KIER CONSTRUCTION LIMITED

INTERPRETIVE REPORT

on

SITE INVESTIGATION

at

UPPER HEYFORD,

OXFORDSHIRE

MAY 2013

REPORT NO: 727738

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DOCUMENT ISSUE RECORD

Contract No:	727738
Client:	Kier Construction Limited
Contract:	Upper Heyford, Oxfordshire
Document:	Interpretive Report on Site Investigation

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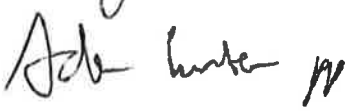
Approved by:		A Cattell
Date:		May 2013

REVISION RECORD

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1 INTRODUCTION

This investigation was carried out on the instructions of Upton McGougan Limited on behalf of Kier Construction Limited.

The purpose of the work was to investigate ground conditions, assess the contamination status of the site and provide information on the construction of existing foundations and construction of new internal walls and mezzanine floors. The work included a Preliminary Risk Assessment, intrusive investigation, laboratory testing, a quantitative risk assessment and the preparation of this report.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and laboratory testing results, and it gives recommendations relating to foundation design, settlement.

It presents an appraisal of geoenvironmental aspects such as soil contamination and ground gas concentrations and gives recommendations on risk reduction. It should not be assumed that these would meet the requirements of the local authority, whose advice should be sought regarding planning permission. This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese Knotweed). It is recommended that these be considered as part of the assessment of development constraints for the site.

The ground investigation has been carried out using a combination of hand dug and machine dug trial pitting techniques, in general accordance with BS EN 1997-1 and 1997-2. Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks.

All information, comments and opinions given in the desk study in this report are based on the information obtained. The information search cannot be exhaustive and there may be records that have not come to light. There may also be circumstances at the site that are not documented.

All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due

to seasonal and/or other effects and may at times differ to those measured during the investigation.

This report was prepared by Structural Soils Limited for the sole and exclusive use of Kier Construction Limited, the funding partner, tenants and two successors in title in response to particular instructions. However no liability will be accepted after a period of 6 years from the date of the report. Any other parties using the information contained in this report do so at their own risk and a duty of care to those parties is excluded.

2 SITE DESCRIPTION

2.1 Location and Topography

This report gives details for two sites located approximately 900m apart along Camp Road, Upper Heyford which lie 7.5km to the west of Bicester (see Site Location Plan in Appendix A). Both sites lie to the south of the former Upper Heyford Airfield.

2.1.1 Officers Mess Hall

The Officers Mess Hall lies to the north of Camp Road and to the east of the entrance into Heyford Park. The British National Grid Reference for this site is SP 515 258. The building present on site is of brick construction and forms a roughly triangular shape measuring 100m by 60m. It consists of both single and two storey parts and two basements are also present beneath parts of the building. This site is roughly flat and level. The building is surrounded by lawns with asphalt access roads and car parks to the east and south. A number of large conifer trees are present in the lawn to the south of the building. Numerous services are located within the building and in the surrounding area including water, gas, drainage and sewage pipes plus electricity and BT telecoms cables. The area to the north and west is occupied by offices and industrial units. A residential area lies to the south.

2.1.2 Sports Hall

The Sports Hall lies to the south of Camp Road to the west of the residential area and hospital associated with the airfield. The British National Grid Reference for the site is SP 506 257. The sports hall itself is constructed from concrete blocks and clad with large concrete panels. The part of the building that is occupied by the main sports hall and squash/racquetball courts is approximately 8m high, whilst the rest of the building varies from one to two storeys. The site slopes gently to the east at approximately 1 in 50. Numerous services are located within the building and in the surrounding area including water, gas, drainage and sewage pipes plus electricity and BT telecoms cables. The building is surrounded by a number of grassed sports pitches, with a small car park to the north. A large number of single storey wooden offices lie to the east of the sports pitches.

2.2 Geology

The British Geological Survey map of Chipping Norton (sheet 218, scale 1:63,360, published 1968) shows the site to be underlain by Great Oolite Limestone consisting of interbedded limestone and argillaceous rocks. The map shows no Drift Deposits on site.

2.3 Hydrogeology

The Environment Agency (EA) website has classified the site's solid geology (Great Oolite Group) as a Principal Aquifer (highly permeable).

'Principal' Aquifers are layers of rock or drift deposits that have high inter-granular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers.

2.4 Hydrology

The nearest surface water to the site is a river approximately 144m to the southwest of the Officers Mess Hall. Groundwater contained within the Great Oolite Limestone is likely to be in potential continuity with this feature. Groundwater is estimated to be flowing in a southerly direction.

2.5 Preliminary Risk Assessment (Desk Study)

2.5.1 Site History from Ordnance Survey Maps

A search of Ordnance Survey maps was undertaken to establish the land-use history of the two sites and their surroundings. Extracts of the maps that are discussed below can be found in Appendix F of this report. Unless otherwise stated, all quoted distances are measured from the site boundary that is marked on the maps.

TABLE 1: SUMMARY OF HISTORICAL MAP DATA

Dates	Scale	Significant features, changes and developments:	
		On site	**In surroundings [distance(m)]**
1880 - 1900	1:10,560 & 1:2,500	The two sites lie within separate fields.	*Quarry* 500m SW of Sports Hall. *Well* 100m N of Officers Mess Hall. *Old Quarry* 400m SW of Officers Mess Hall. Quarry 500m E of Officers Mess Hall. *Leys Farm* 375m SE of Officers Mess Hall. *Field's Barn* 600m S of Officers Mess Hall. *Gorse Covert* Mixed wood vegetation 50m N of Officers Mess Hall. Quarry 50m NE of Officers Mess Hall.
1922 - 1923	1:10,560 & 1:2,500	No significant change.	Well no longer shown 100m to N of Officers Mess Hall Old Quarry expanded in size.
1954	1:10,560 & 1:2,500	No significant change.	Old Quarry no longer present. Area surrounding sites 500 – 1000m now established as *Airfield.* Large paths present surrounding Sports Hall and NW of Officers Mess Hall.
1965	1:10,560 & 1:2,500	Building now present at Officers Mess Hall location.	Numerous buildings now present NE, E and SW 5 -250m from Officers Mess Hall.
1975 -	1:10,560	*Recreational Park* E of	Baseball pitch present 25m W of Sports Hall.

1982	& 1:2,500	Sports Hall overlaps site by 5m. Building, *Tank* and *El Sub Station* now present on Sports Hall. Recreational Park now established as *baseball pitch*.	*Track* present 50m S of Sports Hall. More buildings now situated between both sites. *Tennis courts* present 20m S of Officers Mess Hall. *Hospital* present 200m S of Officers Mess Hall. *Tanks* present 150m SW, 125m N, 200m NW and 400m NE of Sports Hall. *Shopping centre* and *Laundry* present 100m S of Officers Mess Hall. *Tank* 100m W and 150m NW of Officers Mess Hall. *Water Tower* 350m NE of Sports Hall. Water Tower present 250m and 450m E of Officers Mess Hall.
1994 - 2012	1:10,560 & 1:2,500	Sub station established at Sports Hall.	No significant change.

2.5.2 Summary of Site History

Quarries were present offsite from 1880 until 1954 in which the old quarry was backfilled. The Upper Heyford Airfield was established by 1954 but was most likely active before this date. By 1965 a large building is present at Officers Mess Hall in addition to a large number now being present surrounding Officers Mess Hall off-site. The Sports Hall building was built in the late 1970s. Upper Heyford Airfield is no longer an active military facility although it is unclear from the maps when exactly this would have been the case.

2.5.3 Environmental Data

Environmental features such as landfills, groundwater abstraction points, etc, are detailed in the GroundSure EnviroInsight report that can be found in Appendix F of this report. 'Notable' features in these data sets are listed below.

TABLE 2: SUMMARY OF SIGNIFICANT ENVIRONMENTAL DATA

Data Types Showing Notable Issues	No. of Notable Listings (or Yes/No) and Distance (m) from Site				Details of Notable Listings
	On site	0-250	250-500	>500	
ENVIRONMENTAL PERMITS, INCIDENTS & REGISTER					
Part A(2) & Part B Activities & Enforcements		2			Nearest relative activity is Vehicle respraying 174m N.
Radioactive Substances Authorisations		2			Nearest site 40m NW. No longer active.
Licensed Discharge Consents		1	6	-	The nearest is 211m SW discharging into Gallo's Brook.
COMAH & NIHHS sites			1	-	The nearest is Black Cat Fireworks Ltd 351m SW.

TABLE 2: SUMMARY OF SIGNIFICANT ENVIRONMENTAL DATA					
Data Types Showing Notable Issues	**No. of Notable Listings (or Yes/No) and Distance (m) from Site**				**Details of Notable Listings**
	On site	**0-250**	**250-500**	**>500**	
EA Recorded Pollution Incidents		1			The nearest is contaminated water described as firefighting run-off 13m S.
LANDFILL					
EA & Landfill Data Historic and Non-Operational landfills				1	Inert industrial waste located 1236m SW.
GEOLOGY					
Radon Affected Area	Yes	-	-	-	The property is in a radon affected area, as 1-3% of properties are above the action level. No radon protection measures are required for new homes.
GROUND WORKINGS					
Historical Surface and Underground Workings	4	4	-	-	On site were old unspecified quarries from 1898 to 1923 in addition to an unspecified pit dated 1880. The nearest to site is an unspecified pit 56m NE.
Current Ground Workings		2	2	1	The nearest current ground workings are surface mineral workings of Limestone 6m S. The current status is ceased.
NATURAL GROUND SUBSIDENCE					
Shrink-Swell Clay	Negligible	-	-	-	
Landslides	Negligible	-	-	-	
Ground Dissolution of Soluble Rocks	Very low	-	-	-	
Compressible and Collapsible Deposits	Negligible	-	-	-	
Running Sand	Negligible	-	-	-	
BOREHOLE RECORDS					
BGS Recorded Boreholes		48	-	-	The nearest is 18m S to 1.0m depth.
HYDROGEOLOGY & HYDROLOGY					
Groundwater Abstraction Licences				4	The two nearest are 1094m W for domestic, farming and sanitary use.
Potable Water Abstraction Licences				1	The nearest is 1094m W for drinking and sanitary use.
River Quality	No	No	No	Yes	The nearest record is for Lays Farm Ditch 517m NE which has been awarded a C grade.
Surface Water Features	No	Yes	-	-	Stream 144m SW
FLOODING					
Max BGS Groundwater Flooding Susceptibility	Low	Low	-	-	Based within 50m of the site.

TABLE 2: SUMMARY OF SIGNIFICANT ENVIRONMENTAL DATA					
Data Types Showing Notable Issues	**No. of Notable Listings (or Yes/No) and Distance (m) from Site**				**Details of Notable Listings**
	On site	**0-250**	**250-500**	**>500**	
DESIGNATED ENVIRONMENTALLY SENSITIVE SITES					
Environmental Sensitive areas				1	The nearest is 792m W. Upper Thames tributaries
Nitrate Sensitive Areas & Vulnerable Zones	1			1	Apart from on site the nearest is 632m W.
CURRENT LAND USE					
Industrial Site Data	2	22	-	-	On site is an electrical substation and tank situated at the Sports Hall. The nearest to Officers Mess Hall is a marine industrial products 13m N.
Underground High Pressure Oil and Gas Pipeline		1	-	-	The nearest is 160m SW.

N = north, S = south, E = east, W = west

2.5.4 Summary of Environmental Data

The site is in a radon affected area however it does not need any radon protection measures. There is an underground high pressure oil and gas pipeline 160m SW of the site. There is a tank and electrical substation on site at the Sports Hall. Although old unspecified quarries were noted as being onsite in the EnviroInsight report from 1898 to 1923 in addition to an unspecified pit dated 1880 these are in fact half way between the two sites and are not considered to affect either sites.

2.6 Outline Conceptual Model and Risk Assessment

2.6.1 General

This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

The assessment also aims to identify land which would be regarded as 'contaminated land' under the terms of the Environmental Protection Act 1990, Part IIa. This act includes a stricter test for contaminated land than that outlined above. Land is considered to be contaminated if either:

- the land is causing significant harm to people, ecosystems or infrastructure; or
- there is a significant possibility that such harm could be caused; or
- pollution of controlled waters is being, or is likely to be, caused.

The following situations are defined as being where harm is to be regarded as significant:

- chronic or quite toxic effect, serious injury or death to humans;
- irreversible or other adverse harm to the ecological system;
- substantial damage to or failure of buildings;
- death of, or disease or other physical damage affecting, livestock or crops;
- pollution of controlled waters.

2.6.2 Risk Assessment Methodology

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: Preliminary, Generic Quantitative and Detailed Quantitative. An Outline Conceptual Model should be formed at the preliminary risk assessment stage. This identifies potentially complete (termed *possible*) pollutant linkages (source–pathway–receptor) and is used as the basis for design of the site investigation. The Outline Conceptual Model is updated as further information becomes available, for example as a result of the site investigation.

2.6.3 Potential Sources and Contaminants

The potential primary contaminants associated with the sources identified in the desk study are discussed in more detail below:

TABLE 3: POTENTIAL SOURCES AND CONTAMINANTS

Potential Sources: On site	**Likely contaminants**
Tanks (if fuel as opposed to water) & Electricity Sub-Station	PCB and Hydrocarbons
Potential Sources: Off site	**Likely contaminants**
Electricity Sub-Station	PCBs and hydrocarbons
Laundry (if dry cleaners)	Solvents

2.6.4 Outline Conceptual Model

The information presented in previous sections has been used to compile an Outline Conceptual Model. The identified potential contaminants and potential receptors have been considered, along with any possible pathways that may link them.

The resulting pollutant linkages and current resulting risks are considered in the table below:

TABLE 4: OUTLINE CONCEPTUAL MODEL				
Potential Source	**Potential Pathway**	**Potential Receptor**	**Potential Complete Linkage?**	**Comments (e.g. regarding pathways, impermeable strata, site upstream of source, etc)**
Soil contaminants (including naturally occurring arsenic, lead, etc)	Ingestion/ Dermal Contact	Future on-site users (commercial)	Yes	Most at risk are young children.
		Maintenance workers	No	Appropriate PPE should be worn in order to prevent or reduce the risk of these dangers.
		Adjacent commercial	Yes	
	Permeation	Subsurface plastic water pipes	No	This is unlikely to occur.
	Leaching	Groundwater in Principal Aquifer	Yes	Limestone is highly permeable
	Root uptake	Soft landscaping on-site (e.g. phytotoxicity)	No	
Groundwater contaminants (i.e. hydrocarbons)	Ingestion/ Dermal Contact	Future on-site users	Yes	
		Adjacent commercial	No	
		Maintenance workers	No	Appropriate PPE should be worn in order to prevent or reduce the risk of these dangers.
	Permeation	Subsurface plastic water pipes	No	
	Lateral Groundwater migration	Groundwater in Principal Aquifer	No	
Vapours associated with soil and groundwater contaminants and/or bulk ground gases (e.g. asphyxiation, toxicity, explosion and fire)	Migration along backfill around services, more permeable strata inhalation/ explosion	Future on-site users (commercial)	Yes	Type and amount of made ground onsite is main factor. No issue with infilled pits as they are too far away
		Maintenance workers	No	

Please note that construction workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures, such as the use of appropriate PPE, and application of the CDM Regulations.

2.5.5 Outline Risk Assessment Conclusions

The review of information and the construction of the Outline Conceptual Model highlights potential pollutant linkages. In order to investigate any unacceptable risk presented by these, intrusive investigation is recommended. An intrusive investigation will be able to provide further information on actual contaminants present and viable pathways to sensitive receptors.

2.6 Intrusive Investigation

Intrusive investigation is required to assess any significant contaminant sources, pathways and receptors. The change of land use from ex military to educational will require consideration of the former use of the site in terms of any potentially contaminative processes that may have caused contamination of the ground and/or groundwater.

The objectives of an investigation are to:

- Clarify the 'Outline Contamination Conceptual Model'
- Clarify the Outline Risk Assessment
- Provide data for the design of any remedial works that may be required
- Benchmark the contamination status of the site

To achieve these objectives, an investigation was undertaken comprising machine and hand dug trial pits. Where possible the exploratory holes passed through all made ground and into underlying natural soils. Also where possible, the holes extended beyond the base of any obvious soil contamination.

3 FIELDWORK

3.1 Scope of Works

9 no. hand dug trial pits (HDTP1 to HDTP9 and 8 no. machine excavated trial pits (TP1 to TP8) were undertaken on 6 and 7 February 2013 at the locations shown on the Exploratory Hole Location Plans in Appendix A; Figure 2A for the Sports Hall and Figure 2B for the Officers Mess Hall. HDTP1 to HDTP6 and TP1 to TP4 were excavated at the Officer's Mess Hall and the remaining holes were excavated at the Sports Hall site.

The scope of investigation and choice of investigation equipment was decided by Upton McGougan Limited in consultation with Structural Soils Limited. Sampling and in-situ testing details were specified by Structural Soils Limited in consultation with Upton McGougan Limited.

The positions were selected by Upton McGougan Limited and set out by Structural Soils Limited, and adjusted where necessary to take account of buried or overhead services. The positions of the hand dug trial pits were selected to inspect the foundations of the existing structures with respect to the new development. The machine dug trial pits were located to provide information regarding ground conditions across both sites.

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS5930: 1999 (2010 Amendment 2, which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1). Detailed descriptions, together with relevant comments, are given in the logs included in Appendix B.

Prior to the commencement of any exploratory hole or intrusive test a cable avoidance scan was carried out using a cable avoidance tool (CAT) and signal generator ('genny').

3.2 Trial Pits

The hand dug trial pits were approximately 0.50m x 0.50m in plan and were up to 1.30m deep. These pits generally encountered made ground over sandy gravelly clay or sandy clayey gravel.

The mechanically excavated trial pits were approximately 2.50m x 0.60m in plan area and up to 1.70m deep. The trial pits encountered sandy gravelly clay over sandy clayey gravel. Most trial pits except TP2 refused on limestone below the gravel.

Hand vane and/or hand penetrometer tests were carried out in the cohesive strata in the trial pits. Photographs of the trial pits are contained in Appendix B. Small disturbed and bulk soil

samples were taken from the trial pits at regular intervals. On completion the trial pits were backfilled with arisings.

4 LABORATORY TESTING

Samples for potential geotechnical testing were returned to the company's laboratory in Bristol and those for potential contamination testing were sent to an accredited chemical testing laboratory. Geotechnical and contamination tests were scheduled by Structural Soils Limited.

Geotechnical laboratory testing was generally carried out in accordance with BS1377: 1990, *Methods of Test for Soils for Civil Engineering Purposes*, Parts 1 to 8, unless indicated otherwise. Where non-standard procedures have been undertaken, this is recorded on the report sheet. The results are reported in tabular and/or graphical form and included as Appendix C of this report. Contamination testing was carried out in accordance with MCERTs/UKAS standards. The results are reported in Appendix D of this report, along with the accreditation certificate for the laboratory.

4.1 Moisture Content

7 no. moisture content tests were undertaken using the oven-drying method in accordance with BS1377: Part 2: 1990. The results are tabulated in the Summary of Soil Classification Tests and below the Plasticity Chart (see Section 4.2, below).

4.2 Liquid Limit, Plastic Limit and Plasticity Index

7 no. liquid and plastic limit tests were performed in accordance with BS1377: Part 2: 1990. These samples were pre-sieved to remove the >450μm. The results are plotted on the Plasticity Chart (in accordance with BS5930: 1999 Amendment 2) and tabulated below the chart, and in the Summary of Soil Classification Tests.

4.3 Chemical Analyses

6 no. soil samples were tested to determine their pH values and water soluble sulphate contents.

4.4 Contamination

4 no. soil samples were analysed for arsenic, cadmium, chromium (total), lead, mercury, selenium, copper, nickel, zinc, speciated polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (banded TPH), organic matter, soluble sulphate and pH (SSL Soil 1 suite). 2 no. soil samples were analysed for arsenic, cadmium, chromium (total), lead, mercury, selenium, copper, nickel, zinc, speciated polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPHCWG (speciated)), organic matter, soluble sulphate and pH (SSL Soil 3 suite).

5 GROUND CONDITIONS

5.1 General

The exploratory holes were logged by an engineer and the ground conditions encountered are detailed on the logs contained in Appendix B and are summarised below.

5.2 Officers' Mess Hall

Exploratory holes HDTP1 to HDTP3 and TP1 to TP4 internally and HDTP4 to HDTP6 externally.

5.2.1 Made Ground/Possible Made Ground/Topsoil

HDTP1 to HDTP3 and TP1 to TP4 encountered topsoil up to 0.20m deep. Beneath the topsoil made ground was encountered in HDTP1 comprising sandy gravelly clay to 0.30m. Made ground comprising sandy clayey gravel was also encountered in TP2 to a depth of 0.80m, at which depth a 300mm diameter concrete surface water drain was encountered.

HDTP4 to HDTP6 were located inside the building and encountered concrete over made ground comprising clay sandy gravel and sandy gravelly clay. The concrete encountered was between 80mm and 200mm thick. A second 70mm thick concrete slab was encountered in HDTP4 at 0.53m. The made ground was between 0.60m and 0.80m thick. Possible made ground was encountered below the made ground in HDTP4 and HDTP6 to where the pits refused on limestone at 0.75m and 1.25m.

5.2.2 Superficial Deposits

Superficial Deposits comprising sandy gravelly clay were encountered in HDTP2, HDTP3, TP1, TP3 and TP4. The sandy gravelly clay was generally encountered to a depth of 0.30m, however, it extended to 1.00m in TP1. Below this clay dominant layer sandy clayey gravel with low to medium cobble content was encountered to the top of the limestone bedrock at depths of between 0.30m and 1.40m.

5.2.3 Great Oolite Group Limestone

The underlying limestone bedrock is considered to be medium strong and was encountered in all exploratory holes except TP2.

5.2.4 Groundwater

A seepage was encountered in TP1 at 1.30m. The remaining holes were dry.

5.2.5 Existing Foundations

The hand dug trial pits were excavated against various walls and columns to expose the foundation detail. The details of the foundations encountered in each trial pit are summarised in the table below and a sketch showing the foundation in detail is included on the trial pit log in Appendix B.

TABLE 5A: FOUNDATION DETAILS

Trial Pit No.	Foundation Depth (m)	Construction and Type	Foundation Step Out		
			Width (m)	Depth (m) to top of Step Out	Thickness (m)
HDTP1	0.70	Concrete strip	0.10	0.30	0.40
HDTP2	0.50	Concrete strip	0.15	0.15	0.35
HDTP3	0.30	Concrete strip	0.15	0.15	0.15
HDTP4	0.75	Brick strip	None		
HDTP5	0.68	Brick strip	None		
HDTP6	1.25	Concrete strip	0.23	1.00	0.25

5.3 Sports Hall

Exploratory holes HDTP8 and HDTP9 internally and TP5 to TP8 and HDTP7 externally.

5.3.1 Made Ground/Possible Made Ground/Topsoil

TP8 was excavated through asphalt over gravel to 0.20m and HDTP7 was excavated through paving slabs over sand to 0.30m. The remaining holes encountered topsoil, up to 0.20m thick, at the surface. Possible made ground was encountered below the made ground in HDTP7 to where the pit refused on limestone at 0.90m.

HDTP8 and HDTP9 were located inside the building and thus encountered concrete floor slabs. This concrete could not be broken out effectively using hand held equipment, however, the floor was found to be cast against the walls and steel column adjacent to the trial pit locations.

5.3.2 Superficial Deposits

Superficial Deposits comprising sandy gravelly clay were encountered in TP5 to TP8. The sandy gravelly clay was encountered depths of between 0.70m and 1.00m. Below this sandy clayey gravel with low to medium cobble content was encountered in TP5 and TP6 to the top of the limestone bedrock at depths between 0.70m and 1.70m.

5.3.3 Great Oolite Group Limestone

The underlying limestone bedrock is considered to be medium strong and was encountered in all external exploratory holes generally at depths of between 0.70m and 1.10m but deeper in TP5 at 1.70m.

5.3.4 Groundwater

Groundwater was not encountered.

5.3.5 Existing Foundations

The hand dug trial pits were excavated against various walls and columns to expose the foundation detail. The details of the foundations encountered in each trial pit are summarised in the table below and a sketch showing the foundation in detail is included on the trial pit log in Appendix B.

TABLE 5B: FOUNDATION DETAILS

Trial Pit No.	Foundation Depth (m)	Construction and Type	Foundation Step Out		
			Width (m)	Depth (m) to top of Step Out	Thickness (m)
HDTP7	0.90	Concrete strip	0.15	0.80	0.10
HDTP8	Unknown				
HDTP9	Unknown				

6 DISCUSSION AND RECOMMENDATIONS

6.1 Proposed Development

The buildings present on site will, it is understood, be redeveloped to form part of a school. This is to include additional walls and mezzanine floors.

6.2 Site Preparation and Excavation

The soils encountered at the site are considered suitable for excavation by standard mechanical plant such as a wheeled backhoe excavator. In order to excavate the underlying limestone bedrock the use of a breaker may be required.

Our site works indicate that generally groundwater ingress into excavations is unlikely, however, a groundwater seepage was encountered in TP1 at 1.30m. Inflows could occur around periods of heavy rain. Also, our site works revealed that unsupported excavations to the recommended founding depths (or services excavations, etc) are likely to be stable in the short term.

All excavations should be planned and due consideration should be given to providing temporary support or suitable battering. Excavations should be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given in *Health and Safety in Construction.*

6.3 Shrinkage and Swelling

Atterberg Limits tests performed on samples taken from both natural and made ground showed them to be of groups CL and CI as defined in BS 5930:1999. After correction where necessary for their >0.425mm fraction, these samples show low volume change potentials with changes in moisture content, according to the criteria of NHBC Standards, Chapter 4.2 *Building Near Trees*. Based on these results, it is recommended that a low volume change potential be assumed for foundation design purposes.

6.4 Foundations

Foundations should be designed in accordance with the NHBC Standards, which recommend a minimum foundation depth of 0.75m for a soil of low volume change potential. Greater foundation depths may be required in proximity to trees or large shrubs, whether retained or removed. The effects of possible future plantings should also be taken into account during design.

In most hand dug trial pits the existing foundations were found to be laid directly onto the limestone bedrock with the exception of HDTP1 in which the foundation was laid on material comprising firm slightly sandy gravelly clay which is likely to represent weathered bedrock. The limestone was judged to be medium strong which should offer an allowable bearing capacity in the order of 2MPa according to Table 2.3a in *Foundation Design and Construction* 7th Edition (2001). New foundations should be laid directly onto the limestone bedrock. Settlement of the limestone due to the load imposed by new internal walls and foundations or increased loads of existing foundations supporting new mezzanine floors will be negligible.

6.5 Floor Slabs

Ground bearing floor slabs may be used at this site, however, the formation level must be proof-rolled and any soft spots must be excavated and replaced with suitably compacted granular fill.

6.6 Protection of Buried Concrete

The site is classed as brownfield and groundwater is assumed to be mobile.

Soil pH values varying from 7.86 to 11.66 were recorded. From these results a 'Characteristic Value' of 7.99 is derived.

The water-soluble sulphate results from the soil samples tested range from <10mg/l to 530mg/l. The 'Characteristic Value' is therefore 196mg/l and this falls into Design Sulphate Class DS-1 in Table C2 of BRE Special Digest 1 (SD1).

Therefore according to Table C2 the Aggressive Chemical Environment for Concrete (ACEC) class is AC-1 for this site. The designer should utilise these classifications in order to produce the concrete specification.

6.7 Radon

BRE Report 211 is the current guidance to the building industry and is referred to in the Building Regulations. The report applies to residential development. New residential buildings in certain areas may require basic or full radon protection. Basic protection consists of a radon-proof barrier across the ground floor. Full radon protection consists of a radon proof barrier across the ground floor supplemented by either a radon sump or a ventilated subfloor void.

Although there is currently no guidance relating to school buildings it would be prudent to follow the guidance available for residential properties. In this case the two sites are in a radon

affected area, as 1-3% of properties are above the action level, however, BRE 211 states that no radon protection measures are required for new homes.

6.8 Contamination

6.8.1 Risk to Human Health

General

To determine whether contaminants are present at levels that may be deemed to pose a significant hazard to human health, measured contamination levels in soil at the site are compared against derived guideline values ('Tier 2' soil screening), either directly or following statistical analysis. Where contaminants are present above the screening values it is probable that site-specific information will be required to further examine the potential risk of harm arising from such contamination.

The background to the assessment is contained in Appendix D and the findings are summarised in the following pages.

The proposed used of the site is a school and thus the guidelines for residential use with gardens present have been used to assess the results (although this likely to be over-conservative).

Results

There were no olfactory or visual indications of contamination in any of the holes.

Contaminants assessed against the general assessment criteria (GAC) are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, Polycyclic Aromatic Hydrocarbons (PAH) & Total Petroleum Hydrocarbons (TPH).

The mean value test (US95) results for all contaminants were all below the GAC SGV's for a residential end-use. There were no outliers exceeding the SGVs.

The individual result for benzo(a)pyrene from TP3 at 0.20m of 1.22mg/kg slightly exceeded the GAC of 0.83 mg/kg.

6.8.2 Risks to Plants (phytotoxicity).

General

Copper, nickel and zinc can inhibit plant growth. The GAC for this pollutant linkage (see Appendix E) have been taken from Department of the Environment Publication, Code of Practice for Agricultural Use of Sewage Sludge, 1996.

Results

The concentrations determined of these contaminants were below the stated guidelines.

Conclusions

The investigation has shown contaminant levels in the soil to be below the assessment criteria, which indicates that no risks to plants have been identified.

6.8.3 Risks to Water Supply Pipes (Brownfield)

General

One of the samples tested showed TPH results which are slightly above the UKWIR guidelines for PE pipes. Therefore the water company might require PVC or other pipe materials and should be contacted in this regard.

Contamination Conclusion

The results showed one slight exceedance for BaP in natural ground in TP3 at the Officers Mess Hall site. However, the use of residential guidelines is like to be over-conservative. It also appears likely that the guidelines for BaP will be raised in the foreseeable future. Therefore this result is considered unlikely to pose a significant risk and no remediation is likely to be required. Moreover if the area were to be covered by hard development no risk linkage would arise.

6.9 Generic Quantitative Risk Assessment (GQRA) and Final Conceptual Site Model

6.9.1 General

This section of the report aims to refine the 'Initial Contamination Conceptual Model', in the light of the findings of the ground investigation. The methodology used to assess the risk is presented in Appendix E.

6.9.2 Final Conceptual Site Model

The only potential linkage identified is considered to be the possible need for alternative water pipes, if new pipes are to be provided.

Site, landscape and maintenance workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.

6.9.3 Unforeseen Risks During Development

Given the existence of made ground on the site it would be prudent to maintain vigilance during site clearance and construction, in case any further areas of suspected contamination are encountered. If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

6.10 Off-site Disposal of Surplus Soil

6.10.1 General

All excavated material and excess spoil must be classified for waste disposal purposes prior to disposal at landfill. Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all wastes must be classified as:

- 'inert', or
- 'non-hazardous', or
- 'hazardous'.

The Environment Agency's Hazardous Waste (Technical Guidance WM2) document outlines the methodology for classifying wastes. Currently all wastes may require pre-treatment prior to disposal at landfill.

6.10.2 Initial Waste Characterisation

Envirolab have produced an assessment tool that characterises contaminated waste soil by following the guidance within WM2. The 'total solid testing' results from this investigation have been run through this assessment tool to aid potential future off-site disposal of materials. This assessment produces an 'initial' characterisation of the waste which determines if it is hazardous or not (if it is 'not' hazardous, then it may be either inert (insoluble and inorganic) or non-hazardous. However, due to complications with the terminology of 'inert waste' it is best not to refer to it as such until after Waste Acceptance Criteria testing).

Any samples that are classed as hazardous will have light cells with bold text, in the respective sample columns (assuming results are in black & white, otherwise yellow cells on a colour copy). For this site the test results show that the samples tested are not hazardous.

It is important to note that whilst we believe our in-house assessment tool to be an accurate interpretation of the requirements of WM2, thereby producing initial classifications in

accordance with it, landfill operators often have their own assessment tools and can often come to a different conclusion. As a result, some landfill operators could even refuse to take apparently suitable waste.

7 SUMMARY

7.1 The buildings present on site will, it is understood, be redeveloped to form part of a school. Additions include mezzanine floors and internal walls.

7.2 The British Geological Survey map shows the site to be underlain by Great Oolite Limestone consisting of interbedded limestone and argillaceous rocks, which is classified as a Principal Aquifer.

7.3 The nearest surface water to the site is a tertiary river approximately 144m to the southwest.

7.4 Quarries were present nearby and backfilled by 1954. The Upper Heyford Airfield was established by 1954 but was most likely active before this date. By 1965 a large building is present at Officers Mess Hall in addition to a large number now being present surrounding Officers Mess Hall offsite. The Sports Hall building was built in the late 1970's.

7.5 There is an underground high pressure oil and gas pipeline 160m SW of site. There is a tank and electrical substation on site at the Sports Hall.

7.6 Generally made ground was encountered within the footprints of the existing buildings and was up to 0.80m deep. Topsoil was encountered at all mechanically excavated trial pit locations with the exception of TP2 where made ground was encountered to 0.80m where a surface water drain had been installed and TP8 where asphalt and sub-base were 0.20m thick.

7.7 Superficial Deposits comprising sandy gravelly clay over clayey sandy gravel were encountered to depths between 0.30m and 1.70m where limestone bedrock was encountered.

7.8 Groundwater was encountered in TP1 during site works. The remaining holes were dry.

7.9 Details of existing foundation depths and dimensions are given in Section 5.

7.10 The soils encountered at the site are considered suitable for excavation by standard mechanical plant such as a wheeled backhoe excavator. A breaker may be required if excavations are to be taken through the bedrock.

7.11 It is recommended that a low volume change potential be assumed for the clay-rich superficial deposits for foundation design purposes.

7.12 In the hand dug trial pits the existing foundations were generally found to be laid directly onto the limestone bedrock.

7.13 New foundations should be laid on to the limestone which has a presumed allowable bearing capacity of 2 MPa.

7.14 Ground bearing floor slabs may be used at this site.

7.15 The Aggressive Chemical Environment for Concrete (ACEC) class is AC-1 for this site.

7.16 The sites are in a radon affected area, as 1-3% of properties are above the action level. However, BRE 211 states that no radon protection measures are required.

7.17 The contamination test results indicate that risks to human health are not likely to be present. The results showed one slight exceedance for BaP in natural ground in TP3. However, the use of residential guidelines is like to be over-conservative. It also appears likely that the guidelines for BaP will be raised in the foreseeable future. Therefore this result is considered unlikely to pose a significant risk and no remediation is likely to be required. Moreover if the area were to be covered by hard development no risk linkage would arise.

7.18 The results for the samples tested from this site show the 'initial' characterisation of the waste to be not hazardous.

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8 REFERENCES

8.1 BS 5930:1999 *Code of Practice for Site Investigations.* Amendment 2 (2010)

8.2 BS 10175: 2011 *Investigation of potentially contaminated sites*: Code of practice

8.3 BS 1377: 1990 *Methods of Test for Soils for Civil Engineering Purposes*

8.4 British Geological Survey Map, sheet 218, scale 1:63,360, published 1968.

8.5 Environment Agency (EA) website www.environment–agency.gov.uk.

8.6 NHBC Standards, Chapter 4.2, 2011 *Building Near Trees*

8.7 Tomlinson, M.J. *Foundation Design and Construction* 7th Edition (2001)

8.8 BRE Special Digest 1 (2005) *Concrete in Aggressive Ground Part 1: Assessing the aggressive chemical environment.* Third Edition.

8.9 BRE Report 211 (2007) *Radon: Guidance on Protective Measures for New Dwellings*

8.10 Environment Agency Policy. Part IIA – *Detailed Quantitative Assessment of Chronic Risks to Human Health from Contaminated Soils.* Policy Number 199_04, dated 9 March 2004.

8.11 Environment Agency Science Report SR2: *Human health toxicological assessment of contaminants in soil* (Final SC050021/SR2).

8.12 Environment Agency Science Report SR3: *Updated technical background to the CLEA model* (Final SC050021/SR3).

8.13 Land Quality Management/Chartered Institute of Environmental Health, 2nd edition 2009. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, Nottingham.

8.14 CIRIA Report C665 *Assessing risks posed by hazardous ground gases to buildings, London*, 2007.

8.15 S A Wilson & G B Card (1999) *Reliability and risk in gas protection design.* Ground Engineering, February 1999 pp 33-36.

8.16 Environment Agency Contaminated Land Report (CLR) 11 (2004) *Model Procedures for the Management of Contaminated Land.*

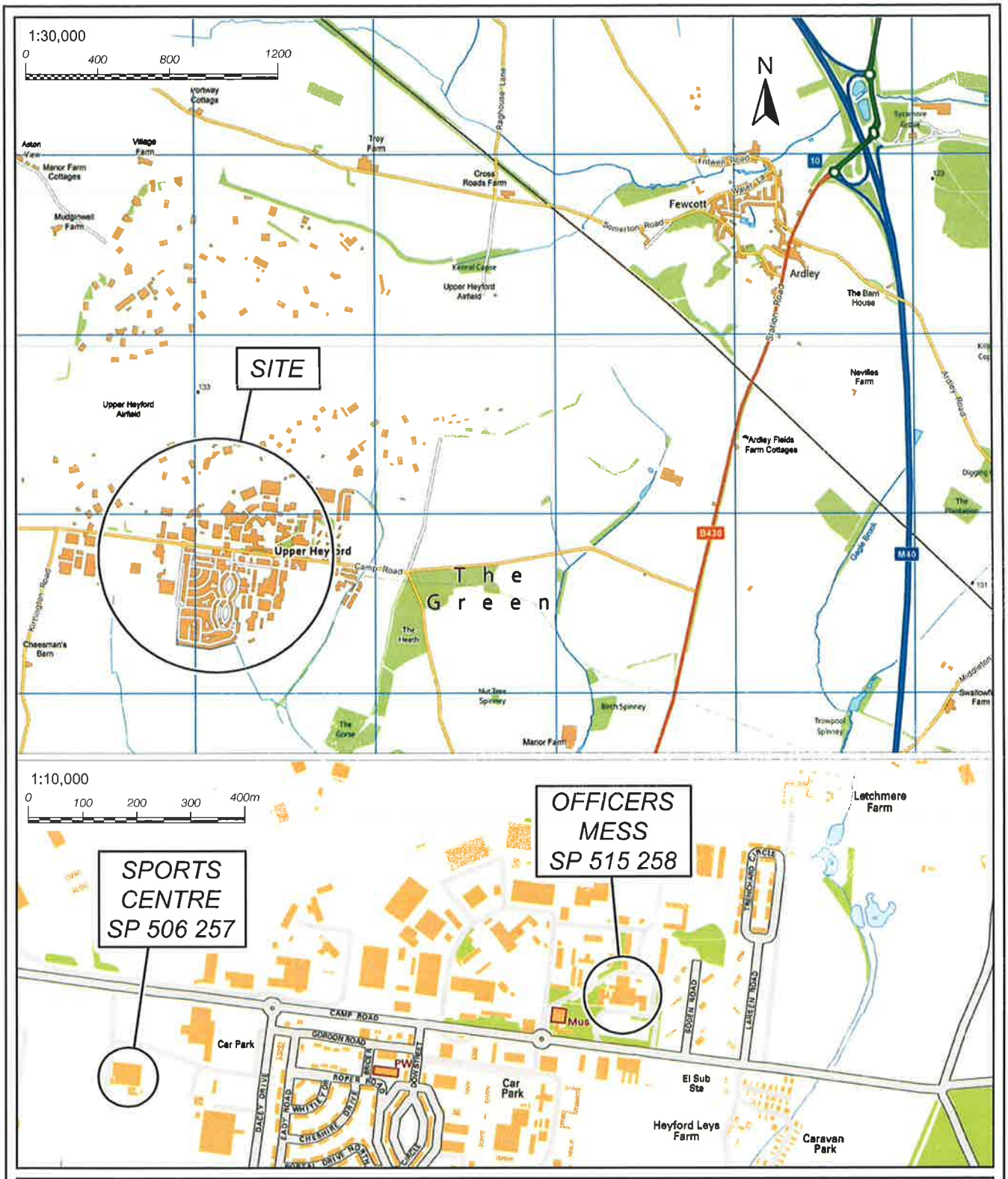
8.17 Landfill (England & Wales) Regulations 2002.

8.18 UK Water Industry Research (2010) UKWIR Report 10/WM/03/21. *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (London: UKWIR).

APPENDIX A

(i) Site Location Plan

(ii) Exploratory Hole Location Plans



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REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	20.05.2013	-	JAH	IF	JS

DIMENSION	SCALE	DRAWING STATUS
m	AS SHOWN	-

CLIENT: Kier Construction Limited

PROJECT: Upper Heyford

TITLE: SITE LOCATION MAP

CONTRACT No	GRID REFERENCE	SCALE BAR	ORIGIN SIZE	FIGURE No
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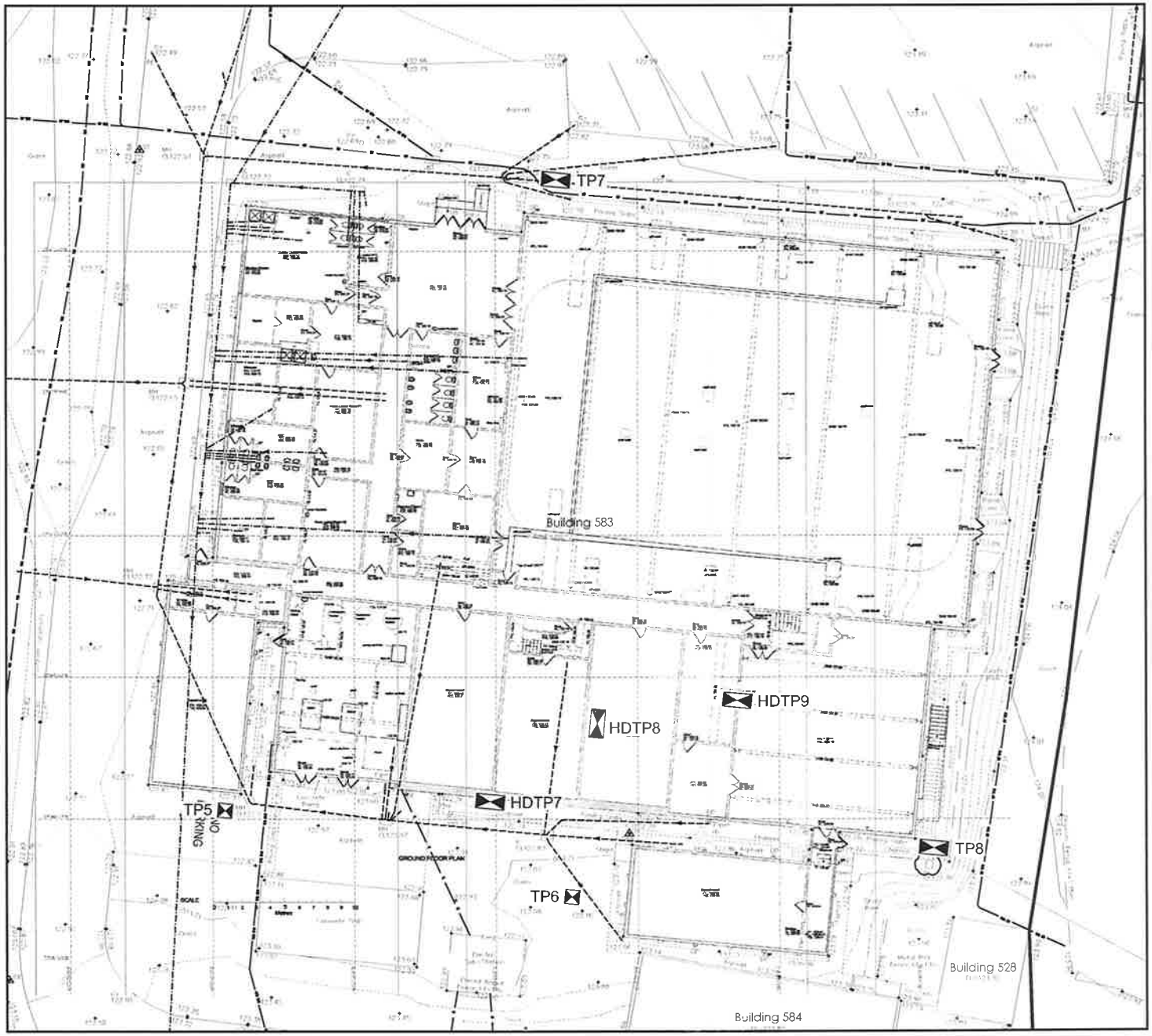

LEGEND

HDTP: Hand Dug Trial Pit Location
TP: Trial Pit Location

N

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	20.05.2013	-	JAH	IF	JS

DIMENSION	SCALE	ORIGIN SIZE
m	1:400	A4

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CLIENT
Kier Construction Limited

PROJECT
Upper Heyford

TITLE
SPORTS HALL
EXPLORATORY HOLE LOCATION PLAN

JOB NO.	FIGURE
727738	2A

DRAWING STATUS	REV.
-	00

0 5 10 15 20m

LEGEND

HDTP: Hand Dug Trial Pit Location
TP: Trial Pit Location

N

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	20.05.2013	-	JAH	IF	JS

DIMENSION	SCALE	ORIGIN SIZE
m	1:500	A4

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CLIENT

Kier Construction Limited

PROJECT

Upper Heyford

TITLE

OFFICERS MESS
EXPLORATORY HOLE LOCATION PLAN

JOB NO.	FIGURE
727738	2B

DRAWING STATUS	REV.
-	00

0 5 10 15 20 25m

APPENDIX B

(i) Key to Exploratory Hole Logs

(ii) Trial Pit Logs