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APPENDIX K1
Geo-Environmental Desk Study Report

National Football Centre
Ltd

**The National Football
Centre**

Geo-Environmental Desk
Study Report

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Geo-Environmental Desk
Study Report

February 2010

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This report takes into account the particular instructions and requirements of our client.

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1 Introduction

National Football Centre Ltd (NFC) propose to develop a at an existing sports facility in Needwood, near Burton-upon-Trent, Staffordshire. It is understood that the development will comprise a two/three storey hotel complex, with a partial basement beneath part of the hotel, indoor sports facilities, including a sports hall, gymnasium, rehabilitation areas and a hydrotherapy pool, and external works comprising car parking facilities for the hotel and access roads. The development will also include the construction of a roof over an existing artificial sports pitch in the southeast of the site, to create an indoor pitch, and relaying of one of the existing outdoor sports pitches. It is also proposed to develop a site within the grounds of the existing facility for a residential end use. A desk study carried out by Arup for the residential development is reported separately.

Arup were commissioned by NFC to provide civil and structural design for the proposed National Football Centre. This included providing geotechnical design and advice on ground related issues associated with the proposed development. As part of this appointment, Arup were requested to carry out a desk study. The desk study comprised a review of readily available geological, historical and environmental information for the site and a site walkover.

This report summarises the findings of the desk study and gives preliminary ground-related considerations for the proposed development and recommendations for further work.

This report takes into account the particular instructions and requirements of NFC. It is not intended for, and should not be relied upon by, any third party and no responsibility is undertaken to any third party.

2 The Site

2.1 Site Location

The site is located within Byrkley Park, Needwood, approximately 6 miles west of Burton-upon-Trent, at approximate National Grid Reference SK 165 235. Byrkley Park is bounded to the north by the B5234 and beyond by open fields, to the east by a stream, Lin Brook, open fields and woodland, to the south by open fields and to the west by Needwood Forest and Tatenhill Airfield.

The site location is shown on Figure 1. The existing site layout is shown on Figure 2.

2.2 Site Description

The site is located within Byrkley Park and is bounded to the north, south and west by sports pitches within the facility, with an area of woodland present to the northwest of the site. To the east, the site is bounded by a stream, Lin Brook. The site is irregular in shape, and covers an area of approximately 22 hectares. The site slopes from northwest to southeast towards Lin Brook, with an approximate level difference of 10m. There is a small slope along the eastern site boundary associated with Lin Brook.

Site walkovers were carried out in November 2009 and January 2010. Features noted during the site walkover survey are annotated on Figure 3. A selection of photographs taken during the site walkover showing general views of the site are included in Appendix A. At the time of the walkover the site was predominantly covered with rough grassland sloping down to the east. An access road crossed the northern and western part of the site.

The northern part of the site was occupied by two level plateaus, where partly constructed foundations and ground works were present (photos 8, 9 and 13). These relate to a previous hotel development which was halted during construction in 2004. The two plateaus are covered in hardcore, with a shallow pond feature present in the western plateau, which it is understood provides a habitat for great crested newts. A steep cut slope connects the two plateaus, with the eastern plateau being approximately 5m lower.

An open chamber, at least 2m deep, was present in the northern part of the site, to the south of the plateaus, which was water filled. This is thought to be a possible historic cess pit or drain chamber, associated with the former lodge (photo 14).

The central part of the site typically sloped from west to east, with a slight valley feature running across the central part of the site, in an east-west direction. A drainage ditch was present within the western part of this feature and ponded water was present in the eastern half of the valley. The area was generally noted to be boggy. To the east of the valley feature, evidence of an apparent collapsed brick culvert was noted, and further east, an old outfall was present feeding the stream (photos 20 and 22), suggesting that a historic culvert may be running in an east west direction beneath the centre of the site.

An artificial football pitch (photos 25, 28, 29) was present in the southern part of the site, with a copse of mature trees present to the northwest. An outdoor pitch, with a landscaped mound to the south, is present in the south western corner of the site.

Lin Brook was present to the east of the site. The brook flows in a southerly direction in a wooded corridor. Two weirs are present on the stream and form two ponds. The southern weir is of brick construction and was noted to be in a poor state of repair. At the time of the site walkover, water levels in the southern pond were very high, causing water to flow over the bank and around the weir (photo 22).

Mature woodland was present to the west of the site, together with sports pitches and service buildings. It is understood that some of the pitches are served by underpitch heating. Fuel tanks associated with the underpitch heating were present 200m west of the site. The tanks were in a bunded enclosure. An oil sheen was present on the water within

the enclosure (photo 16). A building for the ground staff was present 100m northwest of the site and an old building, believed to be the former ice house, was present 150m northwest of the site. Two further fuel tanks were present in this area, 150m northwest of the site. No evidence of any fuel leakage was noted within the bunded enclosure.

During the site walkovers, no evidence of invasive plants, such as Japanese Knotweed, was seen in vegetated areas of the site. It should be noted, however, that not all areas on the site were inspected as part of the walkover. This was supported by the project Ecologist who stated that they had seen no evidence of invasive plants during her site visits. She referenced a report from 2001 which had identified localised Japanese Knotweed to the northwest of the former lodge. The ecologist thought this has been removed as part of the previous development.

During the site walkover discussions were held with a former land owner, F. Thompstone, whose family have farmed the site since the 1930's. Mr Thompstone identified the following points.

- A burial pit for animals infected with Foot and Mouth disease is present beneath the western part of the site. The pit dates to an outbreak in 1967-8, when a total of 733 animals comprising cattle, sheep and pigs were buried. It is understood that the pit was covered with lime. The approximate location of the pit is shown on Figures 3 and 4.
- Earthworks have been undertaken on the site as part of the 2002 previous development. This included the partial infilling of a valley in the centre of the site. This was in the area of the valley feature and boggy ground noted on Figure 3.
- Gypsum mining has taken place within the area of the site. He was not aware, however, of any evidence of mining subsidence or shafts and swallow holes on the site. The gypsum mining is discussed in more detail in section 3.4.
- The airfield to the west of the site was constructed in the Second World War. He was unaware of any bomb damage on the site during the war.
- Demolition of the former lodge commenced in the 1954.

2.3 Proposed Development

At the time of writing it is understood that the proposed development will comprise a two/three storey hotel complex, with a partial basement beneath part of the hotel, indoor sports facilities, including a sports hall, gymnasium, rehabilitation areas and a hydrotherapy pool, and external works comprising car parking facilities for the hotel and access roads. The development will also include the construction of a roof over an existing artificial sports pitch in the southeast of the site, to create an indoor pitch, and relaying of one of the existing outdoor sports pitches. The proposed development at the time of writing is shown on Figure 4.

3 Desk Study

3.1 Introduction

The desk study comprised a review of readily available geological, historical and environmental information and reports relating to the site, supplemented by site walkovers.

The following documents were reviewed:

- A report on a Phase II Soil and Groundwater Investigation undertaken on behalf of the Football Association in February 2001 by URS Dames and Moore [Reference 1];
- A factual report for a ground investigation undertaken on the site by Exploration Associates in August 2001 [Reference 2];
- An interpretative report prepared by GCG on the Exploration Associates ground investigation in 2001 [Reference 3]
- A desk study carried out for The Football Association and De Vere Collection for the National Football Centre in October 2008 by Adams Kara Taylor [Reference 4];
- A planning briefing note provided by Nathaniel Lichfield and Partners in November 2009 [Reference 5].
- A Landmark Envirocheck Report obtained for the site, by Arup, as part of this desk study. The Envirocheck Report is reproduced in Appendix B.

Enquires were also made to the British Geological Survey, British Gypsum, The National Monuments Record, the Environment Agency, and East Staffordshire Borough Council's Building Control and Environmental Health departments. At the time of writing information from some of the enquires was still outstanding.

The findings of the desk study are summarised below.

3.2 Site History

3.2.1 Introduction

The history of the site has been established from a review of historical Ordnance Survey maps contained within the Landmark Envirocheck Report obtained for the site. The Envirocheck Report is reproduced in Appendix B.

3.2.2 Site History

The historical maps indicate the site to have been already occupied by Byrkley Park in the mid 1800's; Byrkley Lodge is shown occupying the northern part of the site in 1884 and remains until 1952. A small electric power station and ice house associated with Byrkley Lodge were shown in the northern area of the site from 1923. The southern area of the site is shown to have been open fields and mixed woodland during the 1800's.

The existing site use has occupied the site since the early 2000's.

The surrounding land uses have included pumping stations, a small gas works associated with the lodge, an airfield, open fields and forest plantations.

A more detailed summary of the site history is given below:

1884 The site is located in an area named Byrkley Park. The northern area of the site is shown to be occupied by Byrkley Lodge. Byrkley Lodge is shown to have several outbuildings including an ice house. The lodge is shown to be surrounded by woodland. Earthworks are shown around the southern area of the lodge, indicating that the site may have been locally raised to construct the lodge. Several paths/small roads are shown to cross the site. The southern area of the site is shown to be occupied by open fields. A single path is shown to cross the southern area of the site in an east-west direction and which continued up the

eastern site boundary. Two distinct copses of trees, one rectangular and one circular in shape, are shown in the central and southern areas of the site, respectively.

A small area of earthworks is shown to straddle the northern boundary of the site. It is thought that the earthworks formed the exterior of a small reservoir. The north and west of the site are shown to be occupied by woodland. An unnamed stream is shown to border the eastern site boundary. There are several weirs and foot bridges associated with the stream. The area around the stream is shown to be mixed woodland. An old lodge is shown approximately 60m east of the site. Two ponds, associated with the stream, one of which is shown to be a fishing pond, are shown towards the south of the site, on the eastern site boundary. A boat house is shown immediately east of the site. The north and northwest of the site are shown to be occupied by woodland. Several plantations and farms are shown to the north, south, east and west of the site. The village of Tutbury is shown approximately 1km north of the site.

1901 The lodge building is no longer shown and two larger buildings are shown in the immediate vicinity, labelled as Byrkley Lodge. Several weirs and fords are shown associated with the stream, which is now named as Lin Brook. The earthworks straddling the northern boundary of the site are no longer shown. The rectangular shaped copse of trees in the central area of the site is now shown as an area of rough pasture. A small pumping station is shown immediately to the southeast of the site. The path across the southern area of the site is no longer shown. An unnamed building is shown immediately to the northwest of the site. Both of the ponds on the eastern site boundary are named as fish ponds.

A gravel pit is shown approximately 350m southwest of the site. A pumping station is shown approximately 500m southeast of the site. A kidney shaped copse of trees is shown approximately 100m west of the site.

1923-24 Several unnamed out buildings are shown around Byrkley Lodge in the northern area of the site. A small electric power station is shown immediately to the west of the Lodge on the western site boundary. The unnamed building, immediately to the northwest of the site, is now shown as a pumping station and an ice house. A gas works is shown approximately 60m northwest of the site. The rectangular shaped area of rough pasture in the central area of the site is now shown as an irregular shaped area of mixed woodland. An overflow is shown on the south fish pond, at the location of the weir seen during the site walkover.

The gravel pit to the southwest of the site is now shown as an old gravel pit. An old Marl pit is shown approximately 750m southwest of the site.

1955 Several small outbuildings to the west of the lodge are no longer shown.

An airfield, understood to have been constructed in the Second World War, is shown 250m northwest of the site.

1974 The southern lodge building is no longer shown. Minor alterations to the footprint of the northern building are shown. Several outbuildings including the Electric Power Station are no longer shown. The area in the south of the site that was previously shown as mixed woodland is now shown as rough pasture.

The airfield to the northwest of the site is shown to have developed with several runways and taxiways, with three circular aircraft aprons present on the western boundary of Byrkley Park. A number of small buildings are shown approximately 500m north of the site which are connected by a network of tracks to the airfield. A building approximately 500m east of the site is named as Byrkley Garden Centre.

- 1994 No change to the site and the surrounding area is indicated.
- 2000 The majority of the buildings associated with Byrkley Park are no longer shown. Byrkley Garden Centre to the east of the site is shown to have been extended.
- 2006 No change to the site and surrounding area. It is known, however, that the site was developed between 2002 and 2004 with the existing sports facility. Additional details are given in section 3.6.
- 2009 All buildings associated with Byrkley Park, in the northern area of the site, are no longer shown, with the exception of the ice house, which is shown as disused. The area of rough pasture in the central area of the site is no longer shown. A path is shown running down the western site boundary from north to south. A sports pitch is shown in the southwest corner of the site. Six additional sports pitches are shown to the southwest and west of the site. The sports pitches are located around the kidney shaped corpse of trees. A small unnamed building is shown on the western site boundary, which is thought to be a plant room and changing facility. Three sports pitches and associated small unnamed buildings are shown on the northern site boundary. A building, understood to be an attenuation tank for the sports pitches, is shown approximately 100m south of the site.

3.2.3 Aerial Photography

The National Monuments Record (NMR) were contacted to establish whether they held any historical aerial photographs for the site.

The aerial photographs identified by NMR gave a limited coverage of the site and dated from 1948 to 1982. NMR have reviewed their search, and as a result additional photographs have been ordered. These had not been received at the time of writing. Selected aerial photographs are included in Appendix C.

The aerial photographic interpretation, for the period 1948 to 1982 provided the following additional information relating to the site history:

- A series of earth bunds are present around the small buildings and tracks 500m north of the site, which were identified in the site history, are shown on the 1948 photograph. These buildings are thought to be munitions stores associated with the adjacent airfield.
- No major changes in landform were identified
- A small firing range was located to the northwest of the site within the airfield.
- A depression was identified to the east of the site, which may be associated with an old clay pit.
- No evidence of depressions or possible mineshafts, that may have been associated with gypsum mining or solution features in the gypsum, were noted the site.
- No evidence of Second World War bomb damage was evident to either the site or the airfield.

3.3 Geology and Ground Conditions

The likely ground conditions at the site have been determined by reviewing the following information:

- British Geological Survey, 1:10,560 Solid and Drift Geological Map, sheet SK12SE [Reference 6];
- British Geological Survey, 1:50,000 Solid and Drift Geological Map, Sheet 140 [Reference 7];
- The geological memoir for the site [Reference 8];

- A ground investigation undertaken by URS [Reference 1];
- A ground investigation undertaken by Exploration Associates [Reference 2], which was interpreted by GCG [Reference 3]
- A desk study carried out by Adams Kara Taylor [Reference 4].

3.3.1 Published Geology

The BGS scale 1:10,560 solid and drift map for the area [Sheet SK 12 SE] and memoir indicates that the site is underlain by Glacial Boulder Clay, underlain by bedrock of the Mercia Mudstone Group. Bedrock in the northwest and west of the site comprises Tea-Green Marl and in the southeast and east of the site Mercia Mudstone (formally known as Keuper Marl). The boundary between the Tea-Green Marl and the Mercia Mudstone is shown on the map as approximate. Immediately to the east of the site, in the vicinity of Lin Brook, rockhead is indicated to be present at ground surface, comprising Mercia Mudstone.

Layers of gypsum and anhydrite are present within the Mercia Mudstone Group, which form part of the Tutbury Gypsum group. The group is noted to be variable in nature and to occur locally between 37 and 65m below the base of the Tea-Green Marl. The gypsum is known to occur in the district in two major horizons within the Mercia Mudstone. The lower bed of gypsum, the Tutbury Gypsum, is 2.7m thick and occurs 45m below the base of the Tea-Green Marl. It has been extensively worked at Hanbury and Fauld, near Tutbury to the north of the site. Mining the gypsum is discussed further in section 3.4.

Two old gravel pits are shown approximately 300 and 500m south of the site. A note associated with one of the gravel pits states shallow workings in gravelly boulder clay.

A fault is shown approximately 700m northwest of the site running in a northeast-southwest direction, with the strata downthrown to the northwest.

3.3.2 Historical BGS Borehole Records

Historic records for eight boreholes, located between 100 and 1400m of the site were obtained from the BGS. The BGS held no borehole records for the site. Two of the records provide information on the gypsum. Copies of these records are reproduced in Appendix D. One of the records, a well records (SK12SW2), located approximately 500m southwest of the site, has a brief description of the stratigraphy that was encountered during drilling of the well. The stratigraphy comprised:

Strata Description	Strata Thickness (m)	Base of Strata (mbgl)
Clay, Gravel and Sand	4.3	4.3
Alabaster	4.8	9.1
Marl	44.5	53.6
Cavity	0.6	54.3
Marl	1.2	55.3
Cavity	0.9	56.4
Marl	0.5	56.9

It is indicated on the logs that the cavities relate to the Tutbury Gypsum Seam.

One of the borehole records (SK12SW19) approximately 550m southwest of the site indicates Tutbury Seam at a depth of 59.64mbgl, with a reported thickness of 3.54m.

A number of deep borehole records are shown on the BGS database in close proximity to the site. These are marked as confidential and are understood to be owned by British Gypsum.

3.4 Mining

3.4.1 British Gypsum Mining Report

A Gypsum Mining Report was obtained for the site from British Gypsum. A copy of the report is reproduced in Appendix E.

The report states:

- Extensive mining operations have taken place immediately to the north of the site. These mining operations were carried out from the Fauld Mine between 1990 and 2000. No gypsum or anhydrite mining has, however, taken place beneath the site.
- The minerals, gypsum and anhydrite, beneath the site are not in the ownership of the British Gypsum, but the land is situated within the present planning consent area for underground mining.
- British Gypsum reserves the right to extract, at some time in the future, all of the minerals for which it has a current planning consent.

Additional enquires have been made to British Gypsum to establish the depth and thickness of the gypsum in the vicinity of the site. At the time of writing this information has not yet been received.

3.4.2 Arup Mining Report

The Arup Review of Mining Instability in Great Britain [Reference 9] confirms that Gypsum to have been mined in East Staffordshire since medieval times and continues to be mined at the Fauld mine, Tutbury, using pillar and stall methods. A map contained within the review shows the 1km grid square immediately to the north of the site to be an area of known evaporite mining.

3.4.3 Adams Kara Taylor - Desk Study September 2008

Adams Kara Taylor (AKT) undertook a desk study for the site in December 2008.

Within the desk study report, AKT state that the site is not located within an area of recorded quarrying or coal mining. As part of the desk study AKT contacted East Staffordshire Borough Council's Building Control department in relation to gypsum mining. They indicated that the site is not located within the area of the mines and that issues associated with ground stability should not be applicable to the development

3.4.4 Summary

Based on the findings of the desk study it is considered that the risk of gypsum mining affecting the development is very low. It is recommended that the additional borehole records held by British Gypsum are obtained to confirm the depth and thickness of the gypsum beneath the site.

3.5 Previous Ground Investigations

3.5.1 URS – Byrkley Park, Phase II Investigation 2001

In January 2001, a ground investigation was undertaken by URS Dames and Moore on behalf of the Football Association [Reference 1]. The Phase II investigations were the follow on from a site walkover which identified several potentially contaminative uses within the Byrkley Park area. The investigation comprised:

- Six trial pits in the area of the former gas works and a geophysical survey to investigate buried obstructions, including one in the location of the gas storage holder;
- Four trial pits in the area surrounding the former Aircraft Aprons, on the western boundary of the Byrkley Park site.
- Two trial pits in the area south of the foot and mouth pit, reported to be present in the western part of the site;

- Three hand augured boreholes in the area of the former lodge;
- A limited geophysical survey in the location of the munitions stores.

The exploratory hole locations are shown on Figure 5.

The ground investigation typically encountered made ground overlying glacial till. Bedrock was not encountered during the investigation as the exploratory holes terminated at a maximum depth of 2.9mbgl.

The investigation focused predominantly on contamination. Visual and olfactory evidence of contamination was only noted in the area of the former gas works. During the excavation of TP5, water seepage occurred at a depth of 0.9mbgl, which had an oily sheen. Both the water and soil had a cokey odour.

The results of chemical testing carried out on soil samples showed that all contamination concentrations were below the relevant Dutch Intervention Values (DIV), with the exception of TP5, in the location of the former gas holder, where concentrations of Lead and Zinc were slightly elevated. Elemental Sulphur and Total Sulphate were also above the adopted screening criteria.

The groundwater sample for TP5 showed all concentrations were below the relevant DIV screening criteria, with the exception of a slightly elevated concentration of Diesel Range Organics.

The report recommended that the area of the gas works should be remediated.

Soil samples taken from the two trial pits excavated south of the foot and mouth pit were also analysed for Bacillus Anthracis (Anthrax). No Anthrax was present.

In the locations of the munitions bunkers, URS concluded that there were several isolated geophysical anomalies that could represent potential ordnance targets that would warrant intrusive work if the area was to be cleared.

3.5.2 Exploration Associates – Byrkely Park, 2001

A ground investigation for the National Football Centre was undertaken by Exploration Associates in May 2001 [Reference 2] on behalf of Building Design Partnership.

The ground investigation was for the wider Byrkley Park area and comprised:

- 20 boreholes using both cable percussive and rotary open hole drilling techniques, to a maximum depth of 17.9m below ground level (mbgl);
- 22 mechanically excavated trial pits to a maximum depth of 5.0mbgl;
- Geotechnical laboratory testing with two samples tested for a suite of contaminants;

The findings of the ground investigation are reported in Exploration Associates factual report [Reference 2].

16 of the exploratory holes were located within the proposed development site boundary. These holes typically encountered topsoil / made ground overlying glacial drift deposits overlying mudstone bedrock. Localised deeper pockets of made ground were encountered in the vicinity of the lodge.

Topsoil was encountered in all the exploratory holes in the south of the site and varied in thickness typically from 0.2 to 0.8m. In the northern part of the site made ground associated with the lodge was encountered up to a depth 3.2mbgl and comprised sandy gravelly clay or clayey gravelly sand with fragments of brick, concrete and ash.

Firm to stiff / very stiff slightly sandy gravelly clay, considered to be the Glacial Till, was encountered in all the exploratory holes beneath the topsoil / made ground to a depth of between 5.8 and 10.5mbgl. The strength of the material increased with depth. The clay was reported to be locally soft at the surface in two of the exploratory holes (TP11 and 11A).

Gravel lenses were encountered within the clay in several holes. To the north of the site four trial pits encountered soft greyish blue gravelly clay between depths of 0.9 and 3.1mbgl, this may be associated with the weathered surface of the Tea-Green Marl.

Bedrock was encountered in four of the boreholes at depths of between 5.8 and 10.5mbgl. The bedrock was typically described as weak grey mudstone, thought to be the Tea-Green Marl. One of the exploratory holes encountered a reddish brown mudstone at a depth of 12.7mbgl, below the Tea-Green Marl. This is thought to be Mercia Mudstone.

Groundwater was encountered in five of the exploratory holes during the site works, at depths of between 1.4 and 3.4mbgl. Post site monitoring works were carried out on one occasion and indicated a variable groundwater level across the site between 1.01 and 7.51mbgl.

The results of the chemical testing were all below the residential screening values selected for the site.

3.5.3 Geotechnical Consulting Group – Byrkley Park, 2002

The findings of the Exploration Associates ground investigation were interpreted by Geotechnical Consulting Group (GCG). The findings are presented in an interpretative report [Reference 3].

In addition to the ground conditions identified above, GCG made the following conclusions:

- The firm to stiff clay is glacial till, which contains lenses or possibly continuous layers, of water-bearing silty sand or silty sandy gravel.
- The rockhead contours are more regular than the ground contours which explains the difference in the glacial till thickness.
- The glacial tills will be weather-sensitive in earthworks. The material will soften readily on exposure to water. Consideration should be given to the use of lime to reduce the water content of the glacial till if it wets up too much as a result of winter working.
- The glacial till contains water-bearing lenses which may lead to softening of the clay when they are encountered in excavations.
- The top of the Tea-Green Marl is highly weathered and of relatively high permeability. Sub-artesian conditions may develop during excavations, leading to the risk of base heave and to the need for groundwater pressure relief.
- The top level on the Tea-Green Marl varies considerably over relatively short distances.

3.6 Previous Development

Construction of a previous scheme on the site commenced in 2002. The scheme comprised the development of the National Football Centre with ten sports pitches and on-site accommodation, including a hotel. The sports pitches were constructed. Ground work and foundation construction was undertaken in two areas of the proposed site for the on-site accommodation, but the works were halted.

A health and safety file for the project was produced [Reference 10] by Shepherd Construction Limited, the Main Contractor for the project. This provided details of new buried services installed as part of the development. It also refers to the foot and mouth pit which was encountered during the earthworks. No location is given in the report and it is stated that the pit was covered back over and left.

Enquires were made to Shepherd Construction, but they do not hold any further information in relation to the foot and mouth pit.

3.7 Environmental Setting

Information regarding the environmental setting of the site has been obtained from the Landmark Envirocheck Report, reproduced in Appendix B. The report included information regarding potentially sensitive or contaminative land uses, hydrology and hydrogeology, abstraction and discharge consents, pollution incidents and radon risk. The information in the report is summarised in this section.

3.7.1 Potentially Sensitive Land Uses

The Envirocheck Report indicates that there are none of the following potentially sensitive land uses within 250m of the site.

- Areas of Adopted Green Belt
- Areas of Unadopted Green Belt
- Areas of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Parks
- Local Nature Reserves
- Marine Nature Reserves
- National Nature Reserves
- National Parks
- Nitrate Sensitive Areas
- Ramsar Sites
- Sites of Special Scientific Interest
- Special Areas of Conservation
- Special Protection Areas

The Envirocheck Report states there to be a Nitrate Vulnerable Zone on the site associated with surface water which was designated in 2006. The source is stated to be the Department of Environmental, Food and Rural Affairs (DEFRA). No further details are given.

A search was also made on the Multi-Agency Geographic Information for the Countryside (MAGIC) Website [Reference 11], which also contains information on potentially sensitive land uses. The MAGIC website indicates that the wooded areas on and around the site are part of the National Inventory of Woodland and Trees (England) and the site is indicated to be part of the National Forest. The site is indicated to be a Nitrate Vulnerable Zone

3.7.2 Hydrology and Hydrogeology

The nearest surface water course to the site is Lin Brook on the eastern site boundary.

The eastern boundary of the site adjoining the brook is in an area identified by the Environment Agency to be at risk from flooding and extreme flooding from rivers and seas. The flooding is localised around the brook. The proposed building area is not shown to be in an area at risk from flooding.

The bedrock beneath the site is classified in the Envirocheck Report as a non-aquifer (negligibly permeable). The drift deposits across the site are not classified in terms of leaching potential.

3.7.3 Potentially Contaminative Land Uses

There are no records of any petrol stations or contemporary trade directories entries within 250m of the site.

3.7.4 Abstraction and Discharge Consents

There are no records of any discharge consents within 250m of the site.

There is one water abstraction consent within 250m of the site. The consent is located 56m northwest of the site, with the permit being issued in April 1992. The abstraction is for general farming and domestic use, with the abstraction type being specified as ground water from a single source. The issuing authority is the Environment Agency, and the operator is Forte (UK) Ltd and the licence number is 03/28/07/0013. The daily and yearly abstraction rates are not supplied. The location of this abstraction consent is consistent with the location of the pump house associated with Byrkley Lodge.

3.7.5 Pollution Incidents to controlled Waters

There are no records of any pollution incidents to controlled waters within 250m of the site.

3.7.6 Registered Land Fill Sites

There are no records of any registered or historic landfills within 250m of the site.

3.7.7 Registered Waste Water Treatments and Disposal Sites

There are no records of pollution controls, waste management, treatment or transfer sites within 250m of the site.

3.7.8 Radon

The Envirocheck Report indicates that the site is not in a radon affected area, with less than 1% of homes are above the action level. As a result the report states that no radon protection measures are likely to be required for the site. This is consistent with BRE guidance on radon protection [Reference 12].

3.8 Additional Enquires

3.8.1 Environment Agency Enquires

An enquiry was made to the Environment Agency (EA) in relation to information they hold regarding landfills, contamination incidents, flood events and the foot and mouth pit. The Environment Agencies response is included in Appendix F and summarised below:

- The Environment Agency have no record of historic flooding in the area of the site.
- The Environment Agency do not hold any records of a livestock burial ground from the 1967 – 68 Foot and Mouth epidemic. Groundwater Authorisation was not required from the Environment Agency at the time of the burial.

3.8.2 East Staffordshire Borough Council

3.8.2.1 Environmental Health Department

An enquiry was made to the Environmental Health department at East Staffordshire Borough Council in relation to information which they hold regarding landfills, contamination incidents, flood events, the foot and mouth pit and any other ground related constraints on or adjacent to the site. Their response is included in Appendix G and states that:

- The gas works to the northwest of the site, which were, present in the 1920's, may present a source of contamination.
- They hold no records of landfills in or around the site; however, two areas of potentially infilled land are present within 200m of the southern site boundary. No further data is held on these areas. They cannot confirm whether or not any such sites were used as burial sites during the Foot and Mouth Epidemics.
- They do not consider the site to be one where significant harm (or significant possibility of such) is being caused due to land contamination or pollution to controlled waters is occurring.

- The site has not been classified as contaminated land as defined in Part IIA of the Environmental Protection Act 1990.
- Any planning application submitted for the site would likely be subject to conditions requiring the investigation of the ground for contamination, focusing mainly around the gas works.

3.8.2.2 Building Control

An enquiry was made to East Staffordshire Borough Council Building Control department in relation to ground related constraints at the site.

They provided a map, from the deeds of the site, showing the approximate location of the foot and mouth pit in the western part of the site (Appendix H). The indicative location of the foot and mouth pit is shown on Figure 3 and 4. Building Control confirmed that the pit was from the 1968 epidemic.

3.8.3 Munitions Survey

A limited munitions survey [Reference 13] was carried out approximately 500m north of the site in November 2008. The survey was concentrated around two bomb stores (No. 2 and No. 4), shown on Figure 4. These stores are consistent with two of the features identified on the aerial photographs. The survey was undertaken by Fellows International Limited, and comprised an electromagnetic search for munitions contamination. The findings of the survey stated that no evidence of munitions contamination was located within the surveyed areas and an Explosives Free Certificate was provided.

4 Contamination Risk Assessment

4.1 Introduction

A qualitative contamination risk assessment has been undertaken for the area of the proposed National Football Centre.

Contamination of soils and groundwater can present a significant financial and environmental risk to site development. The risks to development include the potential to cause harm to health and the wider environment, the financial liabilities of land owners associated with these and the reduction to the value of land.

The legislative framework for contaminated land in the UK is complex. The principal UK legislation is contained within Part IIA of the Environmental Protection Act 1990. Contaminated land issues are also tackled in other legislation and statutory controls including those on pollution (Pollution Prevention and Control Act, 1999), waste, water quality (EC Directives and the Water Resources Act, 1991) and planning. The central objectives of the UK contaminated land legislation and guidance are the prevention of future pollution, promotion of sustainable development and a “suitable for use” approach to land remediation.

The UK follows the source-pathway-receptor principle in its approach to risk assessment and risk management for land contamination. It focuses on establishing where risks to human health or the environment are unacceptable, and then taking appropriate and cost-effective action to deal with them. The principles of the source-pathway-receptor principle are summarised below.

The “source” is defined as any residual contamination on the site, normally associated with previous or existing site activities. A source may affect one or more “receptors” including people, natural soils, plants (landscaping), ecosystems, building materials, services and water resources, both surface water and groundwater. A “pathway” must be present for the source to provide any risk to any given receptor. The magnitude of any such risk must be assessed by considering the vulnerability of the receptor and the possible impact of the source.

A conceptual model showing potential contamination linkages is shown in Figure 6.

The main risks associated with each receptor group are briefly described below:

- **Risk to Human Health** - A range of contaminants including heavy metals, inorganic and organic compounds may present a hazard to human health if they are ingested in contaminated soil, water or produce, inhaled as vapour or dust or absorbed through dermal contact. Targets include construction workers, land users and occupiers, and those who use or occupy adjacent sites.
- **Risk to Ecology (plants and animals)** - A number of contaminants including some metals and inorganic compounds are phytotoxic and can inhibit plant growth by direct root uptake from soil or groundwater. The form and availability of the contaminants and the type of plant control the degree to which the contamination effects plant growth.

A livestock burial pit dating back to a former foot and mouth outbreak is thought to be present beneath the site. This may pose a risk to nearby livestock if the pit is exposed.

- **Risk to Buildings/Services** - Building materials in contact with the ground, including concrete, steel and plastic, can be attacked by and undergo degradation due to a range of aggressive contaminants. Sulphates, including those derived from sulphide oxidation, and acidic conditions are particularly hazardous to concrete. The hazard to building materials is affected by the form of a given contaminant and its degree of mobility/water solubility.

- **Risk to Controlled Waters** - A wide range of contaminants including metals, inorganic and organic compounds may affect surface water and groundwater resources (Controlled Waters). The hazard posed to the Controlled Waters will be dependent on the mobility of the contaminants and the extent to which the site is hydraulically connected to a given water resource.

A preliminary qualitative source-pathway-receptor risk assessment has been carried out for the proposed development area based on the findings of this desk study. Details of the assessment carried are provided below.

4.2 Hazard Identification

The desk study has indicated the site to have had limited previous or current potentially contaminative land uses. Prior to the existing sports facility the site was occupied by Byrkley Lodge and its grounds. A small gas works, associated with the lodge, was located 50m northwest of the site and a small electric power station was located on the north western corner of the site. A foot and mouth burial pit is located beneath the western part of the site.

Based on the findings of the desk study, it is considered that the potential for widespread contamination to be present across the site is low. This assessment is supported by the findings of the two previous phases of investigation undertaken on the site, which did not identify any elevated contamination concentrations on the site. It is, however, considered that there is a low to medium risk of potential localised pockets of contamination to be present associated with the following potential sources:

- The electric power station in the north western part of the site;
- The historic gas works;
- Fill material deposited in areas of the site to possibly fill the valley feature and to create a level development platform for the sports pitches;
- Localised made ground in the location of the historic lodge, which may contain demolition arisings, and fill material which was used to create the level plateau for the historic lodge;
- Above ground fuel storage tanks within a concrete bund. During the site walkover the water within the bund enclosure was noted to have an oily sheen on the surface;

The foot and mouth burial pit, which, lies within the area of the proposed development presents a potential risk to the development. Within this desk study the risk has been identified to be potentially high. Specialist advice should be sought, regarding the risk associated with the foot and mouth burial pit and appropriate methods of mitigation.

The nature and extent of any potential contamination should be confirmed by a development specific intrusive ground investigation and appropriate testing.

4.3 Pathways

The principal theoretical pathways for contamination to reach the receptors identified below are as follows:

- Dermal contact with contaminated soils/dust/groundwater;
- Inhalation of dust/vapours/gas;
- Ingestion of contaminated soils/dust/groundwater;
- Ingestion of contaminated produce;
- Root uptake of phytotoxic contamination by plants;
- Direct in-ground contact with contaminated soils and groundwater;

- Downward seeping/leaching of contaminants to groundwater through drift deposits.

4.4 Receptors

The potential contamination may impact on the following receptors on or near the site:

- Construction and maintenance workers;
- End-users of the proposed National Football Centre;
- Building and service materials;
- Plants and animals;
- Controlled Waters.

4.5 Risk Evaluation

The potential risk to the proposed development resulting from the potential contamination sources has been assessed through a qualitative risk assessment using the source—pathway-receptor methodology.

The proposed development for the site will comprise a two/three storey hotel complex, with water feature, indoor sports facilities including a sports hall, gymnasium, rehabilitation areas and a hydrotherapy pool, and external works comprising car parking facilities for the hotel and access roads. The development will also include the construction of a roof over an existing artificial sports pitch in the southeast of the site, to create an indoor pitch and relaying of one of the existing outdoor sports pitches.

The following table summarises the possible source-pathway-receptor relationships and assesses the risks associated with each relationship based on the information obtained during the desk study. Possible mitigation measures to reduce the identified risk are then given. The risk evaluation has been based on guidance given in 'Contaminated Land Risk Assessment' A guide to good practice', [Reference 14], and the prevailing site conditions.

4.6 Risk Assessment

For the purpose of this assessment it is assumed that any asbestos on the site will be removed by a suitably qualified contractor prior to any intrusive work on site.

It is also assumed that the foot and mouth pit will be located on the site by a carefully monitored investigation. Once identified the pit will then be appropriately remediated to mitigate any risks to construction workers, end users, livestock and controlled waters to an acceptably low level. It is envisaged that these works will be designed and undertaken by a specialist team. The risk is not assessed further in this section.

4.6.1 Human Health – Construction Workers

Construction activities may expose construction workers to contamination on site. Workers may be exposed by dermal contact, ingestion of contaminated soil and inhalation of dust, gas or vapours.

Based on the findings of the desk study, it is considered that the potential risk posed to construction works by soil and groundwater contamination is low. The risks of occupational exposure can be minimised further through the use of appropriate health and safety measures, including good working practices incorporating the use of personal protective equipment, adequate hygiene facilities and dust control measures.

It is considered that the risk posed to construction workers by soil gas or vapours is very low. The risks of occupational exposure can be minimised further through the use of appropriate health and safety and confined space practices.

4.6.2 Human Health – Site End-Users

End users may become exposed to contamination through dermal contact, ingestion of contaminated soils and inhalation of soil gases.

Based on the findings of the desk study, it is considered that the potential risk posed to end users by soil and groundwater contamination is low. The risks could be minimised further by placing an appropriate thickness of clean topsoil and subsoil in areas of soft landscaping.

It is considered that the risk posed by soil gas and vapours is moderate to low, although this would need to be confirmed by ground investigation. It is recommended that a development specific intrusive ground investigation is carried out to determine the nature and extent of the made ground, with in-situ gas testing carried out, if appropriate.

4.6.3 Ecology

4.6.3.1 Plant Growth

Plant growth may be affected by root uptake of phytotoxic contaminants.

Based on the findings of the desk study, it is considered that the potential risks posed by soil and groundwater contamination are very low. The risks will depend on the type of planting proposed.

The risks posed to plant growth may be mitigated further by the placement of clean topsoil and subsoil in areas of soft landscaping.

4.6.3.2 Livestock

Specialist advice should be sought to ensure the risk posed to livestock by the foot and mouth burial pit is mitigated to acceptably low levels prior to site development.

4.6.4 Building Materials

Building materials, including concrete and plastic service pipes may be damaged by aggressive contaminants within the ground.

Based on the desk study there it is considered that that the potential risk posed to buildings and services is low. The risk can be minimised through the adoption of appropriate design and selection of building materials.

4.6.5 Controlled Waters

Based on the findings of the desk study, the solid geology beneath the site has been designated as a non-aquifer within the Landmark Envirocheck report. Therefore it is considered that the potential risk posed by downward leaching of any contaminants from on-site sources to the groundwater is very low. A surface water course is however present immediately to the east of the site and it is considered there is a low risk that potential contaminants could migrate to the stream via surface water drainage outfalls and near surface groundwater movement from the site. The risk to controlled waters has therefore been assessed as low.

4.7 Risk Assessment Summary

Based on the findings of the desk study, it is considered that the potential for widespread contamination to be present beneath the site is low. The potential, however, exists for localised hotspots of contamination to be present associated with previous and current site uses. The risk associated with contamination hotspots is considered to be low to medium rising to potentially high for the foot and mouth burial pit.

This assessment should be confirmed through chemical testing and a full contamination risk assessment carried out as part of a development specific ground investigating.

In particular specialist advice should be sought for the foot and mouth burial pit which lies within the area of the proposed development, in the western part of the site. This should establish what risk this may pose to potential receptors, both through potential disturbance and its vicinity to the proposed development. This may require exhumation of the pit and

appropriate disposal of the livestock or for the proposed development to provide a necessary exclusion zone around the pit location.

Possible Receptor	Source	Possible Pathway	Consequence of Risk	Probability of Risk	Risk Evaluation	Mitigation of Risk
Construction Workers	Soil/water	Dermal contact/ ingestion	Mild	Low likelihood	Low Risk	Site workers to be briefed on the contamination risks prior to the commencement of works. Site workers to be issued with appropriate personal protective equipment. Appropriate site rules regarding food consumption, smoking etc to be enforced. All asbestos to be removed prior to any intrusive work.
	Gas/vapours/dust	Inhalation/ dermal contact/ ingestion	Minor	Low likelihood	Very Low Risk	Damp down site during dry periods to suppress dust. Site workers to be issued with appropriate personal protective equipment.
	Soil/Water/Dust from Foot and Mouth Pit	Inhalation/ dermal contact/ ingestion	Medium	High	High Risk*	Obtain information on pit location. Seek specialist advice to mitigate risks to acceptably low levels
Site end users	Soil/water	Dermal contact/ ingestion of soil/ ingestion of produce	Mild	Low likelihood	Low Risk	Appropriate treatment of made ground materials during site development and placement of clean topsoil and subsoil in landscaping areas.
	Gas/vapours/dust	Inhalation/ dermal contact/ ingestion	Medium	Low likelihood	Moderate/Low Risk	Soil gas monitoring to be undertaken. Basic radon protection measures are not required considered appropriate.
	Soil/Water/Dust from Foot and Mouth Pit	Inhalation/ dermal contact/ ingestion	Medium	Low likelihood	Moderate/Low Risk	Obtain information on pit location. Seek specialist advice to mitigate risks to acceptably low levels

Ecology (Plants)	Soil/water	Root uptake	Minor	Low likelihood	Very Low Risk	Place appropriate topsoil/subsoil thickness as growing medium. Select appropriate plant species.
Ecology (Animals)	Soil/Water/Dust from Foot and Mouth Pit	Inhalation/ dermal contact/ ingestion	Severe	High	Very High Risk*	Obtain information on pit location. Seek specialist advice to mitigate risks to acceptably low levels
Buildings and Services	Contaminants in soil/water	Contact with buried concrete	Mild	Likely	Moderate/Low Risk	Removal of current red shale fill and replacement with clean fill. Design of embedded concrete in accordance with BRE SD 1:2005
Controlled Waters	Leachate / groundwater	Leaching and Groundwater flow	Mild	Low likelihood	Low Risk	None.

* It is recommended that the risk assessment is reviewed once specialist advice has been obtained on the risk posed by the foot and mouth burial pit.

5 Engineering Considerations

5.1 Introduction

The following sections present a summary of the ground conditions and ground constraints identified by the desk study and provides preliminary ground related engineering recommendations for the proposed development.

5.2 Proposed Development

The proposed development will comprise a two/three storey hotel complex, with a basement beneath part of the hotel, indoor sports facilities including a sports hall, gymnasium, rehabilitation areas and a hydrotherapy pool, and external works comprising car parking facilities for the hotel and access roads. The development will also include the construction of a roof over an existing artificial sports pitch in the southeast of the site, to create an indoor pitch and the relaying of one of the existing outdoor sports pitches.

5.3 Ground Conditions

The desk study identified the likely ground conditions beneath the site to comprise thin topsoil / made ground, overlying glacial till overlying bedrock of the Mercia Mudstone Group. Previous ground investigations undertaken on the site identified localised pockets of deep made ground up to a depth of 3.2m in the northern area of the site in the vicinity of the former Byrkley Lodge. The made ground comprised sandy gravelly clay or clayey gravelly sand with fragments of brick, concrete and ash. The glacial till was described as firm becoming stiff to very stiff sandy gravelly clay. Gravel lenses were encountered within the clay in several holes. The glacial drift typically varied in thickness from 4.5 to 7.5m. Mudstone bedrock was encountered in four boreholes on the site at depths of between 5.8 and 10.5mbgl.

A foot and mouth burial pit is present beneath the western area of the site, Figures 3 and 4.

Gypsum is present within the Mercia Mudstone in the vicinity of the site. The gypsum occurs approximately 45m below the top of the Mercia Mudstone and is reported to be up to 2.7m thick. It has been mined from Tutbury to the north of the site. There is, however, no evidence that mining has taken place beneath the site.

Shallow ground water at depths of between 1.4 and 3.4 was encountered in several pits during previous investigations. Groundwater monitoring identified groundwater at depths of between 1.01 and 7.51mbgl.

5.4 Mining

There is no evidence that gypsum mining has taken place beneath the site and based on the findings of the desk study, it is considered that the risk of gypsum mining affecting the development is very low. It is recommended that the borehole records held by British Gypsum are obtained to confirm the depth and thickness of the gypsum.

5.5 Earthworks and Excavations

5.5.1 General

Based on the proposed finished floor levels it is considered that significant earthworks will be required to create the proposed development plateau. Based on the current earthworks proposal, contained within Appendix I, it is anticipated that up to 2m of cut will be required in the proposed car parking areas and to accommodate the basement in the northeast wing of the hotel. Cut of up to 1m is anticipated in the northwest of the proposed indoor sports facility and the western half of the proposed hotel development, with up to 2.5m locally 3m

of fill placed beneath the eastern areas of the hotel and sports facilities. At this stage it is proposed to reuse the cut material to provide the required filling across the site.

Given the variable nature of the near surface drift deposits and its susceptibility to degradation in wet weather it is considered that any earthworks would need to be carefully planned and controlled on site with earthworks in wetter months of the year avoided. Depending on the variability and moisture content of the excavated soils, it may be necessary to employ soil stabilisation techniques, such as the addition of lime, to make excavated material suitable for placement.

Mudstone bedrock was noted to be shallow in the eastern part of the site. Consideration should be given to this for any excavations of services planned in this area.

Based on the findings of the previous ground investigation it is anticipated that shallow groundwater will be present across the site. Consideration will need to be given to the high groundwater table during excavations. Excavations and earthworks should take into account the potential for water inflow and pressure below the base of excavations to ensure base stability, as well as structures being designed to resist groundwater pressures in the long term. Drainage measures may also need to be considered. A detailed understanding of the groundwater regime of the site will need to be established as part of the proposed development specific ground investigation.

5.5.2 Constraints

5.5.2.1 Foot and Mouth Pit

A foot and mouth pit is present on the western boundary of the site, beneath the proposed access road and car parking area, in an area of proposed cut. Specialist advice should be sought on the best way of remediating the area in and around the pit and to establish what the short and long term risks the pit may present to the development. The burial pit will need to be treated prior to the start of the earthworks. It is thought at this stage remediation could comprise the exhumation of the pit, the safe disposal of the buried livestock and the infilling of the excavation with appropriate engineered fill. If this is not practical, consideration may need to be given to redesigning the proposed development layout to avoid construction over this area.

5.5.2.2 Unexploded Ordnance

The desk study has identified munitions stores to the north of the site associated with the airfield. A localised ordnance survey has been undertaken around the two stores, closest to the site, which identified that no ordnance was present. It is not known whether a wider survey, covering the development site has been undertaken. If a site wide survey has not been undertaken it is recommended that a desk based threat assessment is undertaken to confirm the risk posed to the proposed development is low.

5.5.2.3 Buried Obstructions

It is known that a number of buried obstructions are present beneath the site. These buried obstructions include old culverts and manholes and partly constructed foundations and groundworks from the 2002 scheme. An allowance should be made for dealing with buried obstructions. Where structures clash with proposed excavations the structures should be removed and the excavations backfilled with engineered granular fill.

5.5.2.4 Great Crested Newts

A habitat for Great Crested Newts is present in the northern part of the site in a ponded area. It is understood that it is proposed to relocate the newt population prior commencement of the development, but after the proposed development specific ground investigation, section 6.2.

5.6 Foundations and Floors

Based on the current development proposals it is considered that lightly reinforced shallow pad foundations are likely to be the most appropriate foundation solution for the proposed buildings.

Foundations bearing in the made ground are likely to experience unacceptable total and differential settlements. Foundations should therefore be taken down through any topsoil or made ground to found on the undisturbed stiff glacial deposits. Where deep fill is present, foundations will need to be deepened by trench filling techniques, or possibly a raft foundation solution adopted.

Based on the proposed earthworks, it is anticipated that large areas of filling will be required beneath the proposed building. In the areas of filling, it is recommended that a suspended ground floor slab construction is adopted. In the areas where filling is not required it is anticipated that only localised thin made ground will be present and that this could be removed and replaced with engineered granular fill and ground bearing floor slabs could be adopted. The final choice of floor slab will be dependent on the finished level of the proposed building and the depth and extent of any made ground present beneath the proposed building. This should be confirmed by a development specific ground investigation.

Foundations and floor slabs should be appropriately designed to consider the effects of any existing and proposed trees, as set out in the NHBC guidelines [Reference 15].

5.7 Contamination

Based on the findings of the desk study, it is considered that the potential for widespread contamination to be present beneath the site is low. The potential, however, exists for localised hotspots of contamination to be present associated with previous and current site uses. The risk associated with contamination hotspots is considered to be low to medium rising to potentially high for the foot and mouth burial pit.

This assessment should be confirmed through chemical testing and a full contamination risk assessment carried out as part of a development specific ground investigating.

A Foot and Mouth burial pit, understood to be present in the western part of the site, should be located and appropriately remediated prior to site development, section 5.5.2.1.

5.8 Waste Disposal

It is understood, that it is currently proposed, all excavated material will be reused on site. This should be confirmed following chemical testing of the cut material and when the earthworks design has been finalised for the proposed development.

Based on the findings of the desk study, it is considered that the majority of the cut material in the made ground is likely to be non hazardous, however there may be localised pockets of hazardous material associated with hotspots of contamination.

It is considered that the material cut from the natural deposits on site is likely to be inert.

Waste acceptance criteria testing should be undertaken once it is established if any material is being disposed of offsite.

5.9 Infiltration Drainage

Based on the findings of the desk study it is considered that the glacial till deposits beneath the site will be of low permeability. In addition available ground investigation information indicates a shallow groundwater table to be present on the site. As a result it is considered that infiltration drainage will be unsuitable for the site. This should be confirmed following the findings of a development specific ground investigation.

5.10 Invasive Plants

During the site walkovers, no evidence of invasive plants, such as Japanese Knotweed, was seen in vegetated areas of the site. It should be noted, however, that not all areas on the site were inspected as part of the walkover.

It is recommended that prior to works commencing on site a detailed survey for invasive plants is carried out to confirm that invasive plants are not present on the site.

6 Further Work

It is recommended that the following further works are undertaken to assist in the detailed design of the proposed development.

6.1 Further Enquiries

6.1.1 British Gypsum

It is recommended that information is obtained from British Gypsum to confirm the depth and thickness of the gypsum.

6.1.2 Foot and Mouth Pit

Specialist advice should be sought from DEFRA's Animal Health department, regarding the risk associated with the foot and mouth burial pit and appropriate methods of mitigation.

6.1.3 Aerial Photography

The aerial photographic interpretation should be completed, once additional stereo photographs are available. The additional photographs may assist with understanding the potential risk from UXO and possible changes to the landform over the recent history of the site.

6.1.4 Flooding

The potential impact of the localised flooding on the eastern site boundary should be assessed by undertaking a Flood Risk Assessment.

6.1.5 UXO Threat Assessment

If a site wide UXO survey has not been undertaken, it is recommended that a desk based UXO threat assessment for the proposed development site is undertaken.

6.1.6 Tree Survey

It is understood that a number of tree surveys have been undertaken for the site. This information should be compiled and reviewed to confirm whether there is sufficient information to assess the impact of existing trees on the proposed development. Following the review of the information it may be necessary to undertake additional localised tree surveys.

6.1.7 Vegetation Survey

It is recommended that prior to works commencing on site a detailed survey for invasive plants is carried out to confirm that invasive plants are not present on the site.

6.2 Development Specific Ground Investigation

A development specific ground investigation should be carried out to address the ground related risk at the site and to provide geotechnical parameters for detailed design. The aims of the investigation should be to:

- Confirm the ground conditions at the site in the vicinity of the proposed development;
- Confirm the bedrock depth across the site;
- Investigate areas on the site previously identified to have localised deep pockets of made ground, associated with the lodge and areas of infilling;
- Investigate the presence of possible filling in the valley feature, located between the hotel and sports facility;
- Provide samples for chemical testing to confirm the levels of any contamination on the site;
- Provide samples for geotechnical testing to provide parameters for design;

- Install combined gas and groundwater monitoring instruments to monitor both ground gas and groundwater levels. Samples of both ground gas and groundwater should be taken for chemical testing;
- Install piezometers to accurately monitor the ground water levels in the area of the proposed basement excavation.
- Undertake infiltration testing to investigate the potential for infiltration testing;

It is proposed that the ground investigation comprises:

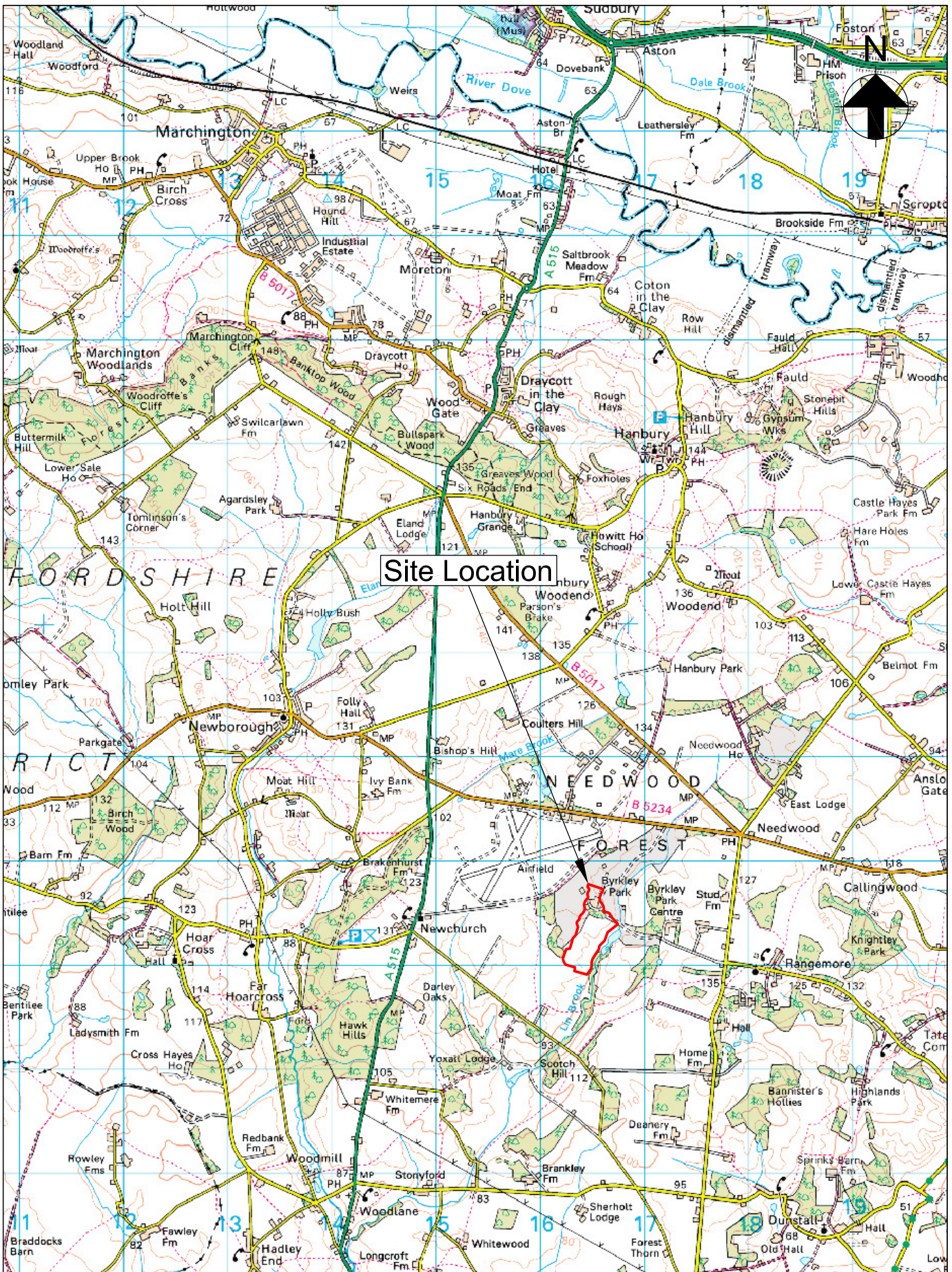
- Machine excavated trial pits to a maximum depth of 4.5m, to investigate the composition of the made ground and the strength of the drift deposits, and to take samples for geotechnical and chemical testing.
- Cable percussive boreholes to a maximum depth of 10m, combined gas and groundwater instruments will be installed in each of the boreholes.
- Machine excavated trial pits to an approximate depth of 2.0m, located in the car parking area and adjacent to the access roads to provide information on pavement design and to enable infiltration testing to be undertaken.

It is likely that a phased ground investigation will be required as access to the areas of the foot and mouth pit and the newt pond will only be possible once these areas have been appropriately cleared.

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FIGURES



Site Location

National Football Centre Ltd

National Football Centre

Geo-Enviromental Desk Study

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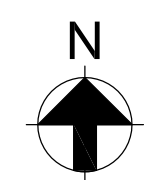
Site Location Plan

ARUP

FEB 2010

1:50000

FIGURE 1



National Football Centre Ltd

National Football Centre

Geo-Enviromental Desk Study

Legend:

— Site Boundary

Existing Site Layout

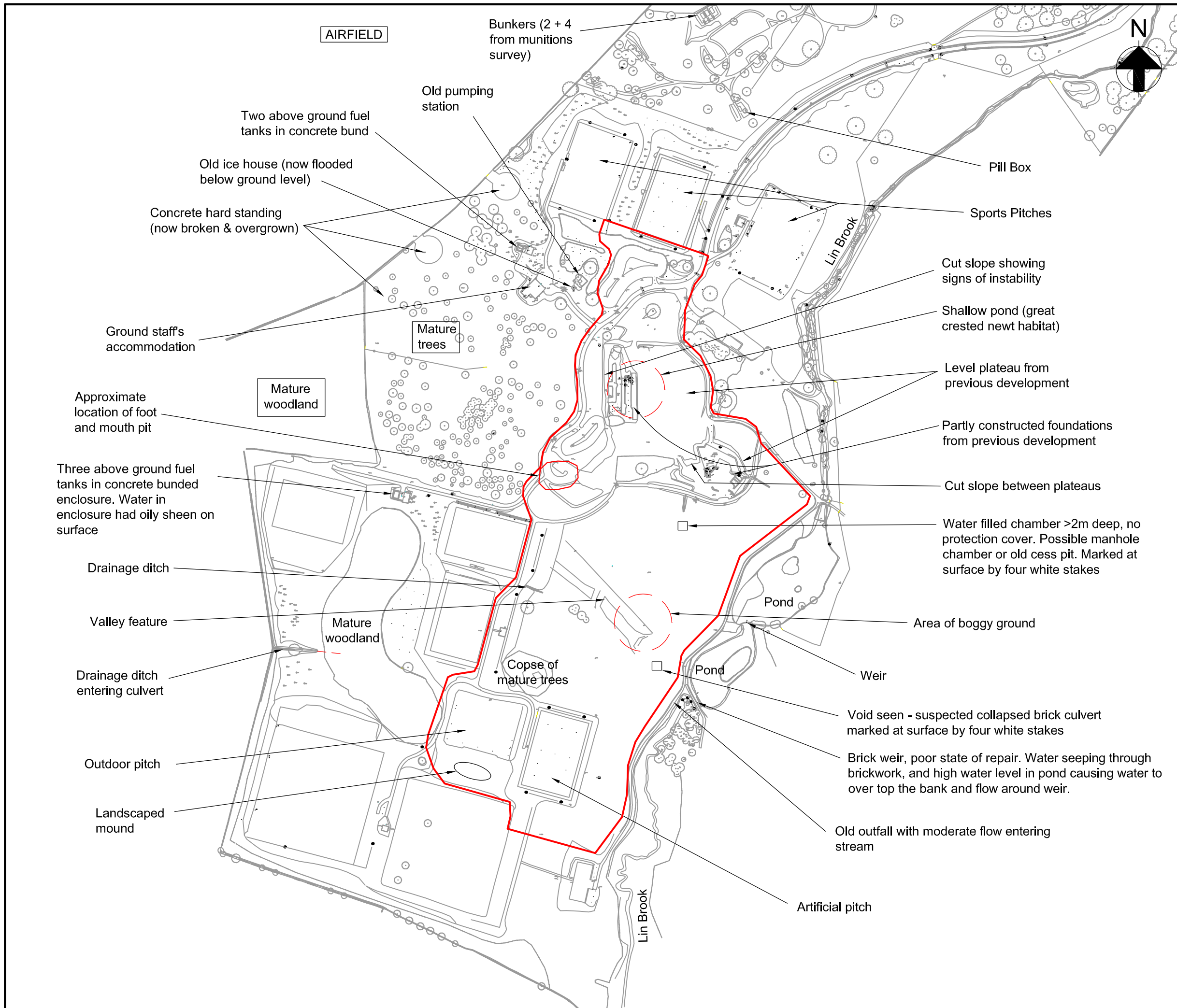
ARUP

FEB 2010

1:10000

FIGURE 2

Job Number 209289/00



National Football Centre Ltd

National Football Centre

Geo-Environmental Desk Study

Legend:

— Site Boundary

Existing Site Layout and Site Walkover Observations

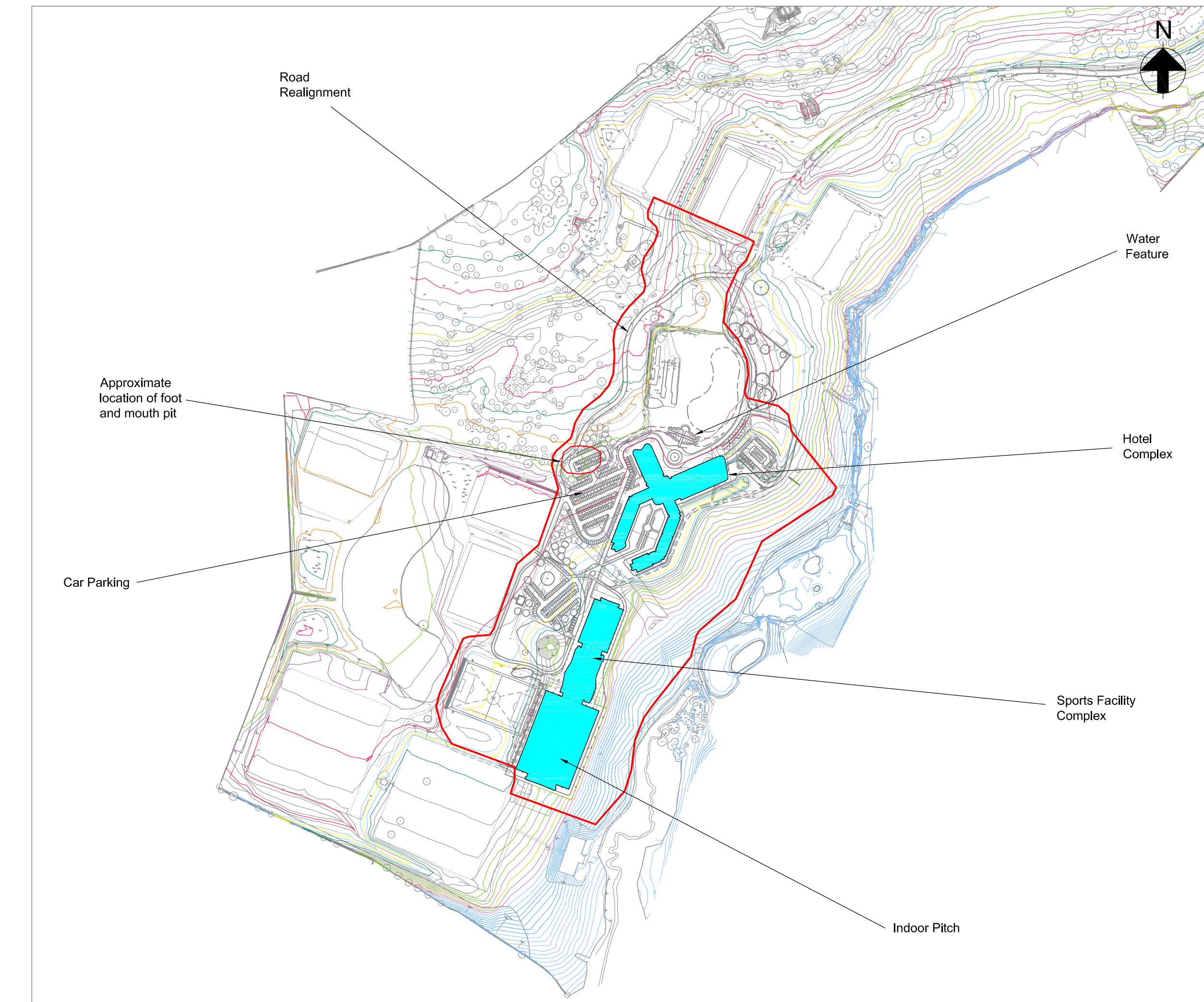
ARUP

FEB 2010

1:5000

FIGURE 3

Job Number 209289/00



National Football Centre Ltd

National Football Centre

Geo-Environmental Desk Study

Legend:







- Site Boundary
- Proposed Building

Proposed Development Layout

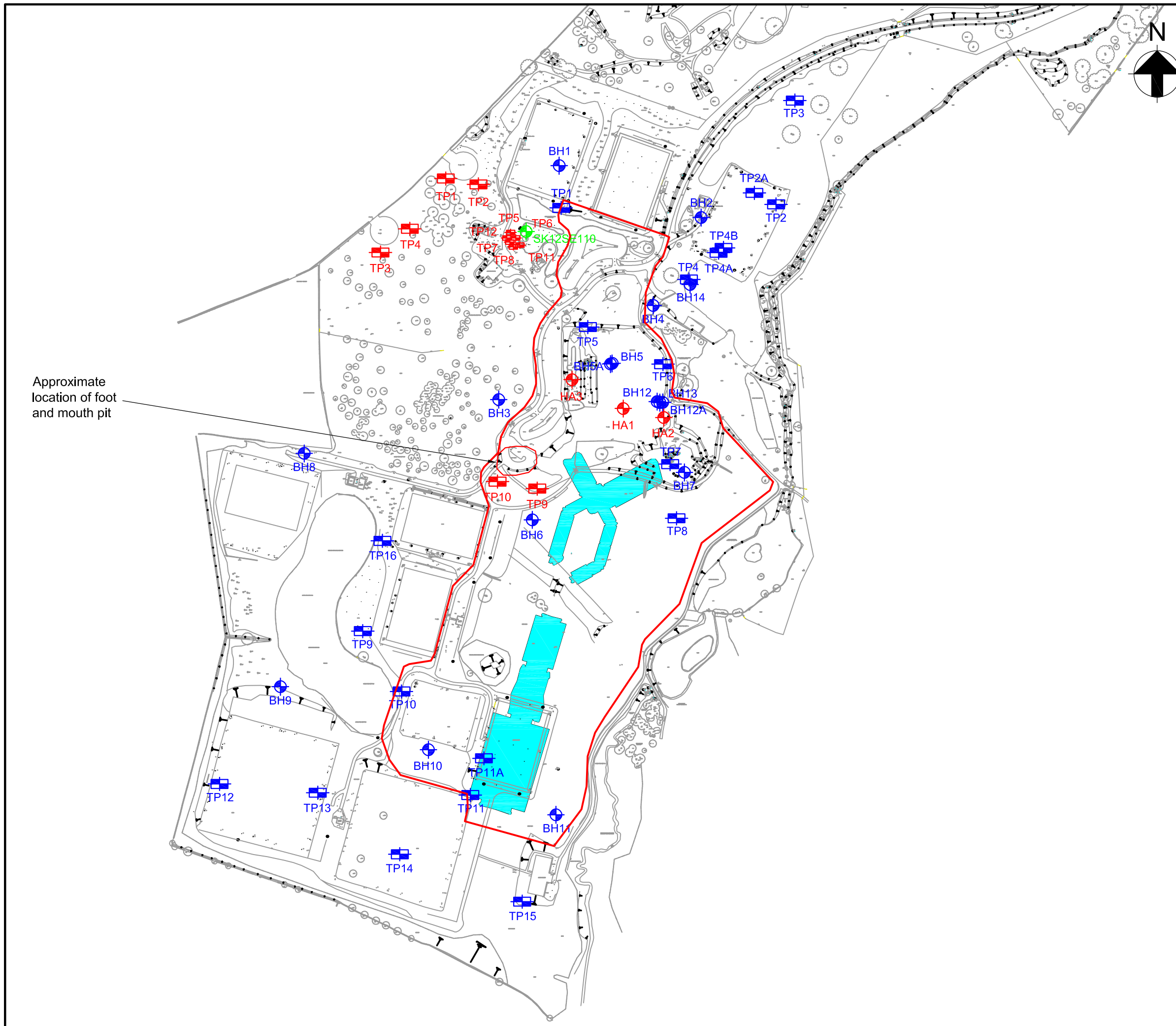


FEB 2010 1:5000 FIGURE 4

Legend:

-  Proposed Buildings
-  Borehole (Exploration Associates, 2001)
-  Trial Pit (Exploration Associates, 2001)
-  Borehole (BGS)
-  Trial Pit (URS Dames & Moore)
-  Hand angled borehole (URS Dames & Moore)

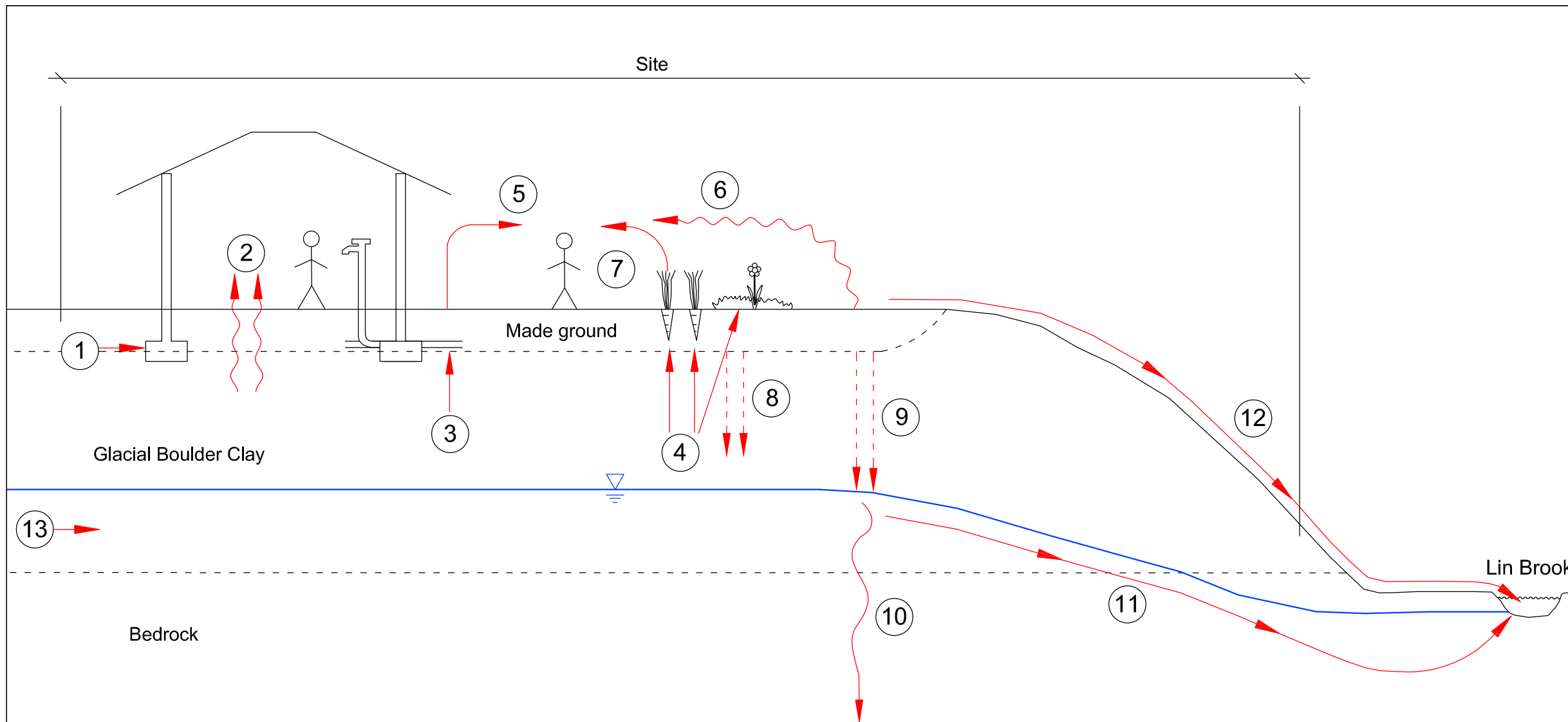
BGS & Previous Ground Investigation Borehole Location Plan



Approximate location of foot and mouth pit

Note:

Foot and mouth burial pit is not specifically shown



Key:

- | | |
|---|---|
| ① Chemical attack on building materials | ⑦ Ingestion of contaminated vegetation/plants |
| ② Migration of gas/vapours into building | ⑧ Migration of contaminants to natural soils |
| ③ Contamination of water supply through services | ⑨ Migration of leachate to local groundwater |
| ④ Contamination uptake by plants | ⑩ Migration of leachate/groundwater to regional groundwater |
| ⑤ Ingestion of contaminated soil/groundwater | ⑪ Migration of leachate/groundwater to Lin Brook via glacial deposits |
| ⑥ Ingestion/inhalation of contaminated dust/vapours | ⑫ Surface water run off to Lin Brook |
| | ⑬ Migrations of groundwater from contaminated sources off site |

Site Conceptual Model

ARUP

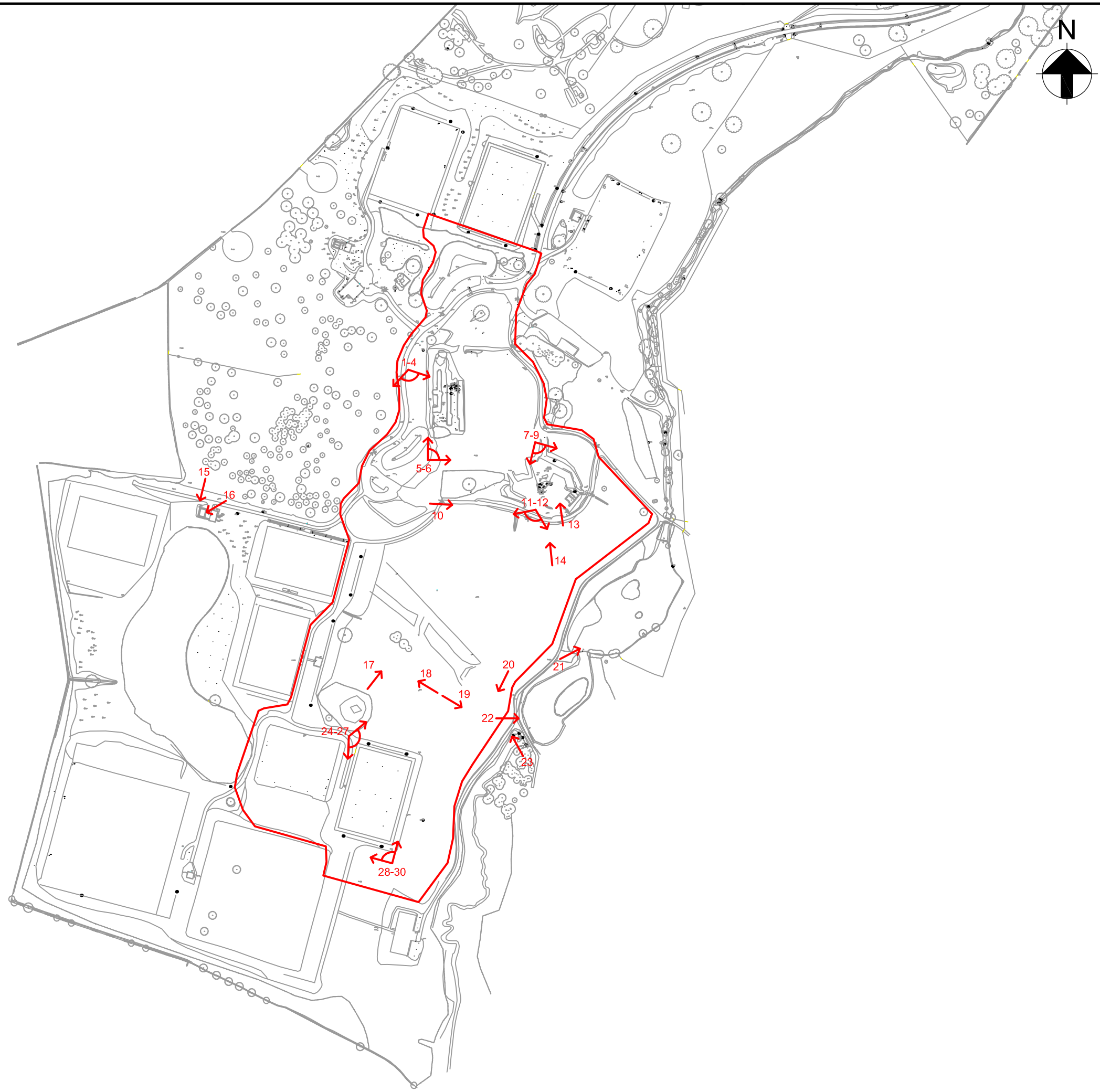
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FIGURE 6

Job Number 209289/00

Appendix A
**Site Walkover
Photographs**



National Football Centre Ltd

National Football Centre

Geo-Environmental Desk Study

Legend:

- Site Boundary
- ← Direction of Photo
- 1 Photograph Number (see appendix A)

Location of Photos from Site Walkover



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1:5000

FIGURE 7

Job Number 209289/00

Created using CAD/CAM software



Photograph 1 Panorama from north west corner



Photograph 2 Panorama from north west corner