metals, they would not exceed the relevant WQTs.

Whilst there are elevated concentrations of Chemicals of Potential Concern, based on the investigation works undertaken to date and subject to agreement with the regulators, Hydrock does not believe the site poses a significant risk to Controlled Water for the following reasons:

- There are no elevated CoPC in the soils at the site.
- The EQS for copper, manganese and nickel are based on bioavailability and so this risk assessment is conservative as it assumes 100% bioavailability.
- There is no indication under present conditions of pollution of Controlled Waters, and conditions following development of the site will not be any worse, indeed they may improve with increased hard cover and little landscaped area.

On the basis of the above, Hydrock considers that and no further assessment of these contaminants is required.

5.6 Ground Gases Risk Assessment

5.6.1 Assessment

Permanent Ground Gases

The risks associated with the ground gases methane (CH_4) and carbon dioxide (CO_2) are assessed using BS 8485:2015 and guidance from CIRIA Report 665 (Wilson *et al* 2007). The assumed development proposals require consideration of Situation A.

The guidance requires the calculation of Gas Screening Values (GSV). For the purposes of the calculation, where the recorded gas flow rate is below the manufacturer's limit of detection for the instrument used, the detection limit has been adopted for the gas flow rate.

The required six monitoring visits have been undertaken and the ground gas readings and gas regime conceptual model derived from the works are considered to be sufficiently rigorous to provide an assessment of the ground gas regime and the likely scope of protection measures,

Methane has not been detected above the detection limit of the analytical apparatus.

Carbon dioxide is typically less than 5%, although on one occasion was monitored at 5.4%.

There is no relationship between elevated ground gas concentrations and low pressure, nor is there a relationship between elevated ground gas concentrations and falling pressure.

The worst case GSV to date have been calculated as 0.0001 for methane and 0.0054 for carbon dioxide.

Based on the above GSV the site is classified as Characteristic Situation 1. Based on the typically low ground gas concentrations and the lack of any relationship between elevated ground gas concentrations and pressure, Hydrock does not believe the site requires upgrading to a higher ground gas classification.

Radon

The site is in a Radon Affected Area with recorded radon levels in 1-3% of homes above the action level. Radon protection measures are not required for new buildings at this location. However, in line with current guidance, consideration should be given to fitting basic protection measures on the 'as low as reasonably practicable' principle in view of the legal responsibilities of rental landlords and employers with commercial properties (see Desk Study report for further details).

Gas Protection Measures

Based on the data no mitigation measures are required.

Ground Workers

It is noted that concentrations of carbon dioxide (an asphyxiant) in the soil exceed HSE Workplace Exposure Limits for personnel in the working environment of 1.5% for short term (15 minutes) exposure and 0.5% for long term exposure. Furthermore, soil concentrations of oxygen are below the HSE recommendations of 18%.

Whilst risks to construction workers are not generally discussed in this report, and soil gas concentrations are not necessarily reflected by those in the breathing zone, all contractors and maintenance workers should be made aware of the possible presence of carbon dioxide and should take all necessary health and safety precautions when working in trenches or confined spaces.

5.7 Water Pipelines

The current guidance on selection of materials for potable water supply pipes to be laid in contaminated land is contained in a document published jointly by Water UK and the Home Builders Federation (Water UK and HBF (2014)). The protocols in that document are for guidance and are not subject to enforcement by Water UK or any agency, but have been adopted by Water UK and by HBF as best practice for their members. Accordingly this guidance is used in the following assessment. For further details see Appendix E.

A formal water pipe risk assessment is beyond the scope of this report. However, the findings of this investigation have been compared to the threshold values in Water UK Table 1 as far as is practicable to give an indication of the possible restrictions to the use of plastic pipes for water supply to the site.

The site is brownfield and there is a presumption in the guidance that barrier pipe will be used. However, the investigation and assessment has indicated no exceedance of the threshold values and as such standard pipework may be suitable for the site. However, this investigation was not designed specifically for water pipe runs and confirmation should be sought from the water supply company at the earliest opportunity.

Until proven or agreed otherwise, it is recommended that barrier pipe provision is assumed pending liaison with the supply company.

5.8 Findings of the Generic Risk Assessments

The source-pathway-receptor contaminant linkages given in Table 5.4 are those which, following the risk evaluation process, require further consideration.

Table 5.4: Final Conceptual Model and Residual Risks Following Risk Evaluation

Contaminant Linkage			Comments	
Sources	**Pathways**	**Receptors**	**General**	**Mitigation**
Asbestos fibres, cement and lagging in soils.	Inhalation of fugitive dust.	Human health (site users, neighbours).	Asbestos noted in soils.	Mitigation measures required in areas of soft landscaping.
Petroleum Hydrocarbon at WS03@ 0.3m bgl	Inhalation of fugitive dust. Direct contact.	Human health (site users, neighbours).	Based on the proposed development it is considered this represents a low risk to site users. Hydrock do not believe mitigation is required.	

5.9 Mitigation Measures

The following mitigation measures are required:

- A clean cover system across soft landscaped areas to sever the linkage between asbestos containing soils and site users. The cover should comprise 450mm clean growing medium, with a minimum of 150mm topsoil. The soils to be used in the cover system are present on site and mitigation can be undertaken by material management. Whilst appropriate PPE and RPE are required, and localised hand picking is required. Hydrock do not believe that these soils need disposal from site.
- The use of barrier pipe for potable water supplies and backfill with clean stone is recommended (subject to liaison with the water supply company).

During the design process, the methodology for the remediation should be detailed in a Remediation Method Statement which will need to be submitted to the regulatory authorities for approval. In addition, the writing and approval of a Materials Management Plan will be required to allow reuse of suitable material at the site.

A verification report prepared by a suitably qualified independent geo-environmental specialist will be required following completion of any remedial works.

5.10 Waste Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose. Further details are given in Appendix F.

If material is to be removed from the site (e.g. foundation arisings) the laboratory test results in Appendix G, should be presented to the proposed receiving landfill site (to aid Waste Characterisation), prior to export, to confirm that it is suitably licensed to accept them. Some

additional testing may be necessary at the time of disposal for the receiving landfill to confirm the Waste Acceptance Criteria (WAC) are acceptable for it to receive the waste.

Based on the WAC testing it would appear that if suitable segregation of different types of waste is put in place, the Made Ground and the Charmouth Mudstone Formation have the potential to be classified as non-hazardous waste (and should be considered as such until proven otherwise). The Alluvium may be classifiable as inert (subject to appropriate WAC tests, if required).

Non-hazardous soils require pre-treatment prior to disposal. Effective pre-treatment, involving separation, sorting and screening can offer cost reductions through reducing the hazardous nature and volume of soil waste. Costs for disposal of non-hazardous/hazardous soils are significant compared to disposal of inert material.

5.10.1 Materials Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.

If site-won material is to be reused on site, a Materials Management Plan will be required, signed off by a Qualified Person as defined in the 'Development Industry Code of Practice' (CL:AIRE, March 2011).

6.0 GEOTECHNICAL ASSESSMENT

6.1 Geotechnical Categorization of the Proposed Development

Eurocode 7, Section 2 advocates the use of geotechnical categorization of the proposed structures to establish the design requirements. For the purposes of this investigation, the proposed structures have been assumed to be Geotechnical Category 2.

The Geotechnical Category should be reassessed at the design stage and a specific Geotechnical Design Report is required during the design process for Category 2 structures.

6.2 Groundwork

6.2.1 Site Preparation

A number of services cross the site, including, but not limited to, 11kv electricity cables, fire water supplies and the culverted Bird Brook in the north of the site.

It is presumed that the redevelopment will involve demolition of the existing building. Buried obstructions were encountered during this investigation associated with the existing construction and there is a possibility of further such obstructions being encountered. Therefore, it is recommended that an allowance be made for breaking out obstructions, for example provision of pneumatic breakers for site plant. If underground structures cannot be removed, they will need to be surveyed in three dimensions and the new structures will need to be designed to accommodate them.

Topsoil and unsuitable Made Ground should be removed from beneath all building and hardstanding areas.

6.2.2 Groundworks

Following breaking out of hardstanding and/or obstructions, excavation of shallow soils should be readily undertaken by conventional plant and equipment. However, excavation through any buried construction/intact rock quality strata may require heavy-duty excavation plant and/or the use of specialist breaking equipment.

Instability of the windowless sampler boreholes was noted during the early part of the investigation and beginning of the investigation and temporary casing of exploratory holes was required to prevent collapse during drilling. Random and sudden falls should be expected from the faces of near vertically sided excavations put down at the site. This situation is likely to be prevalent in the Made Ground, natural coarse soils and natural low strength fine soils. It is likely to be exacerbated by water inflows.

Temporary trench support, or battering of excavation sides, is likely to be required for all excavations that are to be left open for any length of time, and will definitely be required where man entry is required. Particular attention should be paid to excavation at, or close to, site boundaries or existing structures (whether to remain or not), where collapse of excavation faces could have a disproportionate effect.

A risk assessment of the stability of any open excavation should be undertaken by a competent person and appropriate measures adopted to ensure safe working practise in and around open

excavations. Further guidance on responsibilities and requirements for working near, and in, excavations can be obtained from the Construction Design and Management Regulations (2015).

Recorded groundwater levels are generally shallow and dewatering may be required. Groundwater levels will fluctuate seasonally and the timing of construction may dictate the extent of groundwater control required. However, alternative methods of dewatering such cut-offs, or well points may be required.

Any water pumped from excavations is likely to need to be passed via settlement tanks before being discharged to the sewer; discharge consents will also be required.

It is likely that any future development will include regrading of the site (to reduce or remove the step-change in level). On this basis, it may be necessary to consider reuse of existing soils as part of redevelopment proposals.

An earthworks specification will be necessary to ensure the appropriate management and reuse of the existing soils. Once site proposals have been further defined, more specific consideration will need to be given to the reuse of materials and reference should be made back to this office if an earthworks specification is required. The earthworks may also need to be undertaken under a Materials Management Plan (see Section 5.10.1).

6.2.3 Earthworks/Reuse of Site-Won Materials

Spoil resulting from excavations within the Made Ground, the firm and stiffer natural fine soils and the coarse natural soils should be suitable for reuse as general fill subject to further testing and specification. The low strength soils natural alluvial soils may not be suitable for reuse as engineered fill on the basis not only of their low strength and high compressibility, but also their organic content. These soils may be useable for landscaping (subject to the necessary approvals/consents).

An initial assessment has been completed on the potential to reuse site-won materials as an engineered fill material, which indicates the soils which are likely to be reused can be classified as follows:

- Made Ground - Class 2 cohesive (more than 15% passing the 63µm sieve) or Class 2 granular (less than 15% passing the 63µm sieve) - General Fill.
- River Terrace Deposits - Class 2 cohesive (more than 15% passing the 63µm sieve) or Class 2 granular (less than 15% passing the 63µm sieve) - General Fill.
- Charmouth Mudstone Formation - Class 2 cohesive (more than 15% passing the 63µm sieve).

Compaction testing carried out on samples of the Made Ground indicate Optimum Moisture Content of 25%, with a corresponding Maximum Dry Density value of 1.53 Mg/m^3.

Compaction testing carried out on samples of the fine River Terrace Deposits indicate Optimum Moisture Contents of between 19% and 25%, with corresponding Maximum Dry Density values of between 1.52 and 1.72Mg/m^3.

Compaction testing carried out on samples of the Charmouth Mudstone indicate Optimum Moisture Content of 17%, with corresponding Maximum Dry Density value of 1.69 Mg/m^3.

Recorded natural moisture contents in the fine River Terrace Deposits range from 17% to 36%, , indicating that they are generally close to, or 'wet' of, Optimum Moisture Content, but should be suitable for reuse following drying. The addition of binders to control the moisture content is not recommended for soils containing elevated sulphates (e.g. Charmouth Mudstone).

Before the use of hydraulic binders is approved on this site, comprehensive testing will need to be completed, by a Specialist Contractor. This work must be completed in order to satisfy both themselves and the Engineer of the suitability of the soils for treatment, and confirm that the requisite end-performance of the material is achievable.

Where an increased end-performance of the material is required over and above those defined for General Fill materials additional testing and specification will be required, which is outside the scope of the current assessment. However, if the soils are to be used below structures they should be reclassified as Class 7 Selected Fill as defined in the Specification for Highway Works (Highways Agency 2014). Where the as dug material does not meet the requirements of a Class 7 Fill, but is still required for use below structures, it can be treated with hydraulic binders to form a suitable Class 9 fill. The exact sub-class under Class 9 will depend on the hydraulic binder used. This will be subject to detailed design by a specialist Contractor.

Where it is proposed to reuse site won materials as an engineered fill, it will be necessary to develop an appropriate Site Specific Earthworks Specification as part of the GDR which can be adopted as part of the contract documentation. The basis for the Specification should be BS 6031:2009 and the latest version of the SHW, Series 600 Earthworks.

It is assumed that site levels are not changing significantly. If site levels change, the changes in imposed load will need to be assessed as part of the design.

6.3 Foundations (General)

Details of the proposed development are not known, but it is assumed for the purposes of this report that it will be an industrial/commercial site use. It is also anticipated that some site regrading will be undertaken to provide a level development platform.

The Made Ground and low strength natural alluvial and River Terrace Deposits are considered unsuitable in their present condition for use as founding soils on the basis of their relatively low strength and high compressibility and should be fully penetrated by all new foundations. However, these soils only occur to significant depth in the western half of the site (see Drawing KRF-HYD-XX-ZZ-M2-G-0009 in Appendix A).

The Alluvium and River Terrace soils are of low to medium volume change potential. For the purposes of this assessment a medium volume change potential has been assumed.

Trees are noted in the northern, western and central/south central areas of the site, although they are of unknown size, species or maturity. Foundations constructed within influencing distance of these trees (whether on- or off-site and whether to remain or be removed), should be constructed in accordance with the recommendations of BRE Digest 240 (BRE 1980).

On the basis of the above, minimum founding depths are likely to range from 0.90m bgl to >2.50m bgl. Foundations that are carried deep to avoid the influence of trees may be stepped

up, in accordance with the requirements of EC7, BS EN 1997 as long as a suitable founding stratum is present at shallower depth.

If trees are to be removed, the roots should be grubbed out and foundations extended to below the zone of disturbance created by this activity.

The allowable bearing pressure for foundations takes into consideration the risk of shear failure of the ground (ultimate limit state) and acceptable limits of settlement (serviceability limit state).

The preliminary foundation designs in this section are based on the parameters given above. Recommendations for Geotechnical Category 2 structures (according to EC7, BS EN 1997) are presented to aid development proposals only. However, selection of geotechnical design parameters should be undertaken in conjunction with the design process and discussed in a separate Geotechnical Design Report.

As foundations are likely to span founding materials of different stiffness mesh reinforcement should be placed at the top and bottom.

The depth of foundations should be designed, and the formations inspected by, a Geotechnical Engineer. Any sub-formation materials deemed as unsuitable such as soft or loose zones should be excavated and replaced with well compacted suitable granular fill or lean mix concrete.

Foundation excavations should be protected from water and inclement weather including frost and any water should be removed by pumping from a sump in the base of the excavation.

Charmouth Mudstone is an over consolidated clay and can swell and soften readily when allowed access to free water. Groundwater monitoring indicates the presence of shallow groundwater at the site. Therefore, care will be required to ensure that foundation excavations are kept as free of water as practicable and that concrete is poured as soon as practicable after excavation.

6.3.1 Western Part of the Site

For the purposes of foundation construction, the site has been ‘zoned’, as shown on Drawing KRF-HYD-XX-ZZ-M2-G-0009 in Appendix A, based on the ground conditions encountered. The following recommendations relate to the western half of the site.

Pad Foundations

Subject to dewatering, pad foundations should be suitable for foundations constructed in the western part of the site (as shown on Drawing KRF-HYD-XX-ZZ-M2-G-0009 in Appendix A).

Based on the design soil parameters provided in earlier sections of this report, as a guide, an allowable net bearing pressure of 125kN/m^2 should be available for a pad foundation of 2m by 2m bearing at least 300mm into the natural firm and stiffer fine soils, or the medium dense and denser natural coarse soils. This value includes a factor of safety of 3.0 against general shear failure and should result in total settlements of not more than 25mm, keeping differential settlements within acceptable limits.

6.3.2 Eastern Part of the Site

For the purposes of foundation construction, the site has been 'zoned', as shown on Drawing KRF-HYD-XX-ZZ-M2-G-0009 in Appendix A, based on the ground conditions encountered. The following recommendations relate to the eastern half of the site.

Ground Improvement with Shallow Foundations

The deep soft natural clays, Made Ground and loose coarse soils in this part of the site are considered unsuitable in their present condition for use as founding soils. One option would be to treat them *in situ* to improve their bearing characteristics to allow shallow foundations to be constructed.

Treatment by vibroreplacement (stone columns) at suitable spacing (to be determined by a specialist contractor) should lead to significant improvement of the soils by the creation of stone columns, but also by the densification of the granular soils. Full depth treatment of the Made Ground will be required and pre-boring may be required locally at least to ensure penetration through the denser Made Ground, or to penetrate, push aside or break up, obstructions. Where penetration to full depth is not possible, the obstructions should be removed, or if this is not practicable, the column layout redesigned to allow foundations to span/cantilever over the untreated area.

Following treatment, an allowable net bearing pressure of 125kN/m^2 should be available for a ring beam, semi-raft foundation or pad foundation. Confirmation of this allowable net bearing pressure should be confirmed by *in situ* maintained load testing.

Different VSC contractors use different methods of emplacing the stone columns and it would be prudent to ensure that the method deployed ensures that the soils surrounding the stone columns are given a high level of compaction from horizontal vibrations by the vibrating poker.

Foundations laid on soil reinforced with stone columns are still susceptible to clay volume change and should be designed accordingly where they are within the zone of influence of existing or proposed trees.

Unlike piles, stone columns will not be affect the consolidation settlement due to the ground level raising. They may, however, shorten the consolidation period by shortening the seepage paths.

Piled Foundations

As an alternative to ground improvement and the construction of shallow foundations, or where deep excavation proves impracticable due to water entries, piled foundations may be adopted.

Driven piles, bored piles with the use of casing or CFA piles should all be suitable for this site. However, the choice of piling system and detailed design of piles are beyond the scope of this report and should be undertaken the specialist piling contractor taking into account the following considerations.

- Obstructions in the ground, such as old foundations can cause piles to stop at shallower than design depth, or deviate from the vertical, thereby reducing their capacity.

- Boring of piles in coarse soils is likely to result in loosening of the soils, with resultant reduced shaft friction.
- Groundwater was observed during the boring of the intrusive holes and during post-fieldwork monitoring and temporary casing is likely to be required for bored piles unless CFA piles with placement of concrete as the pile is withdrawn, are used.
- Piles should extend a minimum of five pile diameters into the bearing stratum to fully mobilise end-bearing resistance.
- Care should be taken for bored and cast *in situ* piles taken through the Made Ground, soft alluvium and loose River Terrace soils where collapse of the pile shaft or running sand conditions could lead to 'necking' of the pile.

If significant site regrading is undertaken, piles may be constructed through newly placed fill, which is likely not only to settle, but to induce settlements in the underlying soils. Under these circumstances, allowance should be made in the pile design for the effects of negative skin friction.

6.3.3 Heave Protection

Deepening of foundations in accordance with BRE 298 will be required where foundations are within the zone of influence of existing, removed or proposed trees and proposed shrub planting. For existing (and any known removed) trees this will require a tree survey to be undertaken by an arboriculturist in accordance with BS 5873:2012 which must include off-site trees that could have an effect on foundation design, in addition to trees on site. Where foundations are within the influence of trees and are deeper than 1.5m bgl, a suitable compressible material or void former will be required.

Foundations may be stepped up, in accordance with the requirements of EC7, BS EN 1997 as long as a suitable founding stratum is present at shallower depth.

Where foundations are constructed on clay soils within the influencing distance of trees including proposed planting, the upper section of the pile (to the recommended minimum founding depth) should be sleeved or overbored to allow for clay volume change.

6.4 Piling Risk Assessment

Whilst contaminants at the site are considered to pose a low risk to Controlled Waters, the Environment Agency may require a piling risk assessment, as there is a possibility that this could lead to creation of new pathways for migration of contamination.

6.5 Working Platform

A working platform will be required prior to the arrival on site of tracked piling/VSC plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on data on the piling/VSC plant in accordance with an FPS certificate for the rig loadings.

6.6 Ground Floor Slabs

In the western part of the site, ground bearing floor slabs are likely to be suitable, subject to over-excavation and replacement of the Made Ground.

In the western part of the site, ground bearing floor slabs are able to be constructed. However, due to the poor and variable strength of the Made Ground and the Alluvium the floor slab should be founded on VSCs.

In areas influenced by trees, the construction of a ground bearing floor slab will require the over-excavation and replacement with a suitable fill to half the equivalent depth as specified in BRE 240, to incorporate potential heave when in the zone of influence of existing, removed or proposed trees and proposed shrub planting.

Prior to the placement of the founding materials and the construction of the ground bearing floor slab, the sub-formation and formation will need to be inspected and checked by a geotechnical engineer to ensure the ground conditions are as expected. In accordance with The Concrete Society Technical Report 34 (The Concrete Society 2013), this shall include the measurement of modulus of sub-grade reaction (k) determined by static plate load testing to confirm the ground conditions at time of construction are consistent with the design parameters derived from this ground investigation.

Following excavation and testing, suitable imported granular material should be placed and compacted in accordance with a suitable specification such as the Specification for Highway Works (Highways Agency 2014). Incorporation of triaxial geogrid reinforcement at sub-formation level, directly below the compacted granular material, will minimise required excavation depths and help provide a suitable foundation for the ground bearing slab.

The floor slab should be of sufficient thickness and sufficiently reinforced to accept the likely loading from commercial vehicles parked on it and any other applied loads, without unacceptable total or differential movement. Following improvement undertaken to a suitable specification, an indicative value for outline design is for a k of 40 $MN/m^2/m$. However, the final value will be provided in the Geotechnical Design Report.

As an alternative, a suspended floor slab on piled foundations is viable, to remove the requirement for over-excavation and replacement of granular fill.

6.7 Roads and Pavements

Following earthworks, undertaken to a suitable specification, an equilibrium CBR of 2.5% should be achievable. However, because of the presence of deep Made Ground and Alluvium, proof rolling, the removal of soft spots, replacement with suitable fill, and the inclusion of a geogrid in the sub-base, to achieve this value, are recommended.

In situ testing during construction to confirm the design values is recommended.

The formation level should be protected during inclement weather from deterioration; all slopes should be trimmed to falls to shed rain water and the surface sealed to limit infiltration.

Prior to the placement of the founding materials and the construction of the road pavement, the sub-formation and formation will need to be inspected and checked in accordance with a

suitable specification to ensure the ground conditions are as expected. All testing should be carried out in accordance with DMRB IAN 73/06 to confirm that the ground conditions at time of construction are consistent with the previous design parameters.

Where the CBR is less than 2.5%, the sub-grade may be unsuitable for both the trafficking of site plant and as support for a permanent foundation, without improvement works being undertaken. Improvement works should be carried out in accordance with DMRB IAN 73/06 Rev 1 Chapter 5. In summary, consideration may be given to the following potential remedial techniques:

- excavation and re-engineering or replacement of weaker soils;
- the inclusion of geosynthetic reinforcement within the unbound layers of the capping and sub-grade;
- where cohesive soils are present and they are deemed suitable for treatment with hydraulic binders, to employ modification and/or stabilisation techniques on the formation;; and
- where granular soils are present, dewatering and re-engineering the formation.

6.8 Buried Concrete

Based on guidelines provided in BRE Special Digest 1 (BRE 2005), the near surface soils can be classified as Design Sulfate Class DS-1 and ACEC Class AC-1.

This equates to a Design Chemical Class DC-1 for a 50 year design life (see BS 8500-1:2006 for details).

Should piled foundations be required, these will need to be carried into the Charmouth Mudstone and based on guidelines provided in BRE Special Digest 1 (BRE 2005), these soils are classified as Design Sulfate Class DS-2 and ACEC Class AC-3z.

This equates to a Design Chemical Class DC-3 for a 50 year design life (see BS 8500-1:2006 for details).

7.0 UNCERTAINTIES AND LIMITATIONS

7.1 Site-Specific Comments

The footprint of the buildings has not been fully investigated and further investigation is recommended as part of the detailed design process.

Investigation techniques were restricted to boreholes and window samples. Additional works are recommended as part of the detailed design process to establish if pad foundations can be used across a higher proportion of the site then currently available

7.2 General Comments

This report details the findings of work carried out in June and July 2016. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of DB Symmetry and those parties designated by them for the purpose of providing geotechnical and geo-environmental recommendations for the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Hydrock has used reasonable skill, care and diligence in the design of the investigation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater findings described are only representative of the dates on which they were made and levels may vary.

Unless otherwise stated, the recommendations in this report assume that ground levels will remain as existing. If there is to be any re-profiling (e.g. to create development platforms or for flood alleviation) then the recommendations may not apply.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness. It is assumed that previous reports provided have been assigned to the Client and can be relied upon. Should this not be the case Hydrock should be informed immediately as additional work may be required.

The work has been carried out in general accordance with recognised best practice. The various methodologies used are explained in Appendix F. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase ‘suitable for use’ is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health, plant life and controlled waters as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM3, they are not primarily intended for that purpose and

additional analysis may be required should waste classification be required for consideration of off-site disposal of contaminated soils. Further analyses may be required by the receiving tip to meet the Waste Acceptance Criteria for specific landfill sites.

Unless otherwise stated, the chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required.

The preliminary risk assessment process may identify potential risks to site demolition and redevelopment workers. However, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds such as Japanese knotweed, this report does not constitute a formal survey of these potential hazards.

Any site boundary line depicted on plans does not imply legal ownership of land.

8.0 RECOMMENDATIONS FOR FURTHER WORK

The following further works may be required during design and construction:

- discussions with regulatory bodies and water authority as required;
- detailed design works;
- the use of barrier pipework for potable water supplies; and
- soft landscape to be completed with clean, validated, site won material.

No further investigation work is required outside that which would be required for detailed design and construction.

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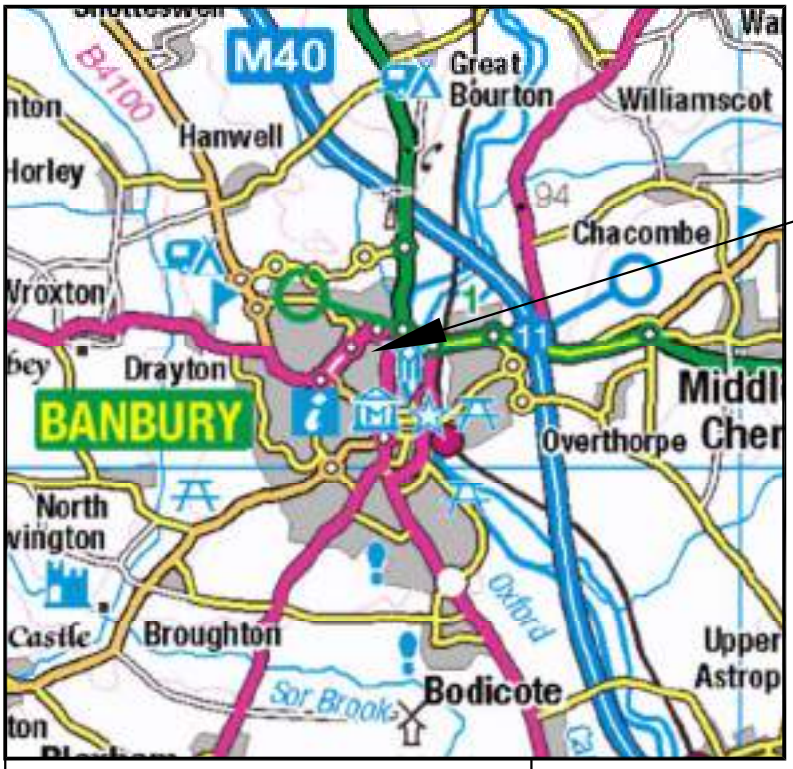
Appendix A

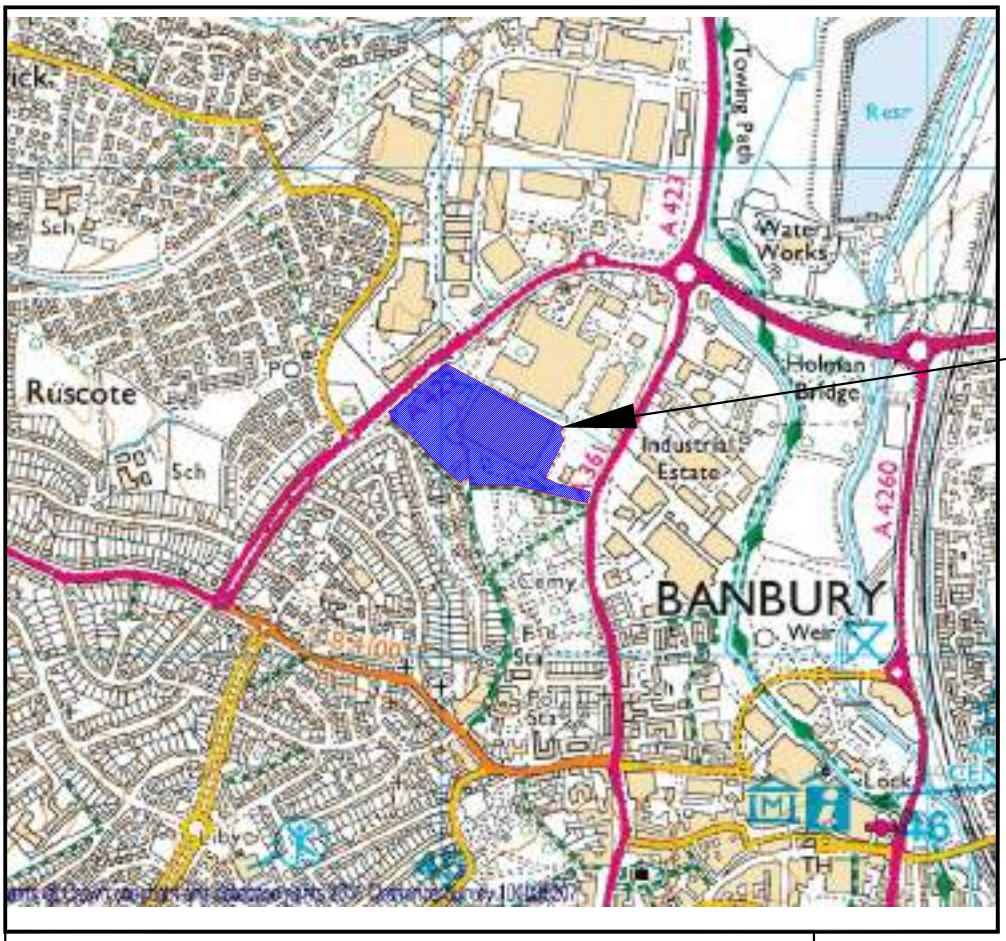
Drawings

Notes:

1. Contains Ordnance Survey data © Crown copyright and database right 2015



THE SITE



THE SITE

Rev	Date	Description	By	Ckd

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Client : dbsymmetry

Project Title: Kraft Phase 2

Drawing Title: Site Location Plan

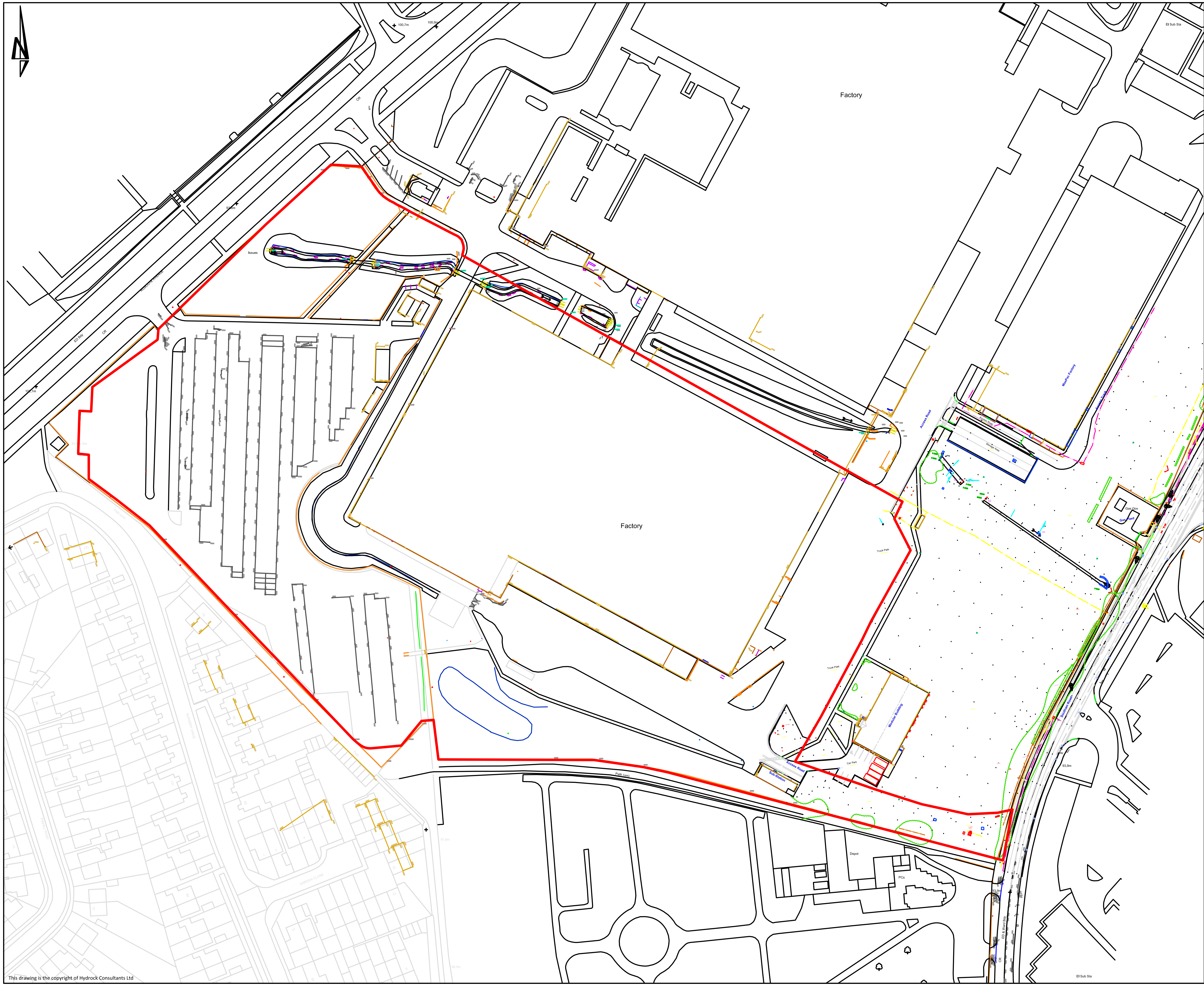
Drawing Status: FINAL

Hydrock Job No: C161279

Drawn	Checked	Scale @ A4	Date	Issue Date
NT	SC	See Drawing	18/04/16	18/04/16

Drawing Number: 161279/D001

Revision: -



Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

Site Boundary

Rev	Date	Description	By	Ckd

Architect :

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Client :
dbsymmetry ltd

Project Title:
Kraft Phase 2

Drawing Title:
Site Survey Plan

Drawing Status:
FINAL

Hydrock Job No: C/161279

Drawn	Checked	Scale @ A3	Date	Issue Date
NT	SC	NTS	18/04/16	18/04/16

Drawing Number: 161279/D002

Revision: -

Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

Legend

BHXXX BOREHOLE

WSXXX WINDOW SAMPLE

KEY TO UNDERGROUND SERVICES

FIRE WATER PIPES
DISUSED FIRE WATER PIPES
ELECTRICAL CABLES
DISUSED ELECTRICAL CABLES
OVERHEAD ELECTRICAL CABLES
DOMESTIC WATER PIPES
DISUSED DOMESTIC WATER PIPES
SURFACE WATER PIPES
DISUSED SURFACE WATER PIPES
GAS PIPES (0.35 BAR).
GAS PIPES-6" STEEL. INTERMEDIATE PRESSURE (@ 7 Bar). NOTE: GROUNDS MUST TO BE DEVELOPED WITHIN 3 METRES EITHER SIDE OF THIS GAS PIPE.
DISUSED GAS PIPES
FOUL SEWER PIPES
DISUSED FOUL SEWER PIPES
TRADE EFFLUENT PIPES
FUEL PIPES
DISUSED FUEL PIPES
NITROGEN PIPES
TELEPHONE CABLES
COMPRESSED AIR LINE
UNKNOWN SERVICES

KEY TO SYMBOLS

FIRE WATER PIPE SYMBOLS
VALVE
VALVE IN PIT
RISING STEM VALVE
POST INDICATOR VALVE
WET RISER WITH ALARM
DRY VALVE WITH ALARM
DRY RISER FIRE BRIGADE
HOSE REEL SUPPLY
UNDERGROUND HYDRANT
NON RETURN VALVE

ELECTRICAL CABLE SYMBOLS
STREET LIGHTS
SECURITY CAMERAS
DRAW PIT

FROM DOMESTIC HOUSING
WSXXX
GRASS AREA
CHECK
CHECK ALL ZIGZAG LINES
MAIN CAR PARK
FOOTPATH
BHXXX
MAIN GATEHOUSE
DISPLAY
SPECIAL SITUATIONS ROOM
CYCLE & M/C PARK
OFFICE
UNIT 6200 RMW/ BIG BAG & MAXPAX STORAGE
TRUCK WASH
TRUCK PARK
ROADWAY
TRAILER PARK
STREAM
PUMP HOUSE & SUBSTATION
RAMP
FOOTPATH
PS3
FD
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Client : SAVILLS

Project Title: KRAFT PHASE 2

Drawing Title: Proposed Exploratory Hole Location Plan

Drawing Status: DRAFT

Hydrock Job No: C161279

Drawn	Checked	Scale @ A3	Date	Issue Date
NT	AB	1:1100	24/05/16	24/05/16

Drawing Number: C161279/D003

Revision: -