PSD16

Sunderland City Council and South Tyneside Council

International Advanced Manufacturing Park Area Action Plan

Geotechnical Technical Background Report

February 2017

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Job number 60283414/M015/Rev 2

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Appendices

1 Purpose

1.1 Overview

1.1.1 This is the Geotechnical Technical Background Report for the International Advanced Manufacturing Park (IAMP) Area Action Plan (AAP). The aim of this report is to summarise geotechnical evidence and constraints to inform the approach and policies in the IAMP AAP.

1.1.2 The report is one of a suite of Technical Background Reports which form part of the evidence base for the IAMP AAP. The evidence can be accessed using the following links:

www.sunderland.gov.uk/iamp

www.southtyneside.gov.uk/localplan

1.2 Introduction to the IAMP

1.2.1 The International Advanced Manufacturing Park (IAMP) represents a unique opportunity for the automotive sectors in the United Kingdom (UK). Located next to Nissan UK's Sunderland plant, the UK's largest and most productive car manufacturing plant, the IAMP will provide a bespoke, world class environment for the automotive supply chain and related advanced manufacturers to innovate and thrive, contributing significantly to the long-term economic success of the North -East of England and the national automotive sector.

1.2.2 The IAMP proposal is for 260,000 m2 Gross Internal Area development aimed primarily at the automotive, advanced manufacturing and related distribution sectors. The IAMP will be located on land to the north of the existing Nissan car manufacturing plant, to the west of the A19 and to the south of the A184. This location benefits from its close proximity to Nissan and excellent transport links with opportunities for integrated connectivity provided by the surrounding Strategic Road Network, rail and port infrastructure.

1.2.3 Development of the IAMP will underpin the continued success of the automotive and advanced manufacturing sectors in the United Kingdom and north-east of England.

1.3 Structure of this Paper

1.3.1 The report is structured as follows:

- Section 2 sets out the evidence relevant to the Technical Background Paper, including a summary of the legislation,

planning practice guidance and a summary and interpretation of desk study information provided by others.

- Section 3 provides an overview of geotechnical constraints.
- Section 4 outlines recommendations for further phases of work including ground investigation to quantify the identified constraints for development.

2 Evidence Review

This section presents a summary of key findings from available information. WSP / Parsons Brinkerhoff undertook initial desk study assessment for the site on behalf of Sunderland City Council and South Tyneside Council, reported in 'Sunderland IAMP Geotechnical Desk Study Constraints Report' (March 2016, Report number 20160314-RH) (SD50). AECOM have reviewed information provided by WSP / Parsons Brinkerhoff and are currently acting as geotechnical advisor for the IAMP scheme.

2.1 Overview

2.1.1 The key issues relating to geotechnical considerations are established through a number of policies, records held by statutory and non-statutory organisations and industry guidance documents, including:

- Local Authorities and Local Planning Policy
- The Environment Agency
- British Geological Survey(BGS)
- The Coal Authority
- Soil Survey of England and Wales
- The obligations for a Developer are set out in The National Planning Policy Framework, March 2012, Department for Communities and Local Government, ISBN: 978-1-4098-3413-7, Paragraphs 120 and 121:

120. To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

121. Planning policies and decisions should also ensure that:

- *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*

- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate ground investigation information, prepared by a competent person, is presented.*

2.1.2 Under the Environmental Protection Act 1990 (as amended) the ("EPA") contaminated land is defined as:

'any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:

(a) significant harm is being caused or there is significant possibility of such harm being caused; or

(b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."

2.1.3 The site is not listed as contaminated land under Part 2A of the EPA. However, Part IIA of the EPA requires a risk based approach for the assessment of land affected by contamination. This involves the identification of possible contaminants, transport pathways and receptors; the evaluation of the likelihood, nature and extent of exposure to a hazard; the assessment of the likely contaminant linkages and the degree of risk; and the evaluation of the need for controlling the estimated risk. Risk assessment therefore, requires an evaluation of 'source-pathway-receptor' linkages.

2.1.4 This approach will be adopted in further geotechnical assessments based on and incorporating the findings of proposed ground investigation, as discussed under Section 4 of this report.

2.1.5 The WSP / Parsons Brinkerhoff Report notes the Desk Study (Item 1 below) is step one of a three stage process, namely:

1. Geotechnical Desk Study Constraints Report (SD50) – to identify potential constraints and inform a targeted ground investigation.
2. Targeted Intrusive Ground Investigation – to de-risk identified constraints and characterise the ground conditions
3. Geotechnical Constraints Report – key findings and recommendations for the masterplan based on intrusive ground investigation.

2.1.6 The information presented in the WSP / Parsons Brinkerhoff Report is a combination of publically available data obtained from the BGS, Envirocheck and The Coal Authority and information provided by the Councils, including previous desk study reports undertaken by others.

This information has been reviewed by AECOM and augmented where required. In summary, the key findings include:

- Historical ordnance survey (OS) maps reviewed in the WSP / Parsons Brinkerhoff Report indicate the site is predominantly agricultural and has changed little since the first map edition was published in 1855. Historical OS maps show the presence of water wells associated with the agricultural farmsteads. Historical site uses were present as isolated areas within the site. These include a smithy, a quarry, the former Pontop & South Shields railway line and an associated small area of rail sidings, an Engine House and a small gas valve compound. There are a number of buried service utilities as well as overhead power lines crossing the site. However, the majority of the site remains predominantly farmland in a greenfield setting.
- The site is adjacent to the Nissan plant (previously RAF Usworth) and is near to historic collieries. Roads bound the site to the north, east and south and a disused railway to the west. There are a number of farmsteads and private dwellings on the site, some of which are listed buildings / structures. The North East Land, Sea and Air Museums is located in the south east corner of the site.
- The site is located within an area of the former Glacial Lake Wear. Large scale geology maps show the site is underlain by superficial deposits comprising Pelaw Clay Member, in turn underlain by the Tyne-Wear Complex and the Durham Lower Boulder Clay. Alluvium is present along the margins of the River Don.
- Superficial soils are underlain by solid strata of the Pennine Upper and Middle Coal Measures Formations which comprise an interbedded sequence of mudstones, siltstones, sandstones and coals, some of which have been worked at depth. Several geological faults are present within the bedrock and rockhead is anticipated to be present at variable depth across the site. Two shallow coal seams (the Top Hebburn Fell and Bottom Hebburn Fell) subcrop in the south west corner of the site which may have been worked sometime in the past pre-dating Coal Authority records. Risks associated with mining activities include collapse of former underground workings or shafts leading to damage of overlying structures and infrastructure. Former workings may present a contamination risk to groundwater and human health risk to site users from ground gas emissions. Risk from unrecorded workings pre-dating Coal Authority records will be assessed of part of future ground investigation works.
- Information obtained from the Coal Authority indicates the site is in the likely zone of influence from (recorded) underground coal workings in 8 seams of coal at 190m to 570m depth, last worked in 1981. However, given the depth of the workings these are not anticipated to significantly impact the development.

- Made Ground is not anticipated to be widely encountered across the site. The existing A1290 was built along the alignment of a former Pontop & South Shields railway line. The road is generally constructed at grade or on low embankment. The Department of Environment Industry Profile for Railway Land indicates imported fill was often utilised during construction of the railways where there was a shortfall of natural excavated material. Imported fill often includes waste material containing clinker and ash. Boiler ash generated by steam locomotives was also often used to form ballast along many railway lines. In addition, the area in the northwest corner of the site is recorded as an Environment Agency Historical Landfill, although no further information is reported to be available in the WSP / Parsons Brinkerhoff Report. There is a small area of former railway sidings present on the south east portion of the site, east of the A1290 and immediately north of the North East Aircraft Museum. A small gas valve compound is present northwest of Hylton Bridge.
- A small (former) sand and gravel quarry is recorded near East House Farm adjacent to west boundary of the site, which may have been infilled with made ground. The presence of the quarry raises the possibility that other unrecorded quarries are present in areas of similar ground conditions across the site.
- Potentially contaminative uses associated with historic land use include railway lines, sidings, quarries and a landfill which were present at discrete locations within the predominantly agricultural greenfield site setting. The risk of possible contamination to pollute the environment, groundwater and the River Don will be assessed as part of further ground investigation works.
- There is a risk of flooding around the River Don and locally across the site as surface water ponding. There are a number of water ‘rises’ recorded on the site. The presence of reeds and other wetland vegetation indicates some persistent wet conditions. However, the roads and railway lines across the site were typically constructed at-grade or low embankment suggesting widespread deep flooding is uncommon. However, localised softening of surface soils would be anticipated in areas prone to waterlogging and ponding.
- There are no aquifer source protection zones within the site. In general the superficial deposits are classified as 'Unproductive Strata' i.e. negligible significance to water supply and river flow. The alluvium is classified as a 'Secondary A aquifer' i.e. permeable layers capable of supporting water supply at a local level. The underlying bedrock is also classified as a 'Secondary A aquifer'. It is currently unknown if there are any public or private ground water abstractions on, or, within the vicinity of the site. Enquiries are currently on-going.

- Available soil quality maps for the site indicate the underlying soils to comprise slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soil. Information provided on MAGIC.gov.uk for agricultural soil classification as supplied by DEFRA indicates that the majority of soils for the site are classified as Grade 3a 'Good Quality' land. There is a small area of Grade 2 'Very Good Quality' land located along the banks of the River Don.
- The WSP / Parsons Brinkerhoff Report indicates that an aerodrome identified as RAF Usworth was present south of the site since 1916. The area has been redeveloped since 1984 and is now predominantly occupied by developments associated with the Nissan car manufacturing plant. The proximity of the aerodrome to the site raises the risk that Unexploded Ordnance (UXO) may be present. As a result, further specific desk study was recommended and undertaken as described below.

2.1.7 Zetica completed a UXO Desk Study & Risk Assessment Report for the site on behalf of WSP / Parsons Brinkerhoff in 2016, Report Reference P5933-16-R1 dated 31st March 2016. The aim of the UXO desk study was to gain a fair and representative view of the UXO hazard for the site and its immediate surrounding area in accordance with the Construction Industry Research and Information Association (CIRIA) Report 681 'Unexploded Ordnance (UXO), a Guide for the Construction Industry' published in 2009. In summary, the key findings include:

- Records indicate that less than 10 high explosive (HE) bombs fell on the site during World War II, reflecting low bombing density consistent with regional statistics.
- Most air raids in the vicinity of the site were carried out by single aircraft dropping a small number of bombs and therefore it is considered unlikely that any Unexploded Bombs (UXB) would have fallen unnoticed.
- No other UXO hazard has been identified at the site.
- Zetica consider that the site has a low UXO Hazard. Figures 5 and 7 from the Zetica Desk Study are included as Appendix B of this report. Where a low risk of UXO is encountered, good practice is to raise awareness of those involved in excavations through UXO awareness briefings and 'Tool Box' talks.

3 Constraints

3.1.1 A geotechnical constraints drawing is provided in the WSP / Parsons Brinkerhoff report and included as Appendix A of the report.

3.1.2 A summary of the constraints, risks to development and proposed mitigation identified in the report is presented in the table below:

GEOTECHNICAL CONSTRAINT	RISK TO DEVELOPMENT	PROPOSED MITIGATION
Superficial Deposits	Pelaw Clay is expected to be present across the site which typically exhibits an inverted strength profile below a stronger surface 'crust'. This can result in rapid excavation collapse, may pose difficulties for shallow foundations and weak pavement foundation (subgrade) conditions. The underlying Tyne-Wear Complex may cause difficulties due to unforeseen ground conditions, even following a ground investigation. Historic boreholes indicate extensive thicknesses of soft and loose materials, making foundation construction difficult. High plasticity of the clay may also cause difficulties and lead to a risk of damage to buildings which are supported on shallow strip footings from seasonally induced shrinkage and swelling movements.	Ground conditions in some locations are unlikely to be suitable for heavily loaded shallow foundations and therefore ground improvement or deep (piled) foundations are likely to be necessary. An intrusive ground investigation will help characterise the site, particularly in assessing the extent of Pelaw Clay and depth to rockhead. Weak pavement subgrade may be improved by either incorporation of geotextiles or lime modification subgrade treatment.

GEOTECHNICAL CONSTRAINT	RISK TO DEVELOPMENT	PROPOSED MITIGATION
Solid Strata Variable Rockhead	Variable rockhead level is evidenced from the available information. Building across such areas may induce differential settlement and associated structural damage. Several geological faults are present within the bedrock. Similar features elsewhere in the former Durham Coalfield have been subject to reactivation which has caused structural damage to overlying buildings. Structures spanning across fault lines should be avoided where possible	The intrusive ground investigation will prove depth to rockhead across the site so that such areas can be identified and accommodated in design.
Made Ground	Made Ground is not anticipated to be widely present across the site. Made Ground is inherently variable and is generally not considered suitable as a founding material due to the possibility of low strength and differential settlement. Other issues associated with Made Ground can be the generation of ground gas emissions.	The intrusive ground investigation will target areas of known historic land-use development to identify the presence or otherwise of Made Ground and the associated depth. Presence of ground gas should be monitored and suitable protective measures incorporated.
Contamination associated with historic land use	Railway lines, sidings, quarries, landfills and farms are amongst the potentially contaminative land use on site at certain discrete locations (see Appendix A). The associated contamination could pollute the environment, groundwater and the River Don and could pose a human health risk to future site workers and users.	A site conceptual model and contamination risk assessment should be undertaken prior to development in accordance with current guidelines and legislation. Ground investigation will include quantitative testing of potentially impacted soils to inform the site conceptual model.

GEOTECHNICAL CONSTRAINT	RISK TO DEVELOPMENT	PROPOSED MITIGATION
Historic Quarrying and Mining	A capped disused mineshaft is present in the northwest but lies outside the site boundary. This is not considered to significantly impact the proposed development. The Coal Authority has records of mining in 8 coal seams of coal at depth which are not considered to significantly impact the proposed development. A high risk coal mining area is identified in the southwest corner of the site where unrecorded workings may be present in the Top and Bottom Hebburn coal seams which published large-scale geological maps indicate subcrop in this area. Risks associated with mining activities include collapse of underground workings or shafts leading to damage to overlying structures and danger to site users, mine gas emissions from worked coal seams and groundwater contamination. A sand and gravel quarry may have been present near East House Farm. This could result in localised soft spots depending on the quality of the reinstatement and differential settlement at the transition line between natural and quarried ground. This quarry raises the possibility of other unrecorded quarries in areas of similar ground conditions across site.	If possible, known areas of mining and quarrying should be avoided. If developing on a quarry, sufficient ground investigation should be undertaken to map its extent such that any structure does not cross the boundary. Unrecorded quarrying will remain a risk Ground investigation will include rotary coring into the underlying bedrock in the south west corner of the site to determine if unrecorded workings are likely to be present.

GEOTECHNICAL CONSTRAINT	RISK TO DEVELOPMENT	PROPOSED MITIGATION
Soft ground surface due to surface water accumulation	Accumulation of surface water was observed during the site walkover (by others) and identified by the Environment Agency's surface water flood risk map. Clay softening due to this water ponding may cause difficulty in trafficking the site during construction and damage to pavement formation soils. Surface water flooding should be controlled through appropriate pre construction drainage enabling works and permanent site drainage measures.	Suitable road foundations, including subgrade improvement where necessary should be used for all highways in accordance with the Design Manual of Contract Documents for Highways Works (DMRB), notably any soft spots should be excavated and replaced by suitable granular fill or be subject to improvement. Suitable drainage and raised levels should be incorporated into the development to reduce damage from surface water accumulation. Ground investigation will be specified to investigation proposed drainage and will include soakaway testing in selected trial pits to aid assessment of feasibility and design of Sustainable drainage systems (SuDS).
Elevated groundwater / surface water	Accumulation of surface water was observed during the site walkover (by others) and identified by the Environment Agency's surface water flood risk map. A number of 'rises' are noted across the site.	Temporary excavations within superficial soils where high groundwater is encountered are likely to be unstable, and require continuous support. Alternatively, temporary excavation faces will have to be battered back to a safe angle as determined on site. Deep excavations may encounter groundwater inflows and may require continuous support. For shallow depths below the groundwater, pumping from conventional sumps in the base of the excavation may be feasible. Water encountered in excavations may be contaminated and require disposal compliant with current legislation

GEOTECHNICAL CONSTRAINT	RISK TO DEVELOPMENT	PROPOSED MITIGATION
Unexploded Ordnance	RAF Usworth was present south of the site since 1916 until 1984 when the area was progressively redeveloped as part of the Nissan car manufacturing plant. The proximity of this to the site raises the risk that Unexploded Ordnance (UXO) may be present. A further UXO Desk Study & Risk Assessment Report undertaken by Zetica has indicated the site to have a low UXO Hazard.	As a precautionary measure, ground investigation will be specified to include magnetometer testing in selected CPT positions prior to intrusive ground investigation works taking place where risk has been identified by Zetica.

4 Recommendations

4.1.1 As part of future development ground investigation is required to provide information on ground conditions at the site to aid in design of the development. BS EN1997-2:2007 Incorporating corrigendum June 2010 Eurocode 7 – Geotechnical design – Part 2; Ground investigation and testing recommends a phased approach to ground investigation, with stages of investigation defined as 'Preliminary Investigation', 'Design Investigation' and 'Control and Monitoring Investigation'. Investigations proposed in support of the AAP are considered 'Preliminary' as defined by Eurocode 7.

4.1.2 Ground investigation will be specified in accordance with the principles of Eurocode 7 (EC 7) to profile and characterise the ground conditions across the site to aid assessment and design of future development proposals, foundation options, road pavement conditions and suitable options for drainage. The ground investigation will target the constraints identified through previous desk study works undertaken by others.

4.1.3 Spacing of exploratory holes across the site will be in accordance with guidance provided in EC 7 for preliminary investigation, typical spacing of exploratory holes proposed is summarised below:

- ~100m grid spacing along primary roads.
- ~200m grid spacing along secondary roads and drainage.
- ~100m grid spacing across plot areas.
- Exploratory holes targeted to identify possible unrecorded coal mine workings present in the southwest corner of the site, the former quarry and other isolated areas of potentially former contaminative site uses.
- Soakaway testing in trial pits will be undertaken at targeted positions to aid assessment of feasibility and design of Sustainable drainage systems (SuDS).
- Environmental testing will be undertaken to inform the site conceptual model and contaminated land risk assessment using the source-pathway-receptor methodology detailed under 2.1.3.

4.1.4 The preliminary ground investigation is anticipated to comprise the components in the table below.

Component	Location	Purpose
Exploratory holes with in-situ and laboratory geotechnical testing including: • Piezocone penetrometers, • Cable percussive boreholes with rotary follow-on • Trial pits.	Distributed across development area and targeted at critical areas.	To characterise ground and groundwater conditions and improve understanding of rockhead profile.
	Targeted areas including: • Historic landfill • Area of Hylton Bridge sidings • Former Smithy • Gas Valve Compound • Potential unrecorded mine workings in the Top and Bottom Hebburn Fell coal seams.	To assess presence and extent of Made Ground.
Environmental testing	Targeted areas of potential contamination source areas.	To assess presence and type of contamination and inform the site conceptual model and contamination risk assessment.
In-situ plate load or CBR tests at varying depths	Targeted to areas of proposed highways.	To assess the CBR at shallow depths to predict required pavement construction.
Groundwater monitoring	Selected boreholes across site.	To understand groundwater regime
Ground gas monitoring	Selected boreholes which have proved Made Ground or organic soils.	To assess risk posed by ground gas emissions.

4.1.5 Prior to any intrusive works, the following works will be undertaken;

- Agree access arrangements with landowners – South Tyneside Council and Sunderland City Council's responsibility;
- Identify and accommodate all ecological constraints;
- Proposed ground investigation to be designed around ecological constraints;

- Undertake CPT Magnetometer testing as precautionary measure in areas of potential Unexploded Ordinance (UXO) risk assessment identified by Zetica; and
- Review utility information from relevant utility providers against ground investigation proposals.

Appendix A

WSP/Parsons Brinkerhoff
Geotechnical Constraints

DISUSED MINESHAFT

WARDLEY COLLIERY DISPOSAL POINT -THICK MADE GROUND, SURFACE DEPOSITS OF COLLIERY WASTE

C45

CLAXHEUGH FAULT

POND

DRIFT GENERALLY MORE THAN 22.9m THICK

C75

C12

ENVIRONMENT AGENCY HISTORIC LANDFILL

C15

HILTON CASTLE

C60

UPPER CLAY 1.5m - 3.0m ON LAMINATED CLAY

POSSIBLE SITE OF HISTORIC SAND AND GRAVEL QUARRY (INDICATIVE LOCATION)

FORMER RAILWAY SIDINGS

SMALL AREA OF WETLAND

UPPER CLAY 1.5m - 3.0m ON LAMINATED CLAY

USWORTH FAULT

TOP HEBBURN FELL

BOTTOM HEBBURN FELL

USWORTH

OBSERVED WETLAND WITH REEDS (APPROXIMATE EXTENT)

0 125m 250m 375m 500m

SCALE BAR

DO NOT SCALE

KEY

SITE FEATURES

- SITE BOUNDARY
- X OBSERVED WATERCOURSE CROSSING
- VEHICLE ACCESS TO SITE

GEOTECHNICAL CONSTRAINTS AND FEATURES (from bgs map and historical mapping)

- FAULTS AT ROCKHEAD, CROSSMARK INDICATES DOWNTHROW SIDE
- COAL SUBCROP (CROSSMARK INDICATES DIP DIRECTION)
- ROUTE OF DISUSED/HISTORIC MINERAL RAILWAYS
- ALLUVIUM

C15 - APPROXIMATE THROW OF FAULT AT POINT INDICATED

NOTES

1. THIS DRAWING SHOWS GEOTECHNICAL CONSTRAINTS ONLY. MOTT MACDONALD HAS PRODUCED A DEVELOPMENT CONSTRAINTS DRAWING (REF (f) WHICH INCLUDES THE FOLLOWING:
   - UTILITIES INFORMATION (EXCLUDING OVERHEAD TELEPHONE WIRES PRESENT ALONG THE ROAD)
   - FLOOD RISK AREAS
   - ECOLOGICAL INFORMATION

   WAY
2. EXTENTS SHOWN ARE APPROXIMATE
3. DRAWING TO BE READ IN CONJUNCTION WITH REPORT "20160314-RH-GEOTECHNICAL DESK STUDY CONSTRAINTS- ISSUE 1.0
4. GEOTECHNICAL CONSTRAINTS IDENTIFIED FROM AVAILABLE INFORMATION AND MAY NOT BE EXHAUSTIVE

REV	DATE	BY	DESCRIPTION	CHK	APP

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PROJECT: SUNDERLAND IAMP

TITLE: GEOTECHNICAL CONSTRAINTS

SCALE @ A1:	CHECKED:	APPROVED:
1:10000 A1 1:20000 A3	Hawton, Rebecca 2016.03.14 13:59:11 Z	Bayliss, Russell 2016.03.14 14:41:21 Z

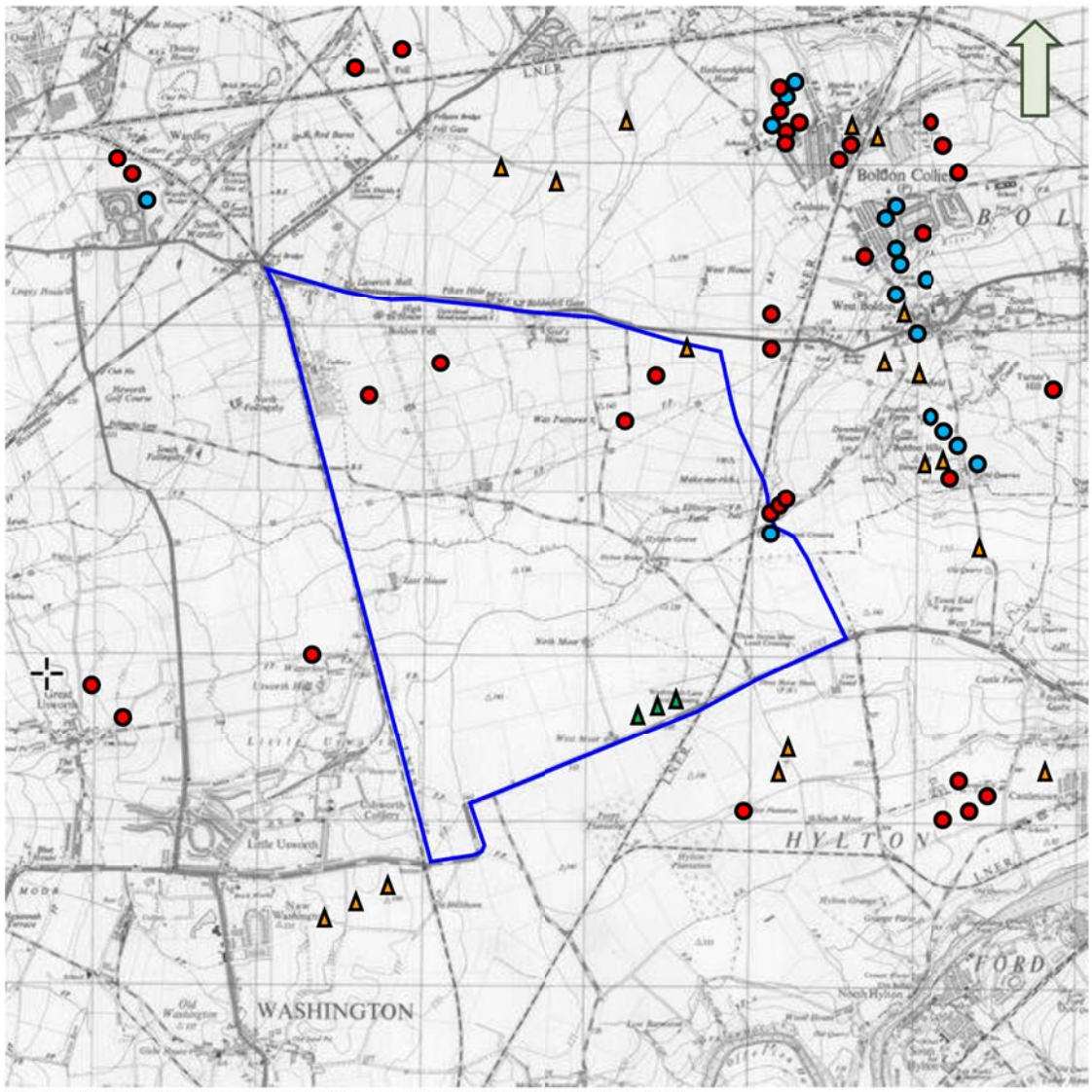
DESIGNED:	DRAWN:	DATE:
RH	SA	25/02/2016

DRAWING No: 62100167-001-WSPPB-02 REV: 1

Appendix B

Zetica UXO

Figure 5	Compiled bomb impact map for the vicinity of the Site



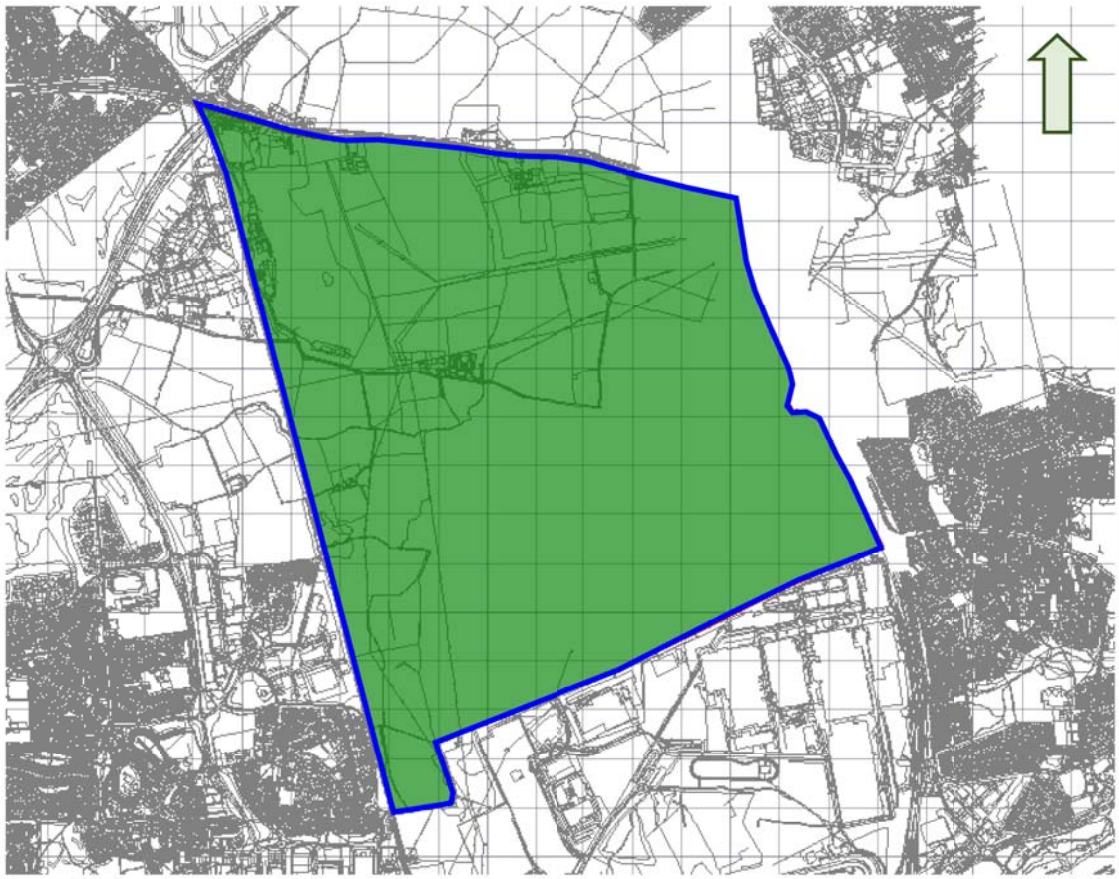
Source: © Crown Copyright 2015. Reproduced by permission of Ordnance Survey *Not to Scale*

Legend	Site boundary	HE bomb	UXB	IBs	APBs

Plates 5 to 11 are aerial photographs of the Site dating from shortly after WWII. There is no evidence of any significant residual bomb damage on the Site.

Possible bomb craters are evident on parts of the Site, some of which correlate with the recorded bomb impacts in the Section above.

Figure 7	UXO hazard zone plan of the Site



Source: Client *Not to Scale*

Legend					
	Very Low		Low		Moderate
	High		Very High		Site boundary

Given that several military aircraft are recorded crashing in the vicinity of the Site, the potential for scattered Small Arms Ammunition (SAA) to be present cannot be totally discounted. This is not considered to provide a significant UXO hazard.