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ES Appendix 14.3 - Land Condition Report

Authored by A-Squared

November 2025

THE CROWN ESTATE

East Hemel

A-squared Studio

East Hemel

Land Condition Report

November 2025

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1. Introduction

A-squared Studio Engineers Limited (A-squared) has been engaged by Expedition Engineering Limited (Expedition) to prepare a Land Condition Report for the Proposed Development at East Hemel, Hemel Hempstead, HP2 4UE (herein called the 'Site'). This Land Condition Report has been prepared to support an Outline Planning Application for the Site which can generally be described as an urban extension comprising two new neighbourhoods and a new employment zone. The development will include new dwellings (including affordable housing and specialist accommodation for older people); new employment and industrial floorspace and ancillary facilities, a sports hub and Sports Pitches; green infrastructure and landscaping works (to include a country park, formal and informal open space, amenity space, Suitable Alternative Natural Greenspace, managed woodland, ecological areas); early years, nursery, primary and secondary education facilities; local centre uses (to include retail, community and employment uses; health and fitness, gym and other cultural and recreational uses; medical centre; transport mobility hubs; drainage works (including foul and surface water drainage infrastructure); ancillary infrastructure works; vehicular and active travel infrastructure; improvements to the Nickey Line and delivery of a proportion of the Hemel Garden Communities Green Loop; land for Gypsy and Traveller pitches; provision of an active travel bridge over the A414; safeguarded land for M1 Junction 8 improvements; ground remodelling, acoustic bund, engineering and demolition works. All matters reserved save for access from the A414/Green Lane junction and access from the B487/ Hemel Hempstead Road (Redbourn Road).

The site has previously undergone several phases of investigation and correspondence with regulatory bodies due to previous site applications and environmental incidents which have occurred in the local area.

In September 2014, the Environment Agency (EA) were contacted for pre-application advice for a different development proposed for the Site in which environmental concerns were identified. These concerns were in relation to the explosion at the Buncefield Oil Depot adjacent to the Site's western boundary in December 2005 that resulted in contamination of the surrounding area from perfluorooctanoic sulphonate (PFOS) and hydrocarbons. The EA response concluded that any development should avoid interfering with groundwater flow across the Site and its design should not move plumes of contamination into areas currently unaffected.

Following the initial correspondence with the EA, several rounds of desk-based study in addition to site investigation and associated interpretative reporting were undertaken across the Site. This included a Preliminary Groundwater Assessment (ST15083, Report Number GWA001), Ground Stability Desk Study (ST13903, Report Number 001), Preliminary Ground Conditions Assessment (ST13903, Report Number 002A) prepared by Wardell Armstrong LLP (Wardell Armstrong) in addition to a Factual Site Investigation Report (C6515) prepared by CC Ground Investigation Ltd (CC) and a Land Quality Desk Study (P23552_R1) prepared by Yellow Sub Geo Ltd (Yellow Sub).

Since the issue of the previous reporting, additional groundwater monitoring and testing has been undertaken to assess changes to the plume(s) of contamination associated within the Buncefield Oil Storage Depot fire, as previously identified and an EIA scoping note for Planning Application 24/02823 in which 'Ground Conditions and Contamination' were scoped out on the EIA although, assessment of contamination of groundwater is included in Chapter 14: Water Resources and Flood Risk of the Environmental Statement.

1.1. Study Aims and Objectives

The Land Condition Report develops an initial Conceptual Site Model (CSM) and provides a qualitative Preliminary Risk Assessment (PRA) for the Proposed Development in accordance with *Land Contamination Risk Management* (LCRM) guidance, published by the Environment Agency on the UK Government website. The Land Condition Report has been prepared in the context of the *National Planning Policy Framework* (NPPF) and *The Building Regulations 2010, Approved Document C - Site preparation and resistance to*

contaminants and moisture (2004 Edition incorporating 2010 and 2013 amendments). The Land Condition Report includes an assessment of whether there are any unacceptable risks (ref. *LCRM* guidance) requiring further geo-environmental investigation.

The outcomes of this desk study have been developed based on information current at the time of writing.

1.2. Information Sources

The desk study has been prepared based on information available in the public domain and in the provided documentation, including the following sources:

- Preliminary Opinion: residential, commercial and industrial development east of Hemel Hempstead (ref NE/2014/121110/01-L01) prepared by the Environment Agency (EA), dated 10th September 2014
- Preliminary Groundwater Assessment (Job number: ST15083, Report Number GWA001) prepared by Wardell Armstrong LLP (Wardell Armstrong), dated November 2017
- Ground Stability Desk Study (Job number: ST13903, Report Number 001) prepared by Wardell Armstrong, dated November 2017
- Preliminary Ground Conditions Assessment (Job number: ST13903, Report Number 002A) prepared by Wardell Armstrong, dated December 2017
- Factual Report, Land East of Hemel Hempstead Ground Investigation (C6515) prepared by CC Ground Investigation Ltd (CC), dated January 2020
- East Hemel: Land Quality Desk Study (P23552_R1) prepared by Yellow Sub Geo Ltd, dated March 2023
- British Geological Survey, GeoIndex Onshore GIS database (accessed 31st July 2025); https://mapapps2.bgs.ac.uk/geoindex/.
- Department for Environment, Food & Rural Affairs (DEFRA), Magic Map Application (accessed 31st July 2025); http://magic.defra.gov.uk/MagicMap.aspx.
- Historic England, online Aerial Photo Explorer (accessed 31st July 2025); https://historicengland.org.uk/images-books/archive/collections/aerial-photos/.
- UK Health Security Agency (UKHSA) and BGS radon mapping (accessed 31st July 2025); https://www.ukradon.org/information/ukmaps.
- Google Earth (ref. earth.google.com/web/), accessed 31st July 2025.
- Flood Maps for Planning (ref. https://flood-map-for-planning.service.gov.uk/), accessed 31st July 2025).
- Local authority planning portal (ref. https://www.dacorum.gov.uk/home/planning-development/planning-applications/search-comment-planning-applications), accessed 18th August 2025
- Buncefield Major Incident Investigation, Initial Report to the Health and Safety Commission and the Environmental Agency of the investigation into the explosions and fires at the Buncefield oil storage and transfer depot, Hemel Hempstead, on the 11th December 2005.
- East Hemel – Groundwater Sampling Factual Report (64225-A2SI-XX-XX-RP-X-002-00) prepared by A2 Site Investigations, dated August 2025

1.3. Common Abbreviations

The following common abbreviations are used within this report:

- CSM – conceptual site model
- PRA – preliminary risk assessment
- m – metre
- OD – above ordnance datum

- bgl – below ground level
- ha – hectares
- NAPL – Non-aqueous phase liquid
- Asbestos – potential free fibres, debris and / or fragments of asbestos containing material (ACM)
- BTEX – benzene, toluene, ethylbenzene, and xylenes
- TPH – total petroleum hydrocarbon
- PAH – polycyclic aromatic hydrocarbons
- BOD - Biochemical Oxygen Demand
- TOC – total organic carbon
- DOC – dissolved organic carbon
- PCB – Polychlorinated Biphenyls
- PFAS – Per- and Polyfluoroalkyl Substances
    - PFOA – Perfluorooctanoic acid
    - PFOS – Perfluorooctane sulfonate
- Ground gas – methane, carbon dioxide (excludes soil vapour).

2. Site Setting

2.1. Site Location

The Site is located to the east of Hemel Hempstead in Hertfordshire, as shown in Figure 2.1. The approximate National Grid reference for the Site is 509155, 208009 and the Site footprint covers approximately 356.8 hectares (ha).

The majority of the Site is located within the administrative St Albans City and District Council (SADC) however, a small area of the proposed highways and infrastructure works along the western extent of the Site are located within the administrative area of Dacorum Borough Council (1.3% of the total Site area). The Site predominantly includes several large agricultural fields which have been sub-divided into four distinct areas:

- EH North: The land north of Punchbowl Lane and south of the B487 (Hemel Hempstead Road) bounded to the east by the M1 motorway, the west by Cherry Tree Lane;
- EH Central: the land between Punchbowl Lane and the A414, bounded to the east by to the M1 motorway and west by Green Lane;
- EH South: The land to the south of the A414, bounded to the north-east by the M1 motorway, the west by Westwick Row, the southwest by Bedmond Road and the south of the A4147 (Hemel Hempstead Road); and
- EH East: the land to the east of the M1 Junction 8, bounded to the north by Hogg End Lane and to the east and south by agricultural fields.

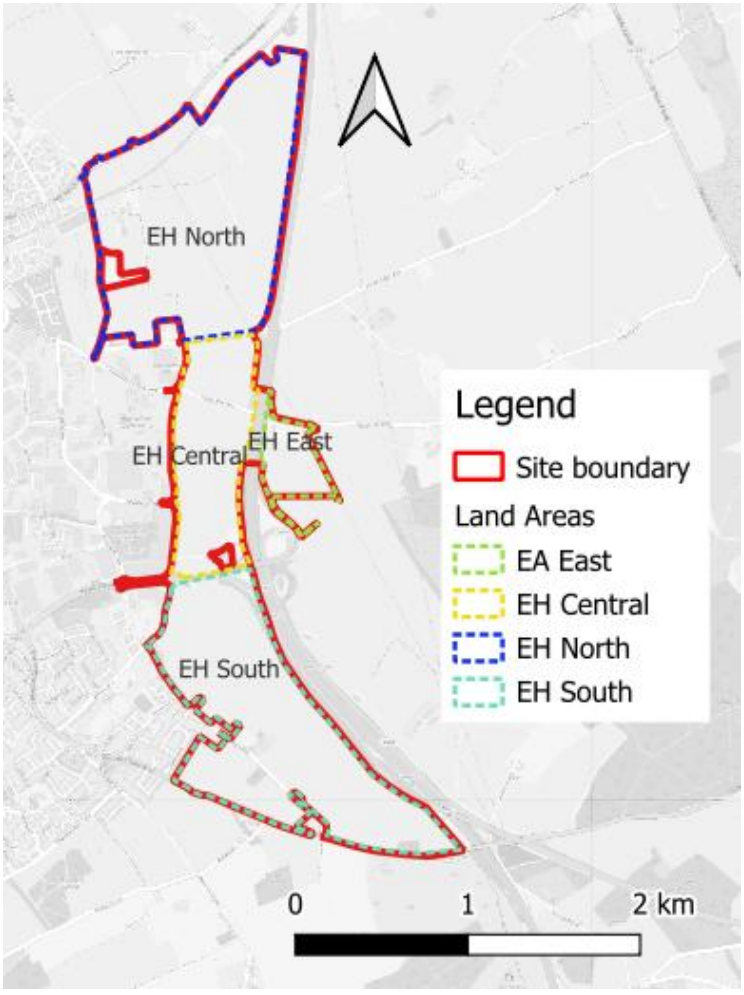


Figure 2.1 Site Location (red line reflects the Site boundary used for this assessment, map data from OpenStreetMap)

2.2. Site Description

The Site is largely undeveloped and comprises of several irregular shaped fields in arable cultivation, with some fields used for pasture (including grazing horses). Much of the Site is bordered by the M1 motorway to the east, the B487 Hemel Hempstead Road to the north (which is known as Redbourn Road to the west), urban areas of Hemel Hempstead to the west (including the neighbourhoods of Spencer's Park and Leverstock Green and Maylands Industrial Estate) and the A4147 Hemel Hempstead Road to the south.

The Site is cut (east-west) by the Nickey Line (a disused railway line that now forms a long-distance footpath and cycle way), Punchbowl Lane, Hogg End Lane and the A414 Breakspear Way. The Site's eastern extent (EHH East) comprises a c. 57.55 ha area located to the east of Junction 8 of the M1.

Descriptions of each of the four distinct areas (EH North, EH Central. EH East and EH South) are discussed below in Section 2.2.1 to Section 2.2.4 with a site feature plan presented as Figure 2.2 to Figure 2.4. This is based on maps, aerial / satellite images and the findings of the walkover undertaken by the consultant Yellow Sub Geo Limited (hereafter referred to as Yellow Sub) on 22nd March 2024 as part of the Land Quality Desk Study referenced in Section 1.2.

2.2.1. EH North

During the Yellow Sub walkover, it was observed that the fields within EH North were under arable use. A property identified as 'Woodend Farm', comprising a residential dwelling and associated agricultural buildings, was also noted. These privately owned properties were not accessed during the walkover. However, ongoing earthworks were observed at Woodend Farm, with material being relocated and stockpiled to the northwest of the property. The composition of this material was not determined by Yellow Sub. In addition, Google Earth imagery indicates the presence of a public footpath, 'the Nickey Line', traversing the northern section of EH North.

The surrounding land use beyond the road networks bounding EH North predominantly comprises undeveloped agricultural fields to the north, east, and south (EH Central). To the west, the land use is characterised by residential dwellings with private gardens and the property identified as 'Cherry Tree Farm'.

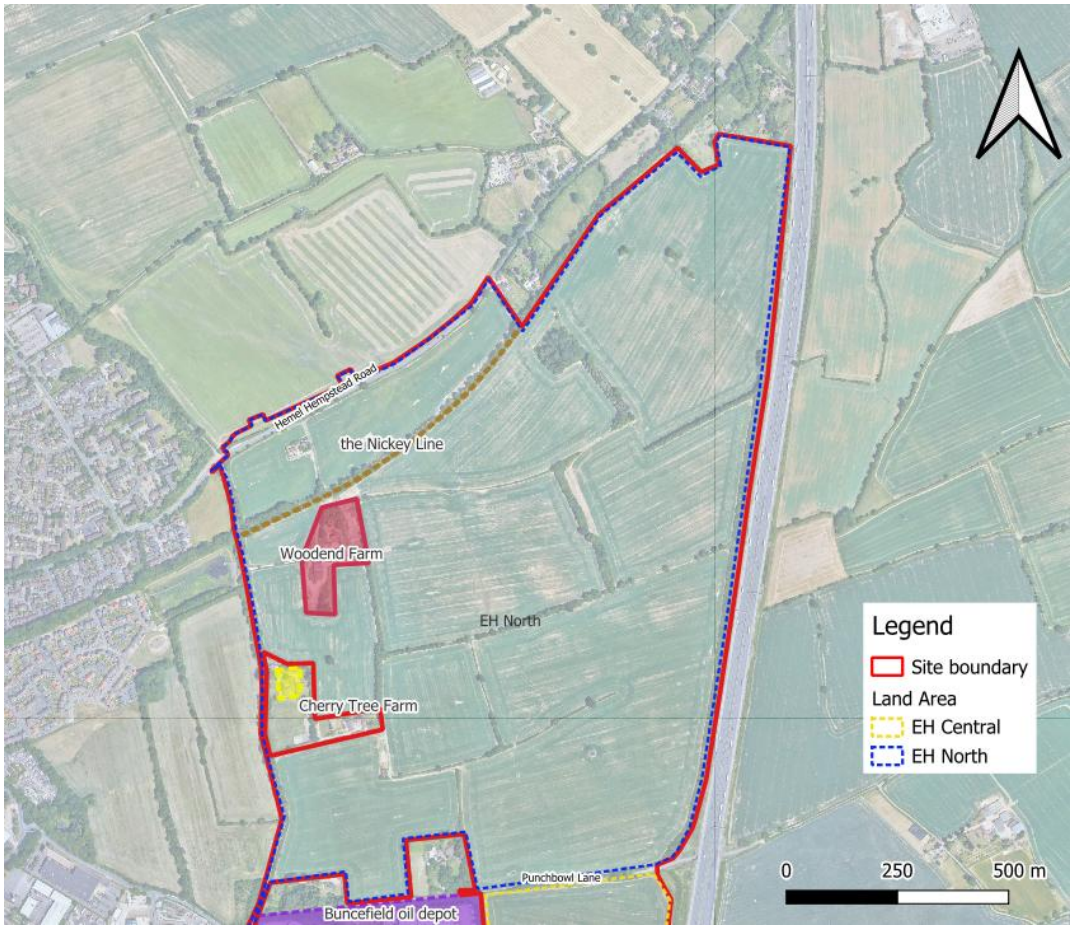


Figure 2.2 Site features plan (EH North)

2.2.2. EH Central

During the walkover undertaken by Yellow Sub, it was observed that the fields within EH Central were also in use as arable land, with no evidence of development identified. However, instances of fly-tipping were recorded, comprising wooden planks, insulation board, bin bags, polystyrene, and suspected ACMs within a small area of scrubland located northwest of the M1 overpass on Hogg End Lane. In addition, a pile of discarded plastic pipework was noted within the neighbouring field to the north of Hogg End Lane, positioned at the central gateway along the southern boundary of the field.

Further observations included the area west of 'Breakspears', a localised topographic low, being waterlogged. The 'Breakspears' site is currently a listed building owned by The Crown Estate which is located adjacent to a depot operated by the Department for Transport. These areas were not accessed during the walkover. A small pond was also identified within the secured area southeast of the M1 overpass on Hogg End Lane.

The surrounding land use of EH Central (beyond the bounding road networks) predominantly comprises undeveloped agricultural fields to the north (EH North), east (EH East), and south (EH South). To the west, land use is characterised by the Buncefield Oil Depot, an operational oil terminal containing several large above-ground storage tanks and associated industrial infrastructure. Other notable features to the west include a cemetery (approximately 100m from the Site), caravan storage facilities (approximately 100m from the Site), and a commercial business park comprising multiple office units.

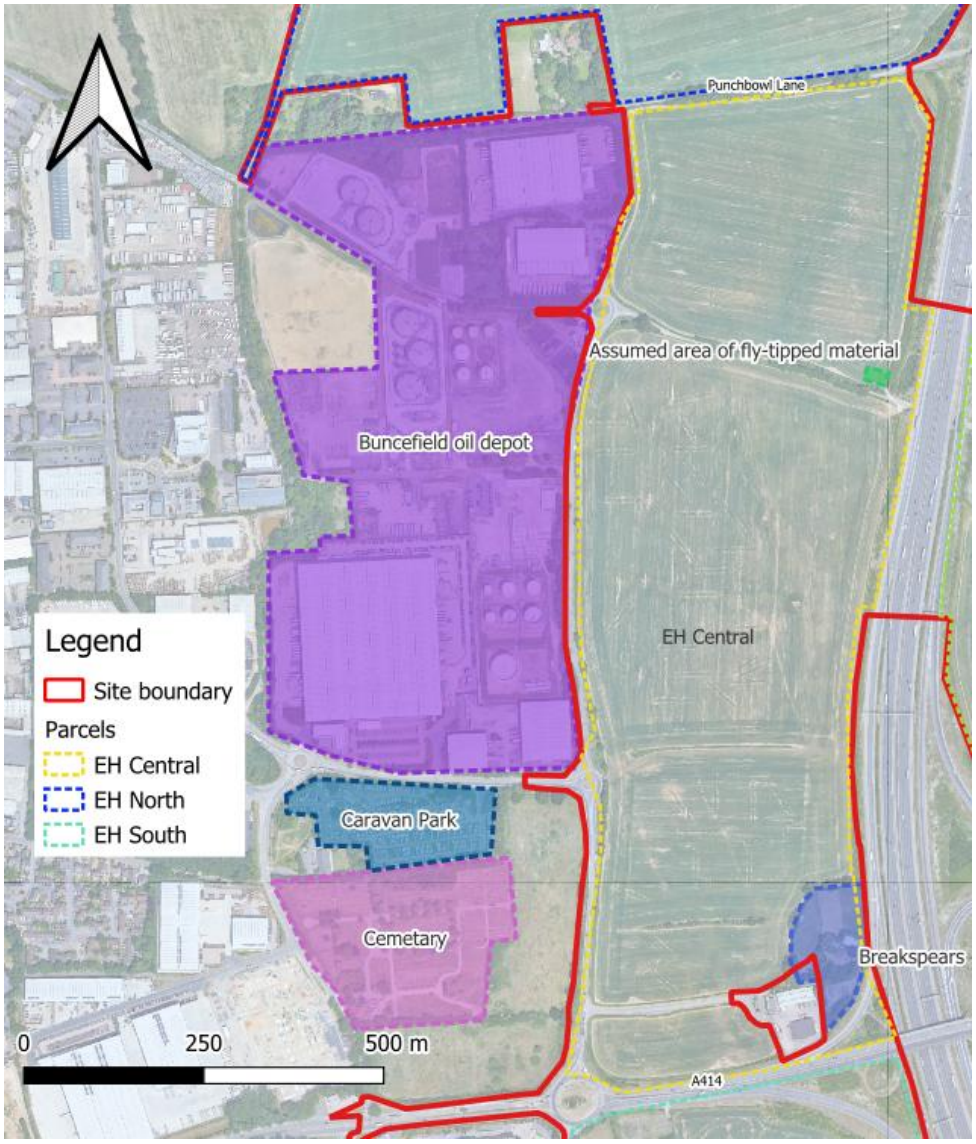


Figure 2.3 Site features plan (EH Central)

2.2.3. EH South

During the walkover, it was noted that EH South comprised predominantly agricultural fields, utilised both for arable cultivation and as pasture for grazing horses. A property identified as 'Westwick Row Farm' was located within the central portion of the area, however, access to this property was not possible during the walkover. In the western portion of EH South, fly-tipped materials, including tyres and bags of general waste, were observed at a gateway opposite 'Handpost Lodge Garden's. Additionally, two small ponds were noted along the southwestern side of 'Westwick Row'.

The surrounding land use of EH South (beyond the bounding road networks) predominantly comprises undeveloped agricultural fields to the north (EH Central), east, and south, together with residential properties with private gardens to the west.

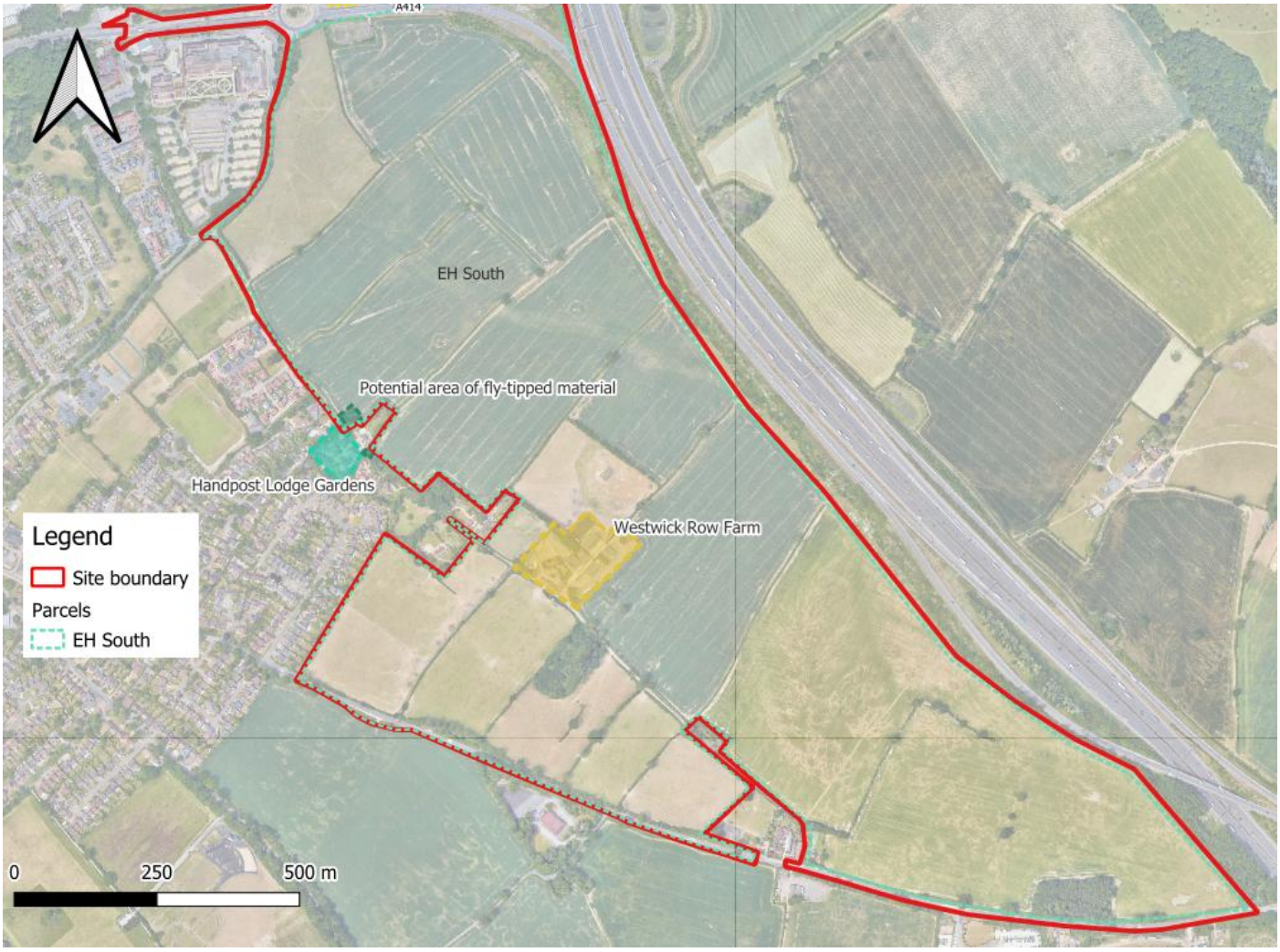


Figure 2.4 Site features plan (EH South)

2.2.4. EH East

EH East comprises undeveloped agricultural fields (specific usage not identified during the Yellow Sub walkover). The area is predominantly surrounded by further undeveloped agricultural land to the north, east, south, and west (EH Central), with the only notable features being the M1 motorway, which forms the western boundary of the Site.

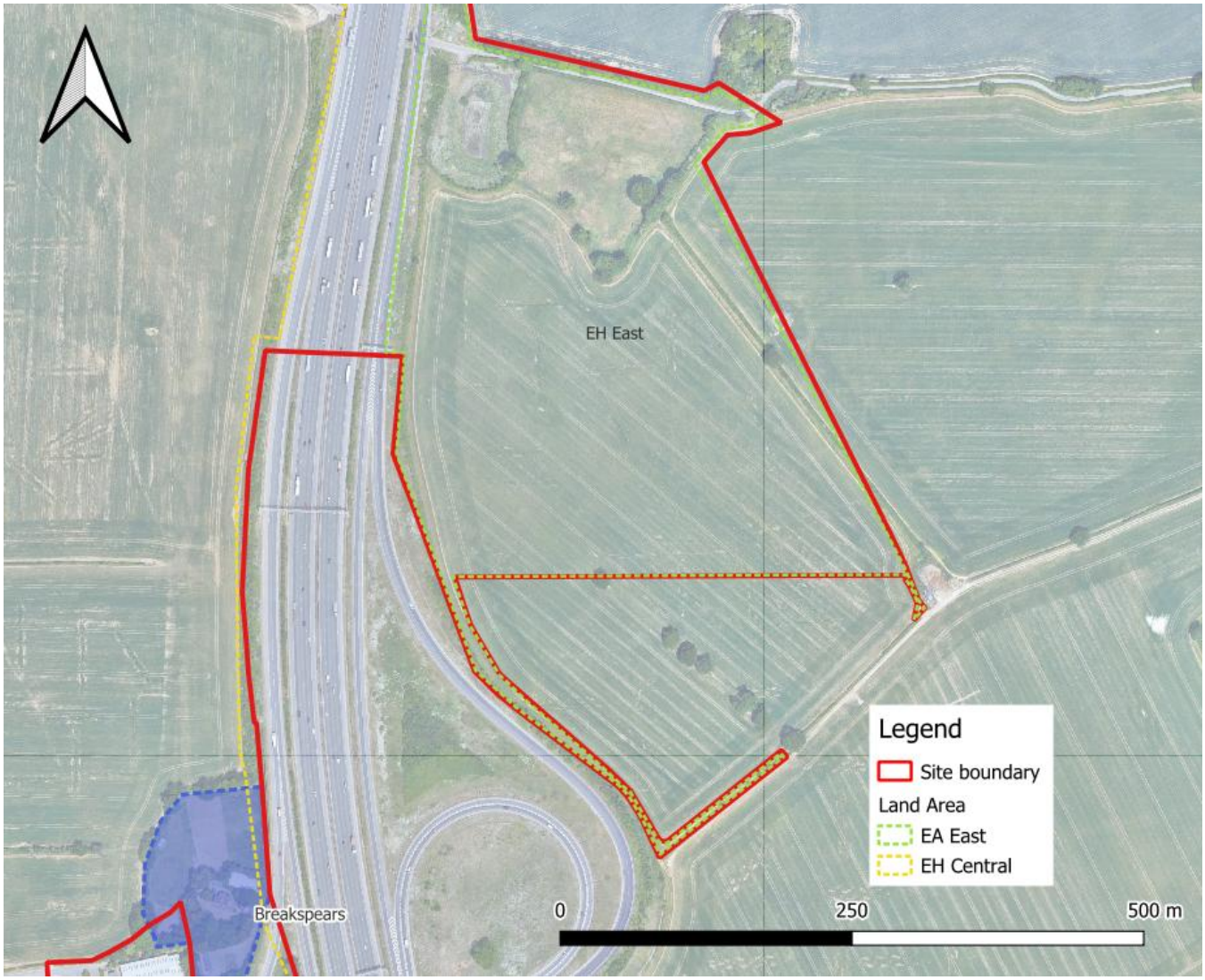


Figure 2.5 Site features pln (EA East)

2.3. Topography

The Site and surrounding landscape exhibit landforms typical of chalk downland, dominated by a series of dry valleys that reflect former fluvial processes under periglacial conditions, as shown in Figure 2.6. Three principal dry valleys traverse the Site on a broadly east-west alignment, located in the northern, central, and southern sectors. These features are the product of surface water incision during periods when the chalk was frozen and impermeable, allowing meltwater to flow across the surface.

Ground levels across the Site vary, with relatively flatter interfluve areas lying between approximately 125mOD and 130mOD, while the floors of the dry valleys range from around 110mOD to 120mOD. This topographic variation emphasises the dissected character of the chalk landscape and highlights the depth of incision achieved during past hydrological activity.

Smaller tributary dry valleys intersect the main systems, generally orientated perpendicular to their axes. Together, these form a dendritic drainage pattern that illustrates the integration of past runoff pathways. Although these tributaries no longer convey permanent water, they remain clearly expressed in the topography and contribute to the dissected landform that characterises the Site.

Under present climatic and hydrological conditions, the valleys are typically dry. However, they may accommodate ephemeral surface water during periods of intense rainfall. From an applied perspective, these landforms represent not only significant geomorphological features but also potential flow pathways for surface runoff and concentrated groundwater recharge.

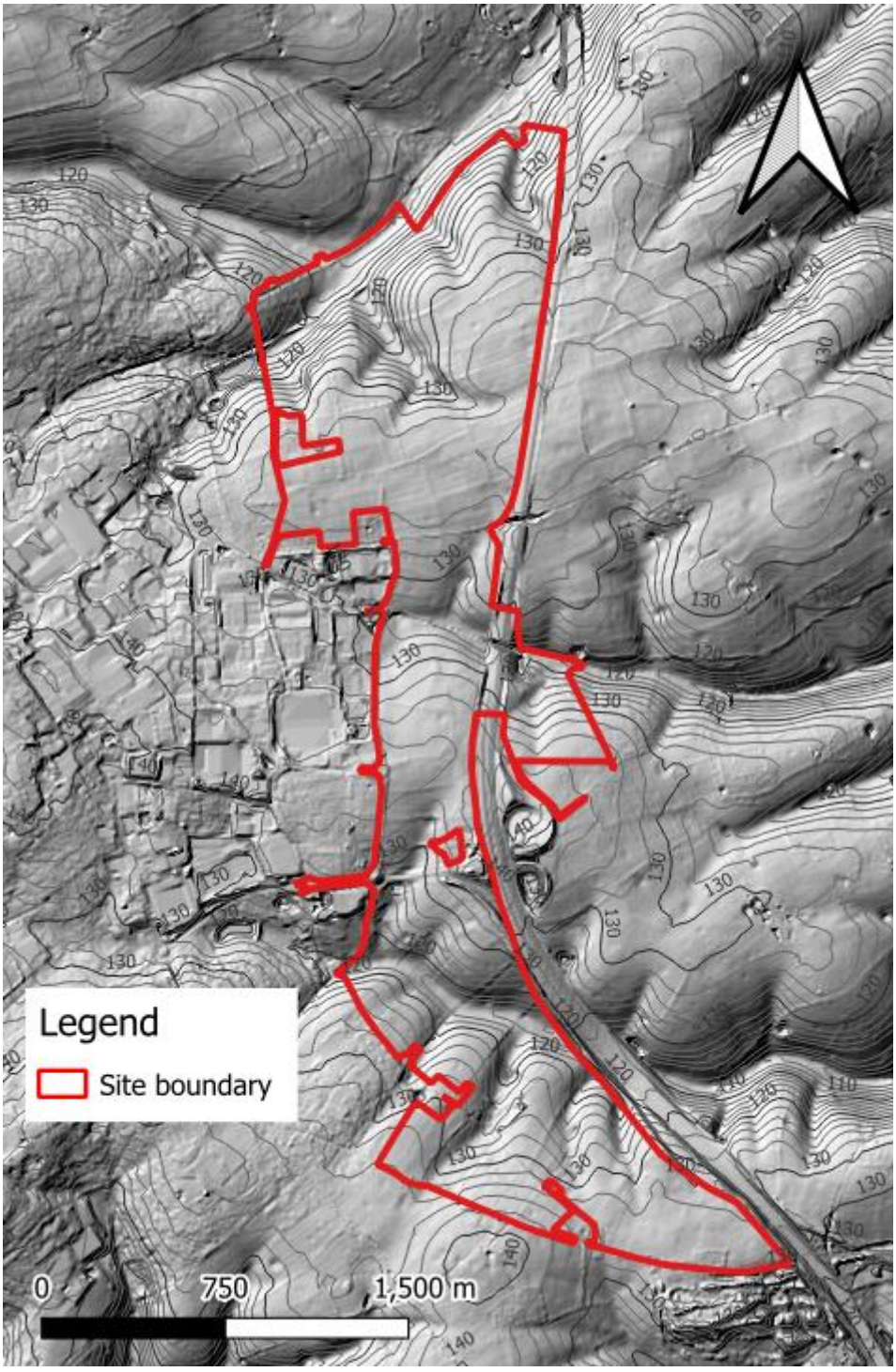


Figure 2.6 Topography (based on LiDAR DTM, hillshade plan at 10x vertical exageration, contours at 2m and 10m intervals)

2.4. Proposed Development

The Outline Planning Application is submitted in duplicate to St Albans City & District Council as the Local Planning Authority (LPA) for development falling within the District, and to Dacorum Borough Council as LPA for development falling within the Borough. The Site is largely undeveloped and therefore will have a change of use. This application seeks Outline Planning Permission for:

- Up to 4,000 new dwellings including up to 640 elderly care / extra care units and 16 supported living units;
- Up to 190,600m^2 of employment use including up to 54,500m^2 business and research & development; and up to 104,277m^2 distribution; and up to 31,850m^2 mixed industrial uses.
- Three Primary Schools incorporating Early Years;
- Secondary School for up to eight forms of entry on a site of not more than 10.78ha.
- Up to 2,000m^2 in total of Community Uses including community centres and meeting places, library use, places of worship and other community facilities;
- Up to 2,300m^2 of health care services (including medical and dental services);
- Up to 18.8ha for a Sports Hub and Sports Pitches including up to 3,400m^2 in total of sports hub uses. Up to 775m^2 health and fitness, gym and other cultural and recreational uses;
- Up to 525m^2 nursery uses;
- Up to 76.8ha of Suitable Alternative Natural Greenspace (SANG);
- Green infrastructure and landscape works to include a country park, formal and informal open space, including natural / semi-natural open space, parks & gardens, amenity space, managed woodland, ecology areas and links including mitigation works, green corridors, outdoor sports facilities including changing facilities, play areas, allotments and associated lighting and infrastructure;
- Mobility hubs;
- An active travel (pedestrian and cycle) bridge over the A414;
- Vehicular and active travel access points and connections to the surrounding highway;
- Vehicular and cycle parking including electric vehicle charging points;
- Pedestrian, cycle, equestrian, vehicle and bus routes, with associated bus stops, crossings, street furniture and lighting;
- Improvements to existing Public Rights of Way;
- Improvements to the Nickey Line through the Site. Delivery of the Hemel Garden Communities (HGC) Green Loop through the Site;
- Land for up to 40 Gypsy and Traveller pitches;
- Safeguarded land for M1 Junction 8 improvements;
- Engineering works including ground remodelling;
- Creation of bunds (incorporating acoustic fencing) adjacent to the M1 motorway;
- Any necessary demolition of existing buildings;
- Retention of and improvements to listed buildings (subject to separate Listed Building Consent);
- Infrastructure works (comprising energy/utilities provision and diversions as necessary);
- Drainage works including foul drainage infrastructure, sustainable drainage systems and multi-function stormwater attenuation features;

An illustrative land use parameter plan of the Site is provided below as Figure 2.7. At this stage, no built development is proposed to the east of the M1 (EH East), the very northern portion of EH North and the southern portion of EH South. At the time of issue, it is currently unknown if any of the Proposed Developments will have basements.

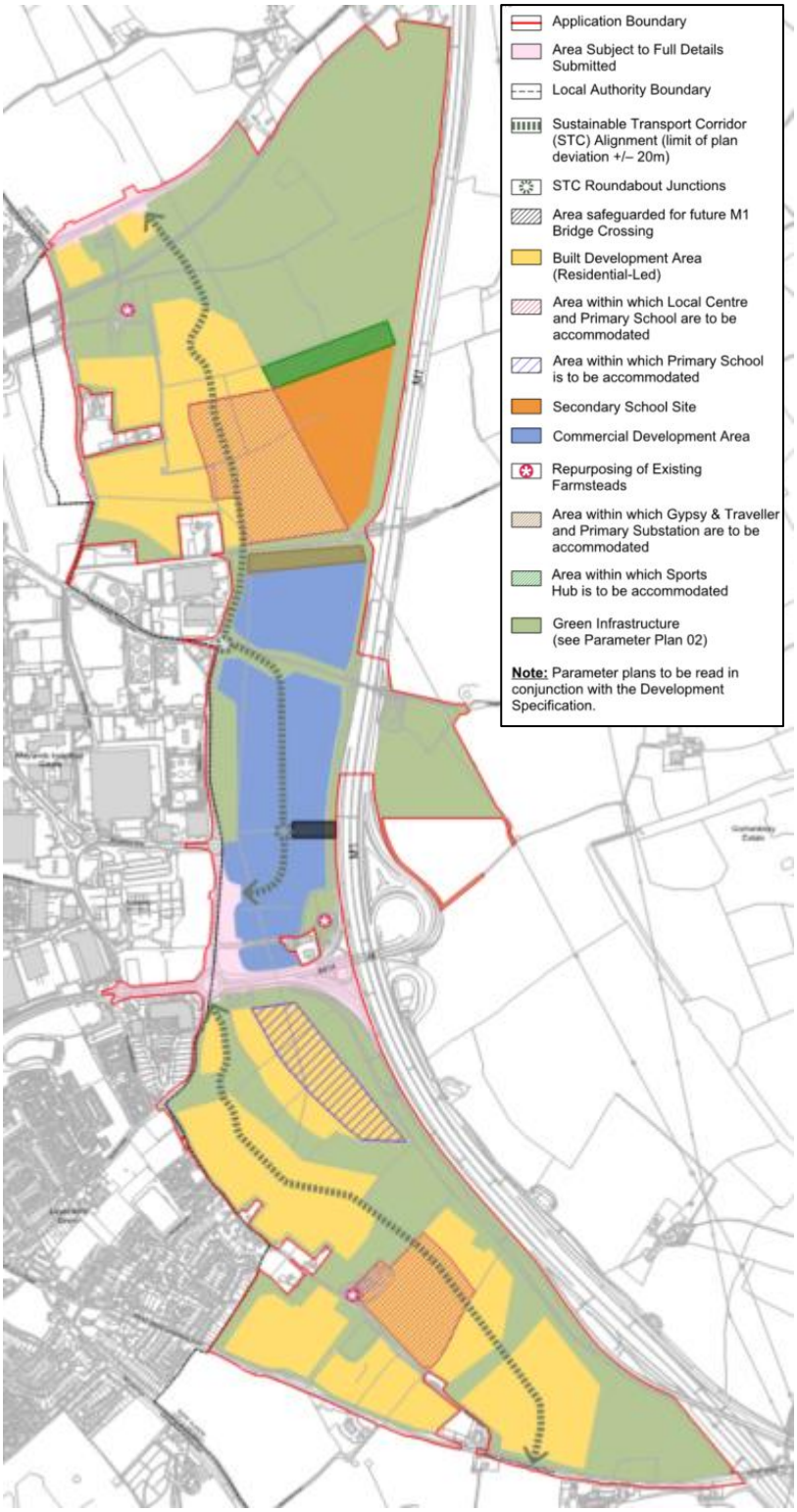


Figure 2.7 Land use parameter plan

2.5. Unexploded Ordnance

Zetica has produced an online mapping relating to potential risks associated with discovering unexploded ordnance (UXO). Based on this mapping, the Site is indicated to be at a low risk of UXOs.

2.6. Buncefield Incident

Early on Sunday the 11th December 2005, a gasoline storage tank was being filled from a pipeline at a fuel terminal in Buncefield Oil Dept located west adjacent to the Site. The safety systems designed to prevent the tank from overfilling failed, and gasoline began to spill from the vents on the tank roof resulting in a low-lying cloud of heavy, flammable vapour accumulating and spreading about 250 metres in all directions around the tank. The cloud eventually ignited, causing a powerful vapour cloud explosion that devastated the depot which resulted in a fire that spread to other tanks and was not fully extinguished for several days. In total, 786,000 litres of foam concentrate and 68 million litres of water (53 million 'clean' and 15 million recycled) were recorded as having been used to contain the incident during the fire-fighting operations. This incident and the use of firefighting foam (expected to contain PFAS) is likely to have impacted the Site and the regional groundwater in the area. For this reason, several environmental assessments have been undertaken at the Buncefield Oil Depot and its surrounding area.

3. Summary Desk Study

3.1. Sources of Information

The summary desk study provided below is based on the data included within the Land Quality Desk Study (ref P23552_R1, dated March 2023) prepared by Yellow Sub Geo Ltd for Temple Group Limited – it is understood that the current client has reliance on this report and the data presented within it. This data has been supplemented with publicly available records to establish the geological, hydrogeological/hydrological, historical and environment setting of the Site.

3.2. Geology

Figure 3.1 illustrates the location of the Site within the context of a 1:50k scale digital geological mapping from the British Geological Survey (BGS). The maps indicate that superficial deposits comprising the Clay-with-flints Formation are present within the Site underlain by the bedrock geology of the Lambeth Group and/or the White Chalk Subgroup.

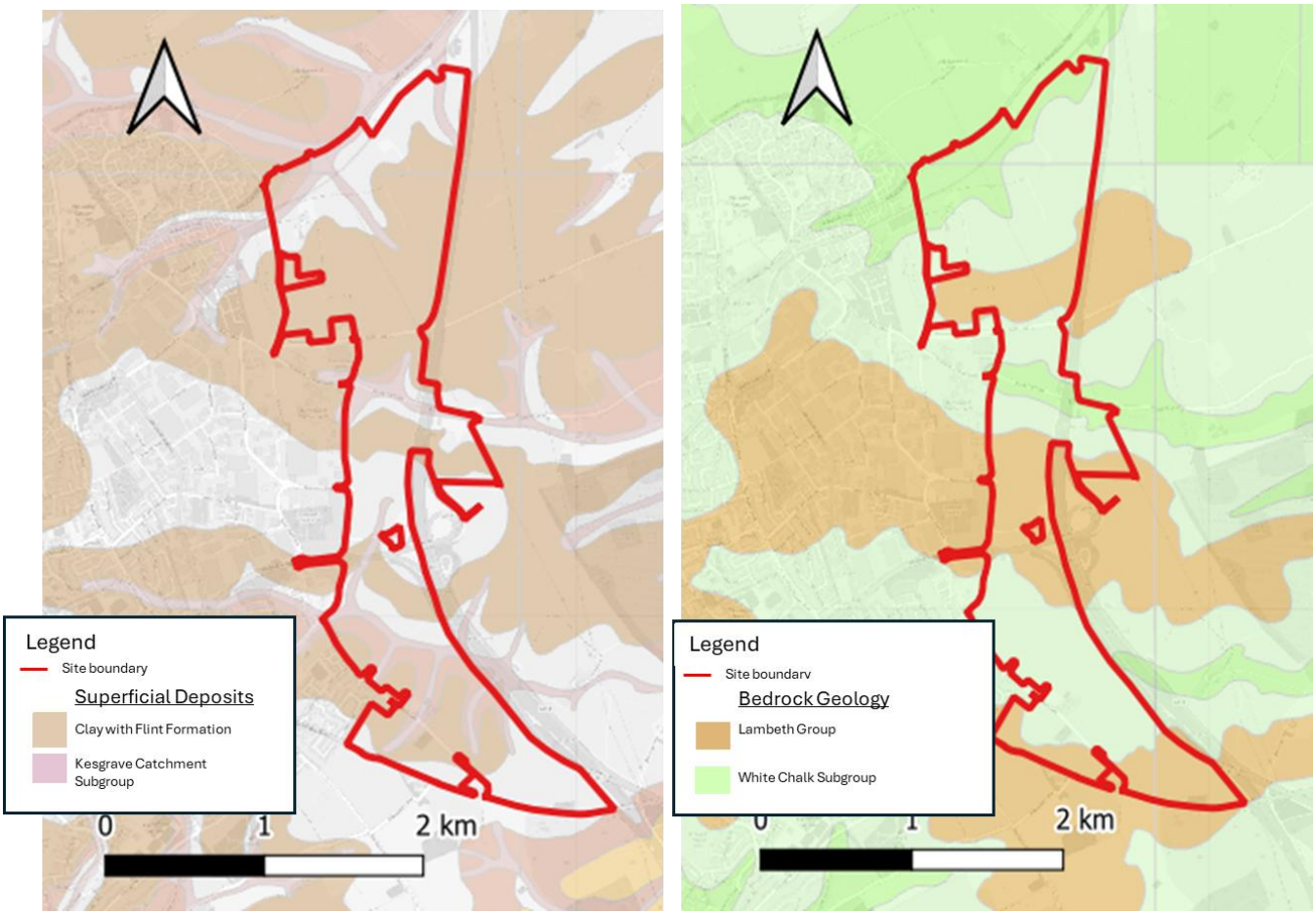


Figure 3.1 Geological context of the Site (superfical deposits -left and Bedrock geology - right)

In the Hemel Hempstead area of Hertfordshire, the Clay-with-flints Formation forms a widespread residual deposit developed across the Chalk downlands. It consists of stiff clay containing abundant flint nodules, gravel, and pockets of sand derived chiefly from the solution and decalcification of the White Chalk Subgroup. Stratigraphically, the unit rests either directly upon the White Chalk Subgroup or, where preserved, on the younger Lambeth Group.

The White Chalk Subgroup (late Cretaceous) provides the principal source of the flint-rich component, while the Lambeth Group (Palaeocene), comprising mottled clays, silts, and sands of estuarine origin, has contributed locally to the deposit where remnants of this younger bedrock have been weathered and incorporated. This results in lithological variability, with reddish-brown sandy clays and silty material mixed into the residual clay-flint assemblage.

The Clay-with-flints Formation is recognised as a pre-glacial formation, produced during prolonged phases of deep subaerial weathering and dissolution in the Palaeogene-Neogene. Its present character and distribution, however, were subsequently modified during the Pleistocene, when periglacial processes (such as solifluction, cryoturbation, and slopewash) reworked and redistributed the pre-existing deposit.

The 'late Cenozoic regional mesofracture system' for the Chalk shows a pervasive NW-SE trending joint set, commonly paired with a conjugate NE-SW set. Fractures are typically steep to vertical and spacing varies with lithology. In the Hemel Hempstead / Boxmoor / Gade valley area, valley incision by the Gade and Bulbourne rivers has imposed local stress relief fracturing, often oriented sub-parallel to the valley sides. This can generate local departures from the regional 'rose diagram'. No faults are mapped within the Site boundary or immediate surrounding area, although two faults are mapped approximately 1.5km to the west of the southern area of the Site, trending in a NNE-SSW direction.

3.2.1. Mining & natural cavities records

A map showing the location of the mining and natural cavities records included in the Groundsure report (appendix A) is presented as Figure 3.2.

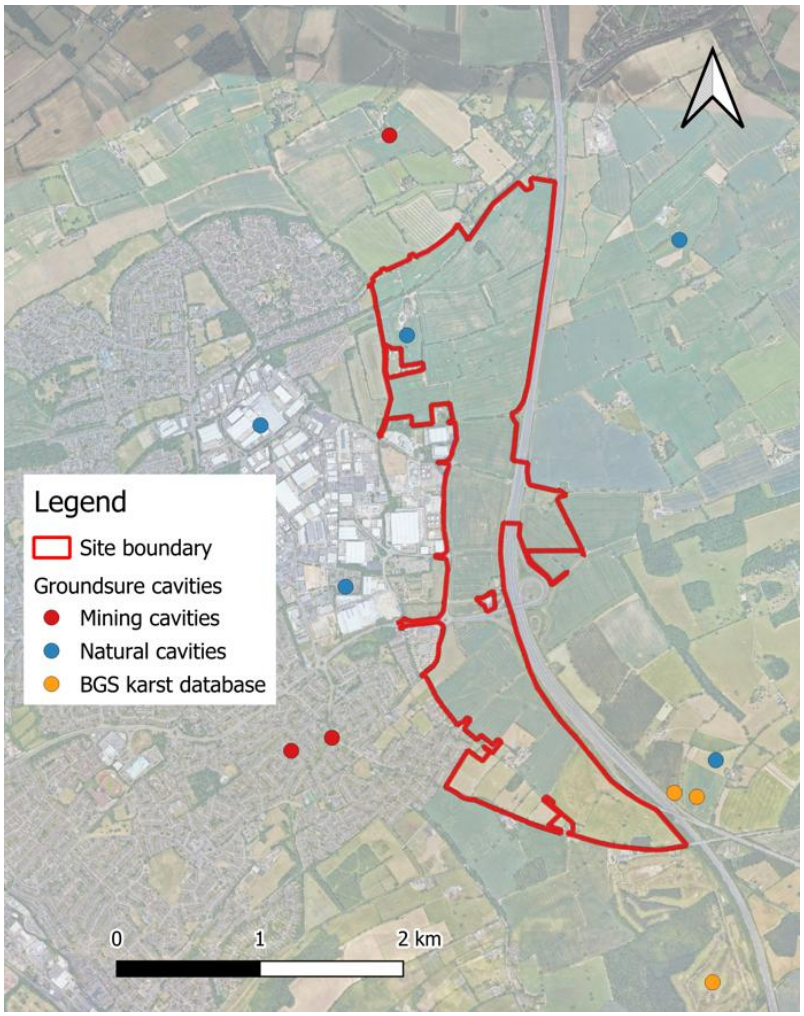


Figure 3.2 Mining and natural cavities records

There is one natural cavity record located within the Site boundary, relating to a solution pipe just south of Wood End Farm in the northern area of the Site. Two natural cavity records are also observed off-site to the south-west and north-east of the on- Site natural cavity record. Further records are located to the west of the Site, to the east of the southern-most part of the site (one natural cavities record and two BGS karst record), with a further BGS karst record to the south-east of the Site.

The mining cavities records located 745m north-west and 770m and 993m west of the Site are associated with chalk and appear to relate to open pits identified on the historical maps and where a surface expression (irregular in shape with relatively 'sharp' edges) is present in the LiDAR DTM.

3.3. Hydrogeology

The Clay-with-flints Formation is listed as Unproductive Strata. Unproductive Strata are low permeability strata that are not considered to retain significant quantities of groundwater. If groundwater is present within Unproductive Strata, for example within more permeable lenses or small fissures, it is typically discontinuous, of low value and very low sensitivity.

The Lambeth Group is classified as a Secondary A Aquifer, defined as containing permeable layers capable of supporting water supplies at a local rather than strategic scale, in some cases forming an important source of base flow to rivers. These strata are aquifers formerly classified as Minor Aquifers.

The White Chalk Subgroup is listed as a Principal Aquifer which is classified as a layer of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The Site is located above the Mid-Chilterns Chalk groundwater body, and is predominantly located within a Source Protection Zone (SPZ) 3. However, the very southeast corner of the Site also falls into an SPZ 2 and SPZ1, indicating that the groundwater on site is used for potable water supplies. The groundwater is currently classified as being of 'poor' chemical status under the Water Framework Directive.

There are various groundwater abstractions from the Chalk aquifer for public water supply in the area, however, none of these are within a 1km radius of the Site. There are various licensed industrial groundwater abstractions to the west of the Site, although several of these relate to groundwater abstraction as part of remediation work after the Buncefield Incident. The closest groundwater abstraction point to the Site not associated with the Buncefield Incident is located 327m north and is used for general farming purposes.

3.4. Hydrology

No substantial surface water bodies are present on site, however, a few small ponds are present adjacent to the M1 and the A414 located in the central region of the Site. The Groundsure Report also lists several inland rivers adjacent to the M1 however, these are noted to actually be drainage ponds.

Within the surrounding area, no substantial water features have been identified other than small inland rivers located east adjacent to the M1, large above ground water features associated with the Buncefield Oil Depot west adjacent to the Site and 'Redbourn Reservoir' west adjacent to the Site. The nearest river is the River Ver, approximately 1.5km to the northeast of the Site.

There are no surface water abstraction points within 500m of the Site boundary.

3.5. Radon

UK Health Security Agency (UKHSA) and BGS radon mapping indicates that the Site covers a range of areas of maximum radon potential. The majority of the Site is in an area where 3% to 5% of homes are estimated to be at or above the Radon Action Level with the southern portion having 5% to 10% of homes at or above the Radon Action Level. This can be observed as within Figure 3.3

below. *The Building Regulations 2010, Approved Document C* state that without a site-specific Radon Risk Report the maximum requirement for radon protection in these areas should be 'basic' (such as installation of a radon protection membrane).

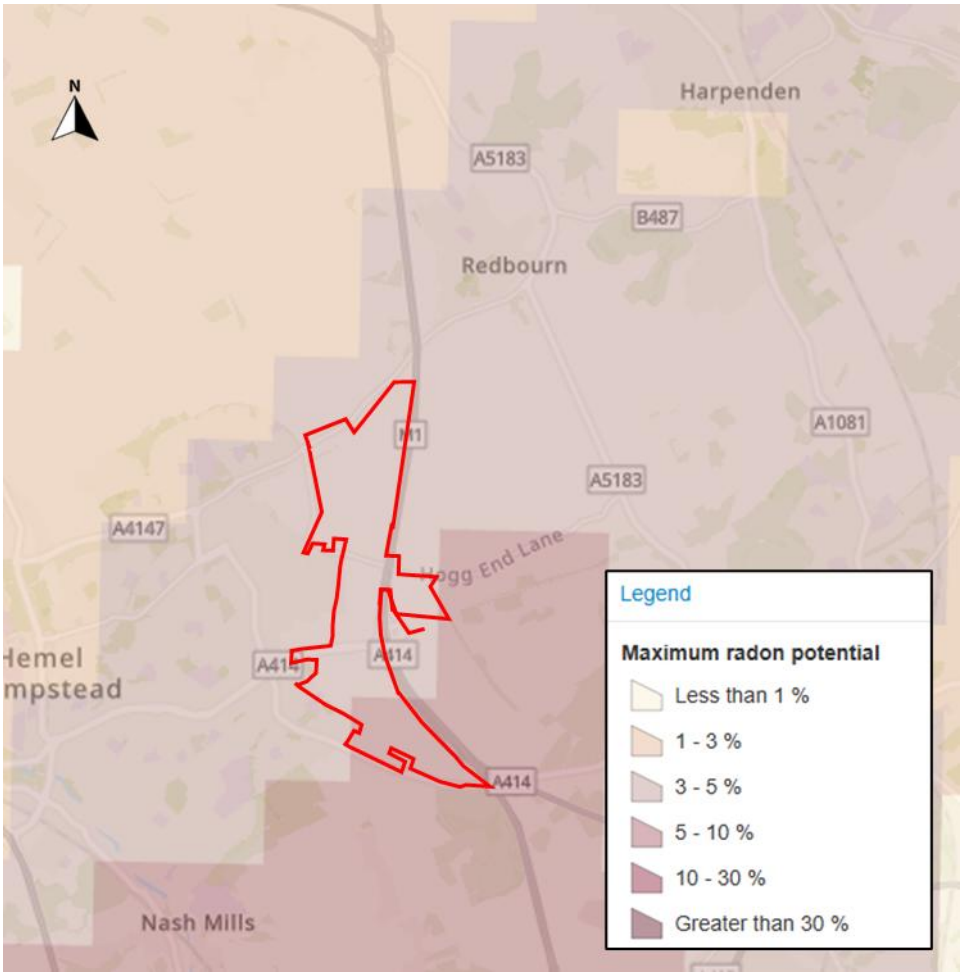


Figure 3.3 Radon mapping of the Site provided by UK Health Security Agency (UKHSA) and BGS (site boundary in red)

3.6. Site History

Detailed historical maps and aerial photographs of the Site and surrounding area dated between 1887 and 2024 (at scales of 1:10,000 and 1:10,560), provided as part of the Groundsure Report within the Yellow Sub Report. This process has been undertaken to identify former land uses at the Site and within the surrounding area that may have geo-environmental implications for the proposed redevelopment.

In 1887, the Site comprised agricultural fields associated with several farms, including *Westwick, Cherry Tree, Woodend, Corner*, and *Megdell Farms*, with a *railway* running along the northern boundary. The surrounding land was also agricultural, with only a small *gravel pit* located approximately 100m north and an unspecified pit about 20m east.

Between the 1920s and 1950s, the gravel and unspecified pits were removed (likely infilled), a reservoir was constructed around 200m to the southwest, a *Fireworks Factory* was established approximately 150m to the northwest, and *Cherry Tree Hospital* was built adjacent to *Cherry Tree Farm* before later being converted into a residence.

By 1963, the M1 and A414 motorways had been constructed across the Site and by 1982 changes to occur to the Site and surrounding area included a small *depot* being established adjacent to the central portion of the Site, the *railway* in the north had been removed, and *Westwick Farm* appeared to have been converted into housing. In the surrounding area, the *Buncefield Oil Depot* and an industrial estate were developed, while the *Fireworks Factory* was demolished and redeveloped for residential use.

Since 1982, on-site changes have been limited to minor extensions at *Woodend Farm*. Off-site changes included the expansion of the depot in 2010, a small electrical substation developed immediately west of the Site, and Buncefield Oil Depot being reconfigured in 2010 following the 2005 incident.

In addition to historical maps, the Groundsure Report has provided a list of historical land uses, tanks and energy features within the vicinity of the Site, the majority of which are associated with the *Buncefield Oil Depot*, former *Fireworks Factory* and industrial estate. Records of the historical industrial land uses, tanks, energy features, and garages in the immediate vicinity have been considered as potential sources of contamination. For a full breakdown of the historical and recent land uses, please refer to the Groundsure Report.

Potential sources of contamination from on-site and off-site sources identified on the historical maps and Groundsure tables have been summarised in Table 3.1 with their location represent on Figure 3.4 and Figure 3.5.

Table 3.1 Potential geo-environmental impact to site from historical land uses / features identified

Historical Feature	Distance and bearing from site	Figure 3.4 and Figure 3.5 reference ID	Approx Date Present	Potential geo-environmental impact to the Site
			On-site	
Agricultural Land (evident by several farms across the Site)	On-Site	N/A (covers entire site)	1882 to present	Since the late 1800s the Site has been used as agricultural land and for this reason could therefore be a potential source of nitrates, sulphates, sulphides, phosphates, ammoniacal nitrogen, PFAS, pesticides and herbicides associated with agricultural land uses.
Railway	On-site (northern portion of EH North)	1	1883 to 1982	Railway lines have been identified along the northern border of the Site. The combustion of fuel associated with trains using the tracks may have the potential to be sources of TPH contamination.
			Off-site	
Motorway	On-site (Dissecting through centre of the Site)	A	1963 to present	Use of the Site as a motorway may potentially have vehicle fuel leaks resulting in potential TPH contamination.
Cheery Tree Farm Hospital	West adjacent to EH North	B	1922 to 1955	A former hospital has been identified west adjacent to the Site. This hospital has the potential to be sources of radioactive wastes however, former hospital uses were likely to be of low radioactivity and have fast half-lives which is unlikely to have caused contamination risks to the Site
Depot	East and west adjacent to EH central and EH East respectively	C	1982 to Present	A depot was established on site which, as identified in Section 2 of this report, is associated with the Department of Transport. Therefore, this Depot could be a potential source of TPHs for fuel leaks associated with the transport infrastructure.
Infilled Gravel Pit	100m north	D	1887 to 1923	The infilled gravel pit, which was last observed in the historical maps dated to 1923, could have been infilled with uncontrolled materials and therefore be a potential source of ground gases. However, given the age and size of the infilled pit, ongoing degradation of organic matter resulting in ground gas generation is not expected. Furthermore,

Historical Feature	Distance and bearing from site	Figure 3.4 and Figure 3.5 reference ID	Approx Date Present	Potential geo-environmental impact to the Site
				given its distance from site, any potentially sourced ground gas is unlikely to migrate onto site.
Infilled Unspecified Pit	20m east	E	1887 to 1923	The infilled unspecified pit, which was last observed in the historical maps dated to 1923, could have been infilled with uncontrolled materials and therefore be a potential source of ground gases. However, given the age and size of the infilled pit, ongoing degradation of organic matter resulting in ground gas generation is not expected. Furthermore, given its distance from site, any potentially sourced ground gas is unlikely to migrate onto site.
Firework Factory	150m north	F	1938 to 1982	A large firework factory with associated electrical substation and tanks was present approximately 150m northeast of the Site. This land use is a potential source of heavy metals due to the use of the determinants for colour and stability within fireworks. However, given its distance from site and the underlying groundwater flow direction, any potentially sourced contamination from the firework factory is unlikely to migrate onto site.
Buncefield Oil Depot	West Adjacent	G	1982 to Present	Buncefield Oil Depot is west adjacent to site and therefore a potential source of TPHs. Furthermore, although site uses would not likely generate PFAS, due to the Buncefield incident that occurred in 2005 using firefighting foam, the Site is also a potential source of PFAS.
Numerous historical energy features - electrical substation	West adjacent, 12m west, 98m west, 140m west and 236m west	H	1986 to present	The electrical substations located off-site are expected to be small and therefore, the mass of PCBs released to the environment is expected to be relatively low and the impact localised to the substation. Furthermore, PCBs generally have low mobility in the environment and were banned from the 1979. On this basis, the off-site electricity substations are not expected to have impacted the shallow soils and groundwater beneath the Site.
Unspecified pit	149m north	I	1878	The infilled unspecified pit, which was last observed in the historical maps dated to 1878, could have been infilled with uncontrolled materials and therefore be a potential source of ground gases. However, given the age and size of the infilled pit, ongoing degradation of organic matter resulting in ground gas generation is not expected. Furthermore, given its distance from site, any potentially sourced ground gas is unlikely to migrate onto site.
Sand Pit	169m east	J	1878	The infilled sand pits, which was last observed in the historical maps dated to 1878, could have been infilled with uncontrolled materials and therefore be a potential source of ground gases. However, given the age and size of the infilled pit, ongoing degradation of organic matter resulting in ground gas generation is not expected. Furthermore, given its distance from site, any potentially sourced ground gas is unlikely to migrate onto site.
Garage	204m southwest	K	1974	Given the distance from the Site, the size of the garage, and the depth to groundwater, it is unlikely that TPH from this garage would migrate onto and impact the Site.

Historical Feature	Distance and bearing from site	Figure 3.4 and Figure 3.5 reference ID	Approx Date Present	Potential geo-environmental impact to the Site
Unspecified pit	119m west	L	1878	The infilled unspecified pit, which was last observed in the historical maps dated to 1878, could have been infilled with uncontrolled materials and therefore be a potential source of ground gases. However, given the age and size of the infilled pit, ongoing degradation of organic matter resulting in ground gas generation is not expected. Furthermore, given its distance from site, any potentially sourced ground gas is unlikely to migrate onto site.

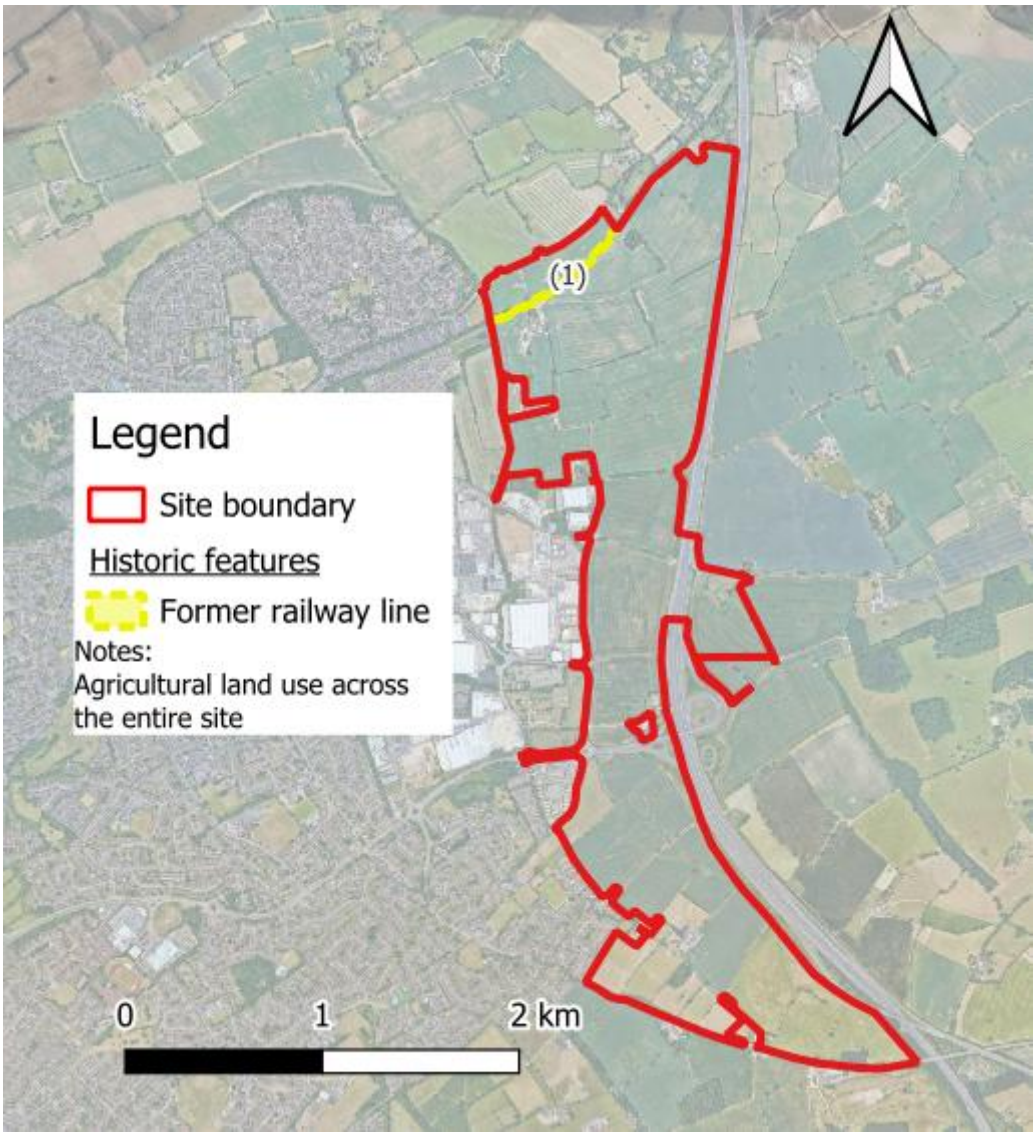


Figure 3.4 Historic on-site uses

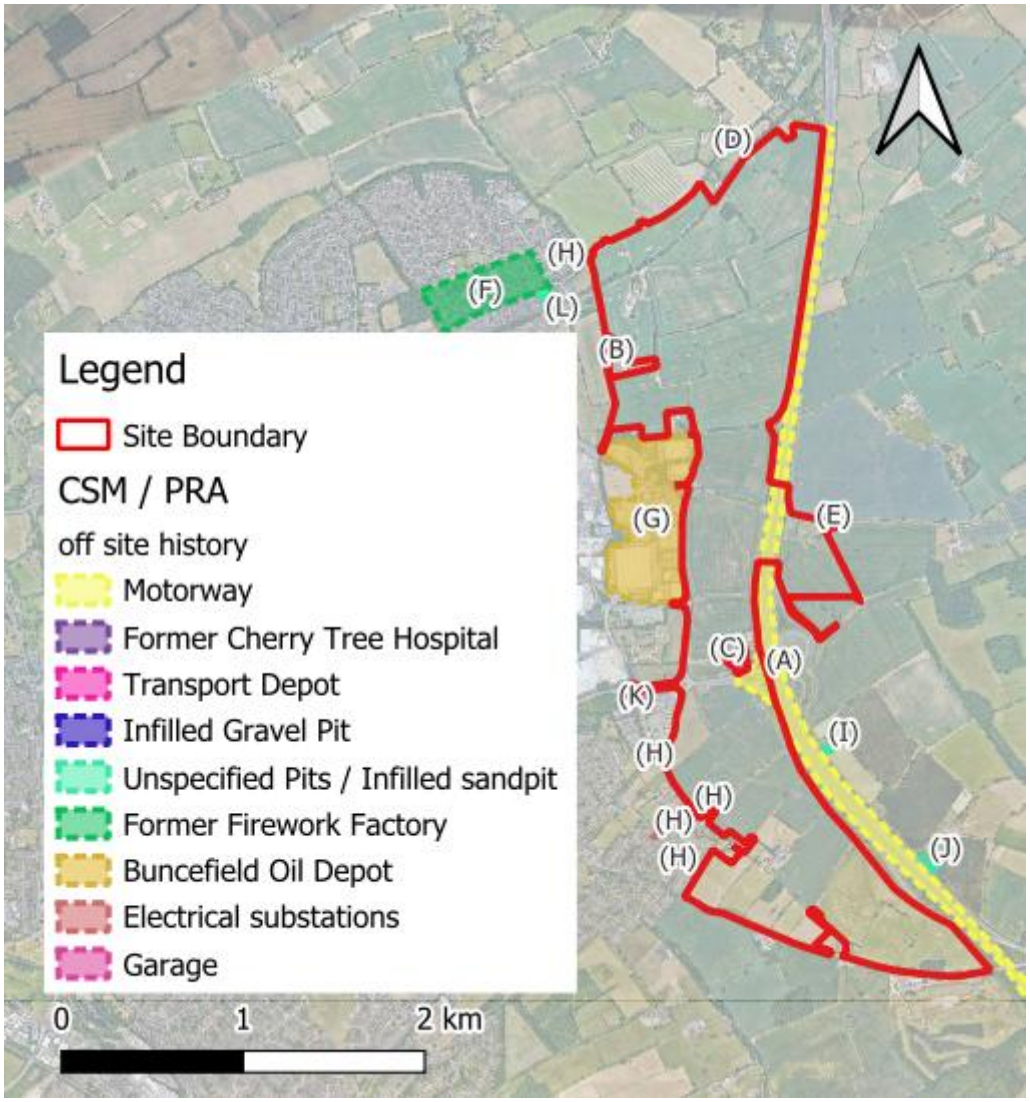


Figure 3.5 Historic off site uses (sources corresponding to Table 3.1)

3.7. Regulatory Data

Regulatory data from the Groundsure Report (supplied as part of the Yellow Sub Desk Study) near the development site within 250m of the Site boundary, but with the inclusion of landfills and other notable infilled ground (if present) within 500m of the Site, has been summarised below. For a full breakdown of the regulatory data, refer to Groundsure Report.

3.7.1. Waste and Landfill

No *historical landfills* have been identified on the Site, and only one has been recorded within a 250m radius. This landfill, located 85m north of the Site, was reported to have accepted inert waste, with its last recorded input in 1963. Based on the anticipated groundwater flow direction and the ongoing degradation of organic matter since the last recorded input in 1963, significant ground gas generation is not expected. For this reason, this historical landfill has not been assessed further as a potential off-site source.

No *waste-licensed sites* are recorded on the Site; however, four are present within a 250m radius. The closest is located 236m southeast, associated with a composting facility at 'Appspond Lane, Potters Crouch'. The second licensed waste site, covering three separate records, is located 243m southeast of the Site and is associated with a wood recycling facility for the treatment of timber. Based on these waste-licensed distance from the Site, they are not assessed further as potential off-site sources of contamination.

There are no *active* or *recent landfills, historical landfills* (as recorded by the BGS or local authority mapping), or *historical waste sites* either on the Site or within a 250m radius.

3.7.2. Recent site uses

The Groundsure report does not list any industrial land uses on site however several have been recorded within a 250m radius of the Site. This includes electrical substation (2m, 7m, 144m and 238m west along with one 24m southwest and 152m northwest), pumping stations (52m southeast and 174m northwest), vehicle parts and accessories (170m west) and a business park (249m west). Based on the distance and size of these land uses, it is unlikely for substantial amounts of potential contamination to be generated and migrate onto and impact the Site. For this reason, they have not been assessed further as potential off-site sources.

The Site has six recorded *Control of Major Accident Hazards (COMAH)* entries. Upon review, all six relate to the Buncefield Oil Depot located immediately east of the subject site. Furthermore, the Groundsure report lists a total of nine records of hazardous substance storage within 250m of the Site, all of which are also associated with the Buncefield Oil Depot.

3.7.3. Discharge Consents

The Groundsure report lists a single on-site *discharge consent* associated with sewage and trade effluent being discharged into an unspecified ditch tributary. This consent was revoked in 2010 and for this reason, the effluent discharge does not represent an significant ongoing source of contamination and has not been assessed further as a potential source of on-site contamination.

A total of 5no *discharge consents* were recorded within a 250m radius of the Site:

- 14m southeast – Treated sewage discharged into the Woolwich and Reading Beds of the Lambeth Group.
- 57m southwest – Sewage discharged into the Chalk aquifer.
- 138m southeast – Treated sewage discharged into groundwater.
- 155m east – Unspecified effluent discharged onto land.
- 166m west – Associated with sewage discharged into ‘Gade’ located at Redbourn Road pumping station

Although these effluent and sewage are being discharged into the underlying groundwater and geology (other than the record 166m west of the Site), due to their distance along with the anticipated groundwater flow direction and ground model, this sewage and effluent are unlikely to migrate onto and therefore impact the Site and future site users. For this reason, they are not assessed further as potential sources of off-site contamination.

3.7.4. Pollution incident (EA/NRW) and releases

On-site records of *Pollution Incidents* include ‘minor impacts’ (Category 3) to land in the central portion of the Site, recorded to be associated with construction and demolition material waste in 2002 located on the M1. In addition, a ‘minor impact’ to land was recorded in the northern portion of the Site, linked to general biodegradable materials and waste likely associated with Cherry Tree Farm. Although they are listed as on-site, these incidents are actually located off-site (on the M1 and west adjacent respectively). Therefore, due to the minor nature of the impact, it is unlikely that contamination from these incidents has migrated onto site and for this reason, they have not been assessed further as potential sources of contamination.

Several *pollution incidents* have been recorded off-site. Only those incidents with an impact to either land and/or water (Category 3 incident or higher) are summarised below. A total of 5no such incidents have been recorded.

- 246m north – Associated with construction waste materials along the motorway.
- 233m northwest – Minor land impact from oils and fuels, linked to the Buncefield site (2003).
- 24m southeast – Minor impact associated with construction and demolition materials related to road works.
- 25m southeast – Minor impact associated with construction and demolition materials related to road works.
- 100m west – Incident in 2003 involving oils and fuels from the Buncefield site.

Off-site incidents within the Groundsure Report were recorded as having only a minor impact on land. Given their distance from the Site, it is unlikely that contamination from these minor incidents is migrating onto the Site and, for this reason, these off-site incidents have not been assessed further. However, it is important to note that the incidents listed in the Groundsure Report does not reflect the 2005 Buncefield incident which is a significant former pollution incident that should be assessed further.

A total of 2no *licensed pollutant releases (Part A(2)/B)* have been recorded off-site: one located 57m northwest, associated with the Buncefield Oil Depot, and the other 244m southwest, associated with petrol storage at a service station. As both of these are listed under a 'Type B' permit they are associated with air emissions and therefore have not been assessed further as potentially impacting the Site. No *licensed pollutant releases* are recorded on-site.

3.8. Flood Risk

Flood Maps for Planning (ref. https://flood-map-for-planning.service.gov.uk/, accessed 9th September 2025) indicates that the Site is located in a Flood Zone 1 i.e. there is a low probability of flooding.

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

3.9. Ecology, Flora and Fauna

No records of potentially sensitive ecological receptors as defined by the *Environmental Protection Act (1990) Part 2a (as amended)* have been identified on-site however, an *ancient woodland* named 'Blackwater Wood' is record 234m south of the Site.

The Site is listed as being within a *Green Belt* and *SSSI Impact Risk Zone*.

An assessment of potential invasive species is not included in this report.

3.10. Planning Records

The Local Authority Planning Portal has been searched for relevant records with relevant geo-environmental documentation located both on site and within the vicinity (50m radius) of the Site.

No relevant geo-environmental documentation was identified on site in the planning portal, including the documentation mentioned in Section 1 of this report supplied by the client which is discussed further in Section 4. However, the following planning applications were observed in close vicinity to the Site with relevant geo-environmental documentation.

The locations of these applications in relation to the Site can be view below as Figure 3.6.

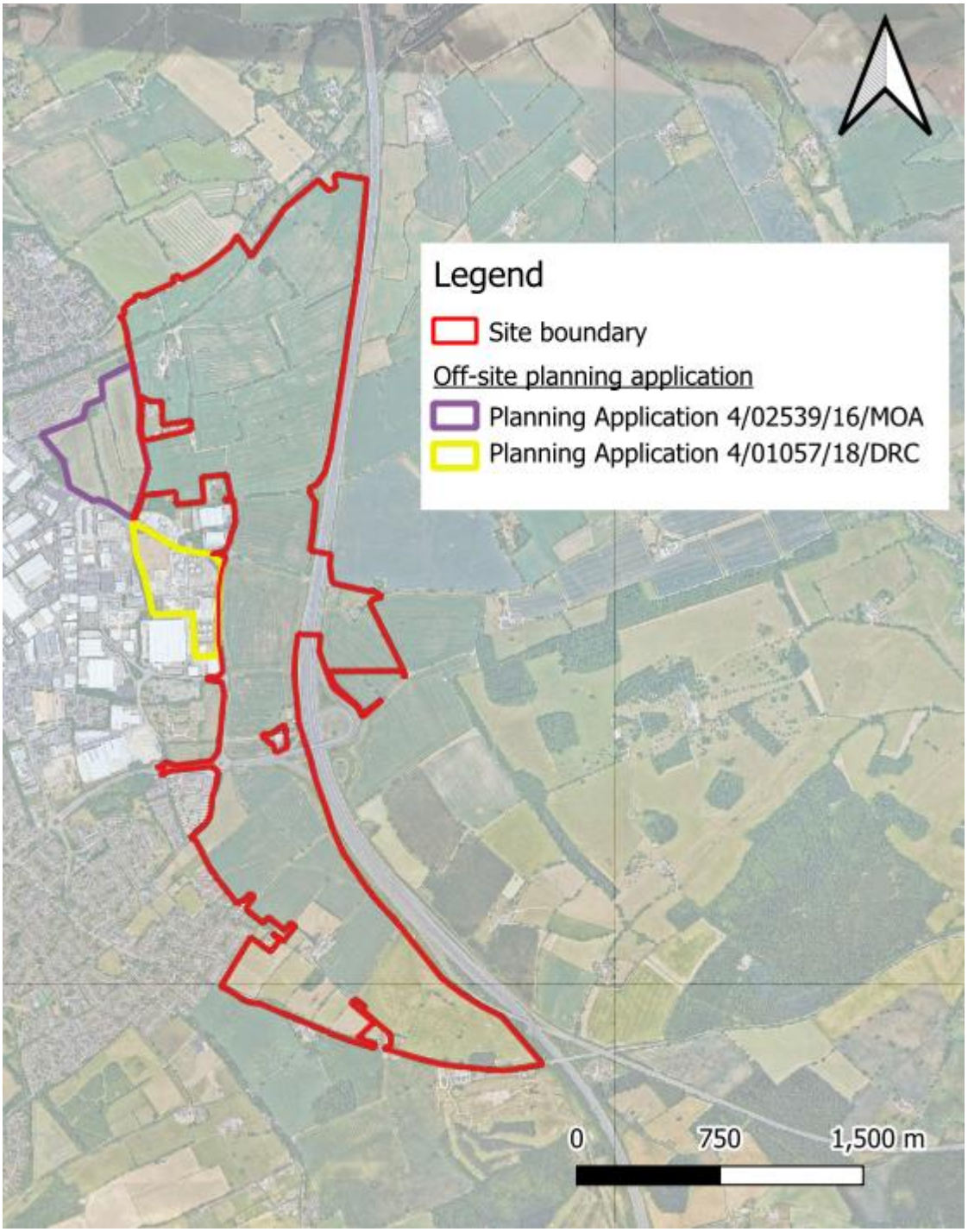


Figure 3.6 Planning application boundaries

3.10.1. Planning Application 4/02539/16/MOA

Planning Application 4/02539/MOA is located west adjacent to the Site and is described as '*Outline planning application to include up to 600 dwellings (c3), land for primary school (d1), land for local centre uses (a1,a3,a4,a5,d1,d2), land for up to 7,500 square metres of employment uses (b1,b2,b8), landscaping, open space and play areas, associated infrastructure, drainage and ancillary works, new roundabout access off three cherry trees lane, new priority junction off three cherry trees lane, new vehicular access to spencer's park phase 1 and an emergency access to the employment land off cherry tree lane. Detailed approval is sought for access arrangement only, with all other matters reserved*'.

As part of the planning application, the following documentation was observed:

- The Crown Estate + The Homes & Communities Agency, Spencer's Park Phase 2, Environmental Statement Volume 1: Main Text,(ST14699) produced by Wardell Armstrong dated July 2016
- The Crown Estate + The Homes & Communities Agency, Spencer's Park Phase 2, Preliminary Ground Conditions Assessment (ST14699), produced by Wardell Armstrong dated July 2016

The Environmental Statement produced by Wardell Armstrong includes a Ground Conditions and Contamination Chapter (Chapter 9) which summarises the likely significant effects of the Proposed Development in terms of ground conditions in the context of the Planning Application 4/02539/16/MOA site and its surrounding area. This Chapter 9 included a review of a Preliminary Ground Conditions Assessment report produced by Wardell Armstrong which included a CSM summarising the potential sources effecting the Planning Application 4/02539/16/MOA site as the Buncefield incident, the Sites former agricultural use and a former demolished structure located within the Site. Based on the CSM, a PRA was produced by Wardell Armstrong which identified a maximum 'moderate risk' to future site users, 'low' risk to vegetation, 'high' risk to groundwater, 'low' risk to surface waters and a 'moderate to high' risk from ground gases.

Following this PRA, a ground investigation was undertaken in which no visual or olfactory evidence of contamination was encountered. The investigation included the collection of soil samples and ground gas monitoring (from boreholes installed with monitoring wells) undertaken on two occasions. Ground gas monitoring recorded a maximum CO_2 reading of 1.4%, maximum CH_4 reading of <0.1% and no measurable flow.

Findings of the investigation concluded that additional investigation was required due to the elevated nickel concentration detected within the underlying superficial deposits and to further investigate potential impacts to ground water sourced from the former Buncefield incident.

The council approved Planning Application 4/02539/16/MOA on the 30th April 2019 with conditions. Of these conditions, only one was in relation to contamination, however, this relates only to unexpected contamination encountered during the construction.

3.10.2. Planning Application 4/01057/18/DRC

Planning Application 4/01057/18/DRC is located west adjacent to the Site and is described as '*Details required by condition 3 (contamination) and 4 (contamination) attached to planning permission 4/01536/17/ful - installation of overflow pipes to existing fuel tanks, protective coating to tanks, foam house, alterations to existing bund and addition* [sic]'

As part of the planning application, the following documentation was observed:

- Preliminary Risk Assessment, Environmental Risk Assessment, Environmental Summary Report and Remediation Strategy (ref: 2968510110), produced by Arcadis UK Limited, dated April 2018

Arcadis UK Limited (Arcadis) was commissioned by BP Oil UK Limited (BP) to provide support in relation to the discharge of planning conditions at the BP Hemel Hempstead Terminal. As part of the Preliminary Risk Assessment report, several environmental reports were reviewed. The CSM in the report lists several sources of contamination which include fuel storage on site, interceptors/separators, surface spillages, vehicle maintenance buildings, imported Made Ground and the use of firefighting foam as part of the Buncefield fire incident.

The report states that, based on previous investigation undertaken on the Site, a Detailed Quantitative Risk Assessment (DQRA) was required. The model outputs of the subsequent DQRA undertaken by Arcadis were supported by sampling data obtained which concluded that the vertical mitigation of impacts into the unsaturated zone was limited and that the Clay-with-flints Formation afforded adequate protection to the underlying aquifer. Furthermore, PFAS concentrations (likely associated with the Buncefield incident) in soil and perched groundwater were considered to likely either remain stable or improve with time as no continuing source was

identified. Based on the finding of the DQRA, no remediation was deemed necessary other than if unexpected contamination is encountered during construction.

The council approved Planning Application 4/01057/18/DRC on the 28th of April 2018 with the Site continuing to be used for commercial/industrial uses.

3.11. Regulatory Consultation

The Environment Agency was contacted for pre-application advice in September 2014 regarding a previous development associated with the Site (as discussed in Section 0), during which environmental concerns were identified. These concerns related to the explosion and fire at the adjacent Buncefield Oil Depot in December 2005, which resulted in contamination of the surrounding area with PFOS and hydrocarbons such as benzene and xylene. The Environment Agency response concluded that any development associated with the Site should avoid interfering with groundwater flow, and that soakaways as part of Proposed Developments would be highly unlikely to be acceptable due to the potential risk of moving contamination plumes into currently unaffected areas of the aquifer.

Following this initial interaction, the Environment Agency was contacted by Expedition for their consultation on a groundwater testing specification supplied in December 2024 in relation to the proposed masterplan development discussed in Section 2.4. The Environment Agency reviewed this document and concluded that, depending on the finding of the monitoring, more monitoring wells would be required to assess areas not previously investigated. In addition, the Environment Agency stated that PFAS testing in addition to fertilisers, pesticides, insecticides and herbicides should be undertaken on groundwater samples due to the Sites predominant use as agricultural fields and due to the former Buncefield incident.

A-Squared contacted the Environment Agency on 27th March 2025 with an updated groundwater testing specification in relation to the Proposed Developments associated within this report. This correspondence outlined the intention to complete an initial round of groundwater sampling to assess changes to the plume(s) of contamination associated with the Buncefield Oil Depot incident, as previously identified in investigations undertaken in 2017. This initial groundwater monitoring round was intended to provide an updated baseline condition to support the development of a CSM for submission as part of an Outline Planning Application. Additionally, it was noted that initial soakaway testing would also be undertaken in the areas of the proposed attenuation ponds to assess ground conditions and soil permeability, in support of the proposed drainage strategy.

The Environment Agency replied to this correspondence on 4 April 2025, stating that the proposed approach was acceptable. Correspondence with the Environment Agency is presented as Appendix B.

4. Ground Investigations

Several previous phases of investigation have been undertaken on site which are summarised in Section 4.1 to Section 4.3 below with further ground condition discussions provided in Section 5.

4.1. Wardell Armstrong 2017

4.1.1. Preliminary Groundwater Assessment

Thames Water and Hertfordshire District Council (as the Local Lead Flood Agency) advised that soakaway drainage for a former development proposed for the Site was to be investigated as an option for surface water disposal for the Proposed Development. It was assumed that soakaway drainage would be discharged to deep groundwater within the underlying chalk aquifer that underlies both the Site and the adjacent Buncefield Oil Depot site. The Environment Agency raised concerns with this as the soakaway drainage could risk altering groundwater flows within the aquifer, such that groundwater contamination from the Buncefield Incident could be caused to migrate into areas of the aquifer that were currently unaffected.

For this reason, a site investigation was undertaken by Van Elle Ltd (supervised by Wardell Armstrong) between the 9th of January and the 27th of February 2017, with subsequent monitoring rounds and laboratory testing. As part of this investigation, the Site was divided into four areas (Area A, B, C and D, see Figure 2.1) depending upon proposed end use.

The site investigation consisted of the following:

- 21no. Openhole rotary boreholes drilled down to a depth of between 25m and 68mbgl (A1, A2, A4 to A7, A9 to A11, B3, C1 to C5, C7, D1, D3 and D4).
- 7no. Rotary cored boreholes were drilled to a depth of between 19.5m and 68.0mbgl (A3, A8, B1, B2, C6, C8 and D2).
- 52no In-situ variable head permeability tests within all boreholes to carried out in general accordance with CIRIA 211 (two tests per boreholes).
- 3no return groundwater sampling rounds.

The site investigation plan for the above listed works can be observed below as Figure 4.1

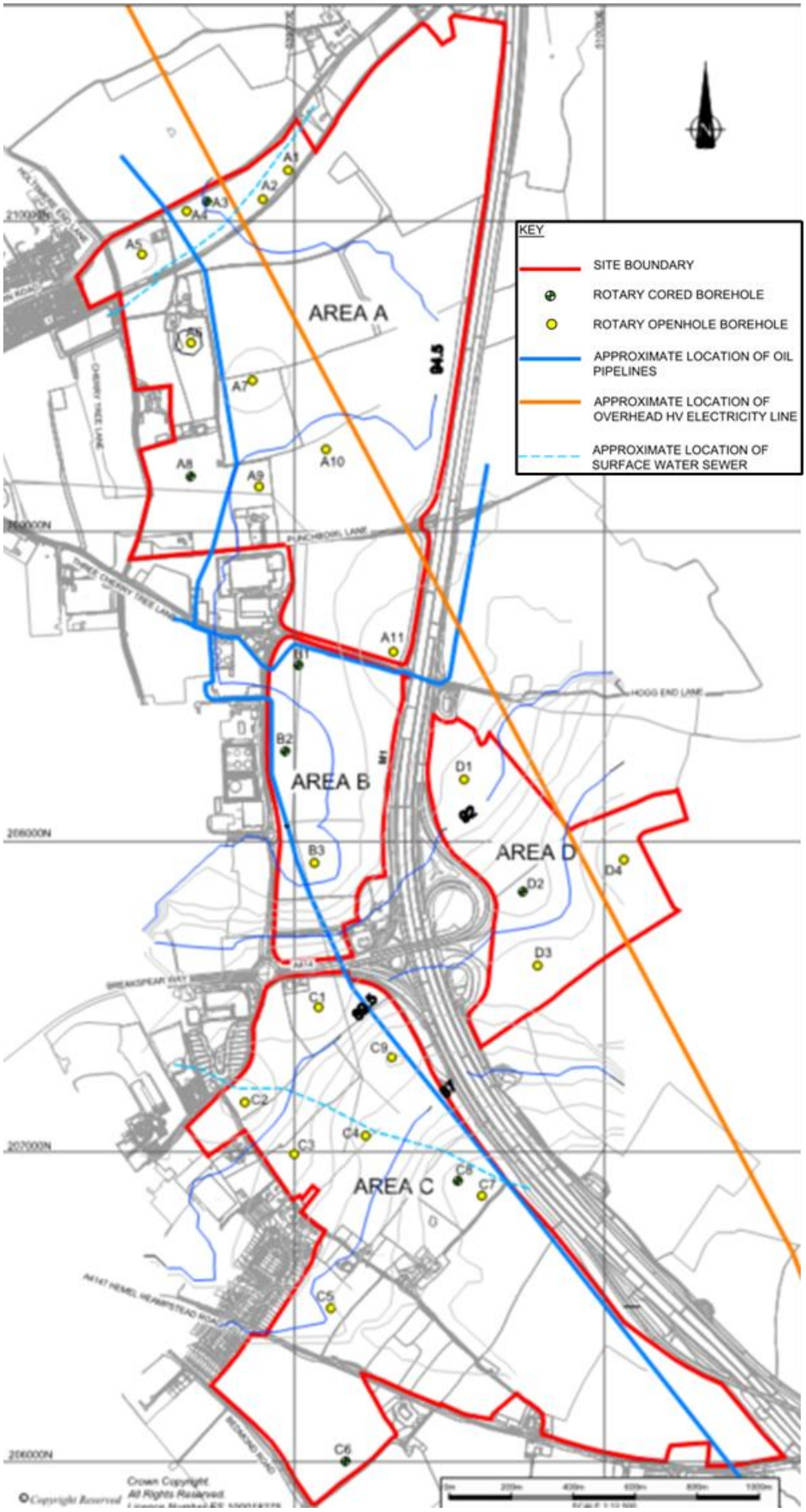


Figure 4.1 Wardell Armstrong 2017 Preliminary Groundwater Assessment investigation plan

4.1.2. Preliminary Ground Condition Assessment

Wardell Armstrong undertook a Preliminary Ground Condition Assessment in December 2017 in which documentation and correspondence with local bodies were reviewed. Following this review, a qualitative risk assessment was undertaken in general accordance with the regulatory framework (at the time of writing) for contaminated land risk assessments and related technical guidance (e.g. DEFRA/Environment Agency publication CLR 11 "Model Procedures for the Management of Land Contamination" and CIRIA C552 "Contaminated Land Risk Assessment: A Guide to Good Practice"). As part of this qualitative risk assessment, Wardell Armstrong produced a CSM which highlighted the potential on-site sources of Made Ground and agricultural uses in addition to the off-site Buncefield incident. Following to construction of a CSM, a PRA was completed.

The PRA produced by Wardell Armstrong concluded that there was a 'moderate' risk to future site users and a 'low to moderate' risk to construction workers in relation to direct contact, ingestion and inhalation of soil along with the inhalation of vapours and ingestion of vegetables impacted by Made Ground / affected as part of the Sites former land uses. In relation to potential ground gas sourced from on-site Made Ground and soils affected by the historic land uses, Wardell Armstrong assessed risks to humans and buildings as a 'low to moderate' risk. In relation to controlled water receptors of the underlying Principal Aquifer (Chalk Formation) and surface water feature (River Ver), risks from on-site sources were assessed as 'high' and 'moderate' respectively whilst risk to vegetation were assessed as 'low'.

Based on this PRA, a site investigation was undertaken which consisted of the following:

- 3no trial trenches were excavated to a maximum depth of 3.80mbgl (TT1 to TT3).
- 46no trial pits were excavated to a maximum depth of 3.30mbgl (TP01 to TP46).
- 5no cable percussive borehole were drilled down to 10mbgl (CPR01 to CPR05).
- 2no rotary boreholes were drilled to a depth of 20mbgl (RC1 and RC01).
- 5no soakaway pits were excavated to a maximum depth of 2mbgl (S1 to S3, S4a and S5).
- Gas monitoring was undertaken at the five cable percussive boreholes (CPR01-CPR05) on one occasion (23 December 2014).

The site investigation plan for the above listed works can be observed below as Figure 4.2

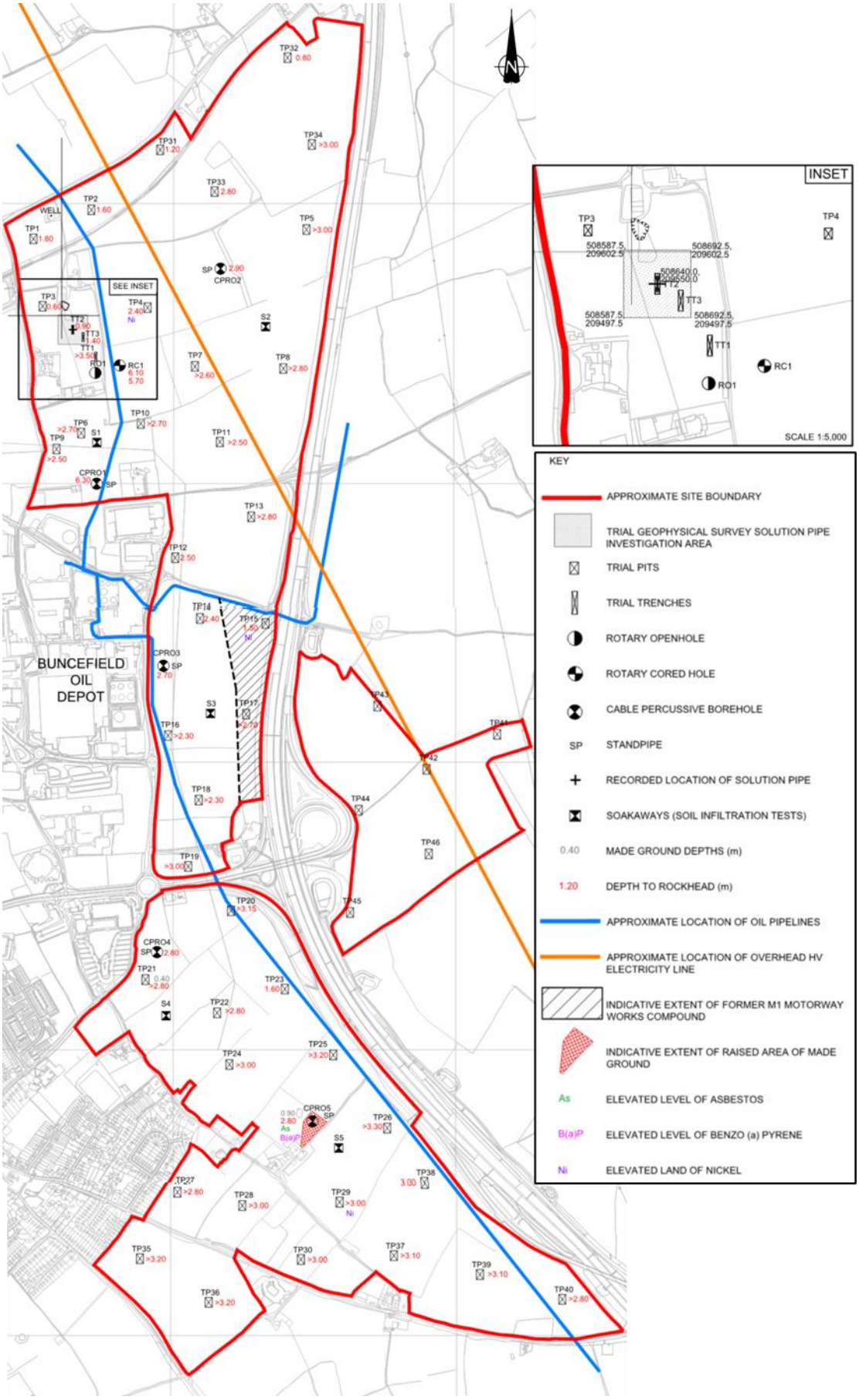


Figure 4.2 Wardell Armstrong 2017 Preliminary Ground Condition investigation plan

4.2. CC Ground Investigations Ltd 2020

An investigation was carried out by CC Ground Investigations Ltd (CCGI) on the instruction and on behalf of The Crown Estate under the technical direction of Wardell Armstrong. The purpose of the ground investigation was to provide geotechnical and geo-environmental data assess the ground conditions and assist in preliminary design of earthworks, noise bunds and proposed highways routes as part of previous proposed site development.

The site investigation was undertaken by CCGI between the 16th of September 2019 and the 29th of October 2019 consisting of the following:

- 38no Multipurpose boreholes (dynamic sample with rotary core follow on) to a maximum depth of 20.7mbgl (MP1001 to MP1038)
- 50no Cable percussive boreholes to a maximum depth of 20mbgl (CPBBH1001 to CPBH1050)
- 109no Windowless sample boreholes to a maximum depth of 5.0mbgl (WS1001 to WS1108 and WS10553A)
- 107no Trial pits to a maximum depth of 4.0mbgl (TP1001 to TP1107)
- 2no BRE365 soakaway tests (TP1022 and TP1024)
- 100no California Bearing Ratio tests to a maximum depth of 0.91mbgl (CBR1001 to CBR1100)
- Installation of 19 standpipes at selected locations (MP1015, MP1038, CPBH1004, CPBH1006, CPBH1009, CPBH1011, CPBH1018, CPBH1020, CPBH1024, CPBH1028, CPBH1032, CPBH1037, CPBH1039, CPBH1041, CPBH1044 to CPBH1047)

The site investigation plan for the above listed works can be observed below as Figure 4.3.

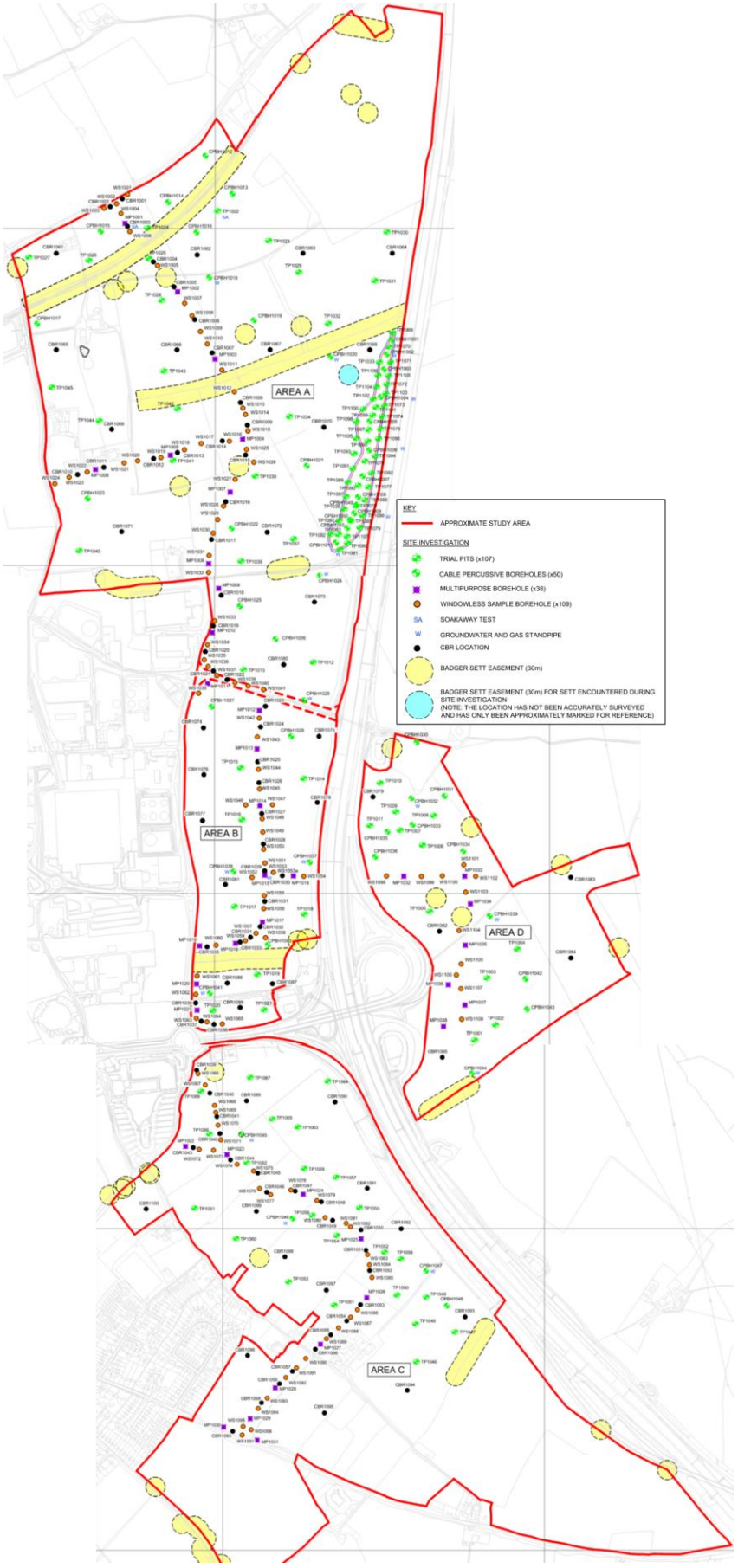


Figure 4.3 CC Ground investigation plan

4.3. A2SI 2025

4.3.1. New Groundwater Baseline Condition

A round of groundwater sampling was undertaken between the 22nd and 23rd of July 2025 by A2 Site Investigation Ltd (A2SI) with A-squared acting as the investigation supervisor. Details of the ground investigation findings are presented in the *Factual Report* (as referenced in Section 1), which is included as Appendix C.

The primary purpose of the ground investigation was to collect groundwater samples for laboratory chemical analysis to provide an updated baseline condition for the Site. For this reason, sampling included the same testing undertaken by Wardell Armstong in 2017 in addition other contaminants of concern raised by the Environment Agency which included fertilizers, pesticides, insecticides, herbicides due to the use of site as agricultural land.

The general scope of the investigation is summarised as follows:

- Inspection of former monitoring wells installed as part of the 2017 Wardell Armstong Preliminary Groundwater Assessment (A1 to A11, B1 to B3, C1 to C8 and D1 to D4.
- A single return groundwater elevation monitoring rounds with low flow sampling techniques.

Of the former monitoring wells, the only locations which could be found and sampled were A3 to A6, A8, A11, B1 to B3, C1, C3 to C6, C8 and D2 to D4. The other locations (A1, A2, A7, A9, A10, C2, C7 and D1) could not be found or were block / damaged.

A series of in-situ and laboratory geo-environmental tests were performed as part of the investigative. This included quality assurance / quality control (QA/QC) testing during the groundwater sampling round in the form of Trip Blanks, duplicates, equipment rinse blank to determine potential PFAS impacts to the samples during the monitoring process.

Geo-environmental Laboratory Testing (Groundwater):

- 14no. BOD
- 14no. TPHCWG
- 14no. PFAS Broad Suite
- 14no. pH
- 14no. SVOC
- 14no. VOC
- 14no. Hardness (as $CaCO_3$)
- 14no. PAHs
- 14no. Heavy metals and metalloids
- 14no. TOC
- 14no. DOC
- 14no. Sulphate as SO_4
- 14no. Nitrogen
- 14no. Nitrite
- 14no. Nitrate
- 14no. Chloride
- 14no. Ammoniacal Nitrogen
- 14no. Organochlorine Pesticides

QA/QC Laboratory Testing (Groundwater):

- 6no. BOD

- 6no. TPHCWG
- 10no. PFAS Broad Suite
- 6no. pH
- 6no. SVOC
- 6no. VOC
- 6no. Hardness (as $CaCO_3$)
- 6no. PAHs
- 6no. Heavy metals and metalloids
- 6no. TOC
- 6no DOC
- 6no. Sulphate as SO_4
- 6no. Nitrogen
- 6no. Nitrite
- 6no. Nitrate
- 6no. Chloride
- 6no. Ammoniacal Nitrogen
- 6no. Organochlorine Pesticides

Laboratory testing was undertaken by ALS Global Ltd (ALS), a United Kingdom Accreditation Service (UKAS) accredited laboratory.

The PFAS Borad suite provided by ALS contains a total of 50no different PFAS compounds of which 48no are included in the latest DWI list – it is noted that the ALS laboratory reports include a Total DWI 47 PFAS concentration as the ALS suite of testing had not been updated at the time the investigation was being commissioned to include the DWI 48 PFAS (released in January 2025), although the 6:2 FTAB compound (which took the DWI suite from 47 to 48 PFAS) is included within the ALS suite of testing. The breakdown of the PFAS compound suites can be observed as part of Appendix D.

4.3.2. QA/QP checks

4.3.2.1. Equipment Blanks

An equipment blank is a quality control sample used to assess potential contamination from sampling equipment during field activities. It typically involves rinsing decontaminated sampling equipment with laboratory-grade water, which is then collected and analysed under the same conditions as the environmental samples. During the monitoring round, an equipment blank was collected and analysed each day for PFAS to verify the effectiveness of the decontamination procedures and to ensure that the sampling equipment did not introduce contamination into the groundwater samples. None of the testing undertaken on the equipment blank was recorded above the laboratory detection limit and therefore the equipment is unlikely to have significantly affected the groundwater samples collected.

4.3.2.2. Trip Blanks

A Trip Blank is a quality control sample consisting of laboratory-grade water that accompanies sample containers throughout the sampling, transport, and storage process but is not opened during field activities. It is used to assess the potential for contamination during transport or handling. During the monitoring round, Trip Blank was included. These samples were tested alongside the groundwater samples under the same laboratory conditions. Trip Blank 1 was scheduled and transported with the groundwater samples collected from A3, A6, B 1 to B3, C1, C3, C4, C6 and C8. Trip Blank 2 and Trip Blank 3 were scheduled and transported with groundwater samples collected from C5 and D2 to D4.

The following contaminants were observed to exceed their respective limit of laboratory detection in each of the Trip Blank samples:

- Trip Blank 1 – barium, zinc and copper
- Trip Black 2 – barium, chloride, hardness, nitrate, sulphate,
- Trip Blank 3 – barium, bis(2-ethylhexyl)phthalate, DOC, chloride, sulphate, nitrate and hardness

Compounds detected above their respective limits of detection in the Trip Blank were generally the same across samples. The concentrations above the detection limit indicates that there may have been some contamination introduced during sample transport or handling of the samples effecting the integrity of the results.

4.3.2.3. Duplicate Samples

A duplicate sample was collected from C3 (Dup 1), C4 (Dup 2) and D2 (Dup 3) during the monitoring round as part of routine QA procedures. Of these samples, exceeds of the Relative Percent Difference (RPD) threshold of 30% for the following were identified:

C3 and Dup 1

- PFBA (40%)
- 3:3 FTCA (109.7%)
- PFBS (30%)
- PFHxA (33%)
- PFHpA (31%)
- PFOA (33%)
- PFHxS (103%)
- PFNA (44%)
- Linear PFOS (48%)
- Total PFOS (40%)
- Total PFAS DWI 47 (31%)
- Copper (81%)
- Zinc (84%)
- Chloride (61%)
- TOC (50.6%)

C3 and Dup 2

- Branched PFOS (47%)
- Aromatics >EC21-EC35 (95%)
- Total Aromatics >EC12-EC35 (95%)
- Total Aliphatic & Aromatics >C5-35 (95%)
- Lead (83%)
- Zinc (42%)
- Nickel (74.6%)
- Phosphate (Ortho as P) (37%)
- TOC (117.2%)
- Suspended Solids (66%)
- Hardness (58%).

D2 and Dup 3

- Suspended Solids (199%)

- PFOA (134%)
- Nitrate (195%)
- Nitrogen total (195%)
- Chromium (78%)
- Copper (35%)
- Zinc (78%)
- Hardness (164%)
- Total Aliphatic & Aromatics >C5-35 (186%)
- Carbon, Organic (32%)
- Aromatics >EC21-EC35 (141%)
- Total Aromatics >EC12-EC35 (141%)

The highest RPD for each sample was observed to be 109.7%, 117.2% and 199% for duplicate sample Dup 1, Dup 2 and Dup 3 respectively. It is also important to note that for several of the compounds in the samples, concentrations were reported as below the limit of detection (i.e., "<"). These results may indicate some variability, and as such, additional sampling is recommended with duplicate sampling to build a more robust and reliable dataset. However, it is important to note that concentrations are generally recorded at relatively low levels (µg/l), meaning that even small changes can result in proportionally large differences in calculated values.

The RPD comparison between the duplicate and corresponding samples can be viewed as Appendix E.

5. Ground and Groundwater Conditions

5.1. Ground conditions

The ground conditions described within the previously investigations comprise topsoil, or locally limited thickness of Made Ground, over superficial deposits and Chalk. The soils above the Chalk have not been differentiated further than 'superficial deposits', i.e. no differentiation between Clay-with-flints Formation and Lambeth Group (and no identification of Head Deposits). A summary is provided in Table 5.1.

Table 5.1 Summary of ground conditions

Stratum	Depth (mbgl)	Level (mOD)	Thickness (m)	Notes
Topsoil	GL	105.3 to 139.61	0.1 to 1.2	
Made Ground	GL	117.5 to 136.47	0.15 to 1.2	Encountered in the following locations only: CPBH1024, CPBH1025, CPBH1026, CPBH1027, CPBH1028, CPBH1029, CPBH1038, CPBH1039, CPBH1040, CPBH1045, MP1008, MP1009, MP1010, MP1022, TP1019, TP1020, TP1021, CPR05
'Superficial Deposits'	0 to 1.2	104.98 to 139.31	0.1 to 21.3	Thickness range where base of stratum not encountered: >2m to >19.7m
Chalk	0.2 to 21.5	100.79 to 134.25	n/a	Structured chalk encountered at 2.7mbgl to 18.5mbgl (92.87mOD to 132.04mOD) in the following locations: MP1001, MP1003, MP1004, MP1005, MP1006, MP1007, MP1008, MP1009, MP1010, MP1011, MP1012, MP1013, MP1014, MP1015, MP1016, MP1017, MP1018, MP1020, MP1022, MP1023, MP1024, MP1025, MP1026, MP1028, MP1029, MP1030, MP1031, MP1032, MP1033, MP1034, MP1035, MP1036, MP1038, TP1016, TP1019.

Further consideration of the ground model for the Site is provided in Section 6.3.

5.2. Visual / olfactory evidence

During the site investigations, no visual/olfactory evidence of contamination was encountered.

5.3. Groundwater

Groundwater data from the Wardell Armstong 2017 Preliminary Groundwater investigation encountered groundwater depths on site ranging from 12.65mbgl and 53.77mbgl (84.56mOD to 96.27mOD) within the White Chalk Subgroup. Groundwater level contours during the investigation general indicated an easterly groundwater gradient within the chalk in the north and centre of the Site, and a general southeasterly groundwater gradient in the south of the Site. Localised perched water may also be present associated with any Made Ground at the Site.

A summary of the groundwater depths/levels during the return monitoring round undertaken between the 22nd and 23rd July 2025 are shown below in Table 5.2.

Table 5.2 Groundwater depth/elevation

Monitoring Well Location	Groundwater elevation (mOD)	Groundwater depth (mbgl)
A3	96.12	10.97
A6	95.56	34.5
A8	94.90	39.5
B1	95.34	30.91
B2	96.02	37.07
B3	95.66	40.43
C1	91.5	37.05
C3	92.01	32.79
C4	88.32	26.91
C6	86.63	52.98
C8	85.74	30.53
D2	91.46	45.32
D3	90.09	43.73
D4	89.26	41.83

Groundwater elevations collected during each round have been plotted and displayed as Figure 5.1 to Figure 5.3, broadly indicating a south-eastly groundwater flow across the Site. However, it is noted that groundwater flow in the area is likely to be complex and highly influenced by fracture flow in the chalk, rather than matrix flow.

Similar to the Wardell Armstong investigation, groundwater elevations collected during the A2Si investigation also indicate a general groundwater flow to a southeasterly direction as can be observed in Figure 5.4.

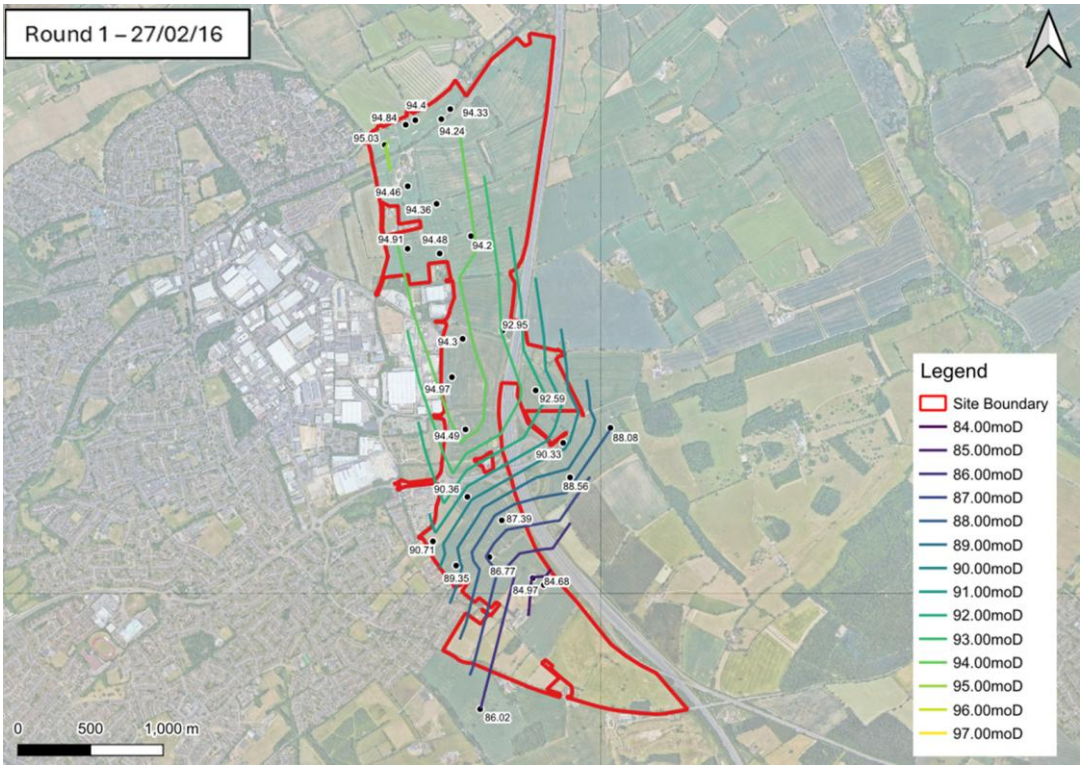


Figure 5.1 Wardall Armstong groundwater elevation plots (round 1)

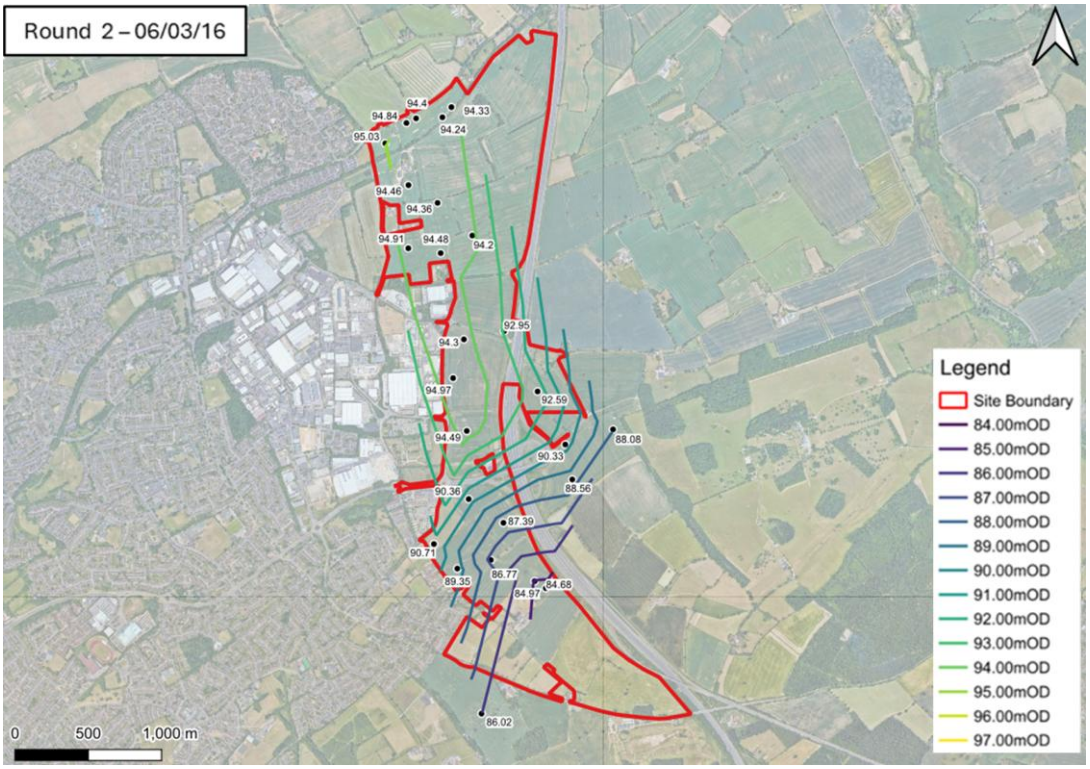


Figure 5.2 Wardall Armstong groundwater elevation plots (round 2)

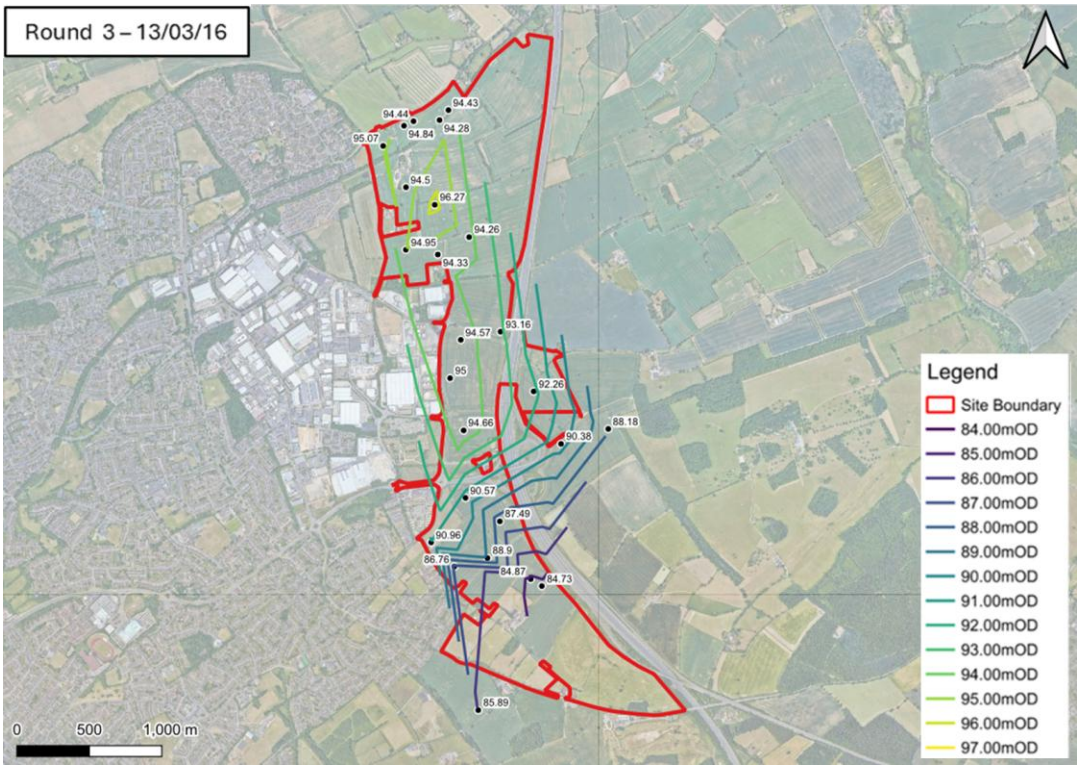


Figure 5.3 **Wardall Armstong groundwater elevation plots (round 3)**

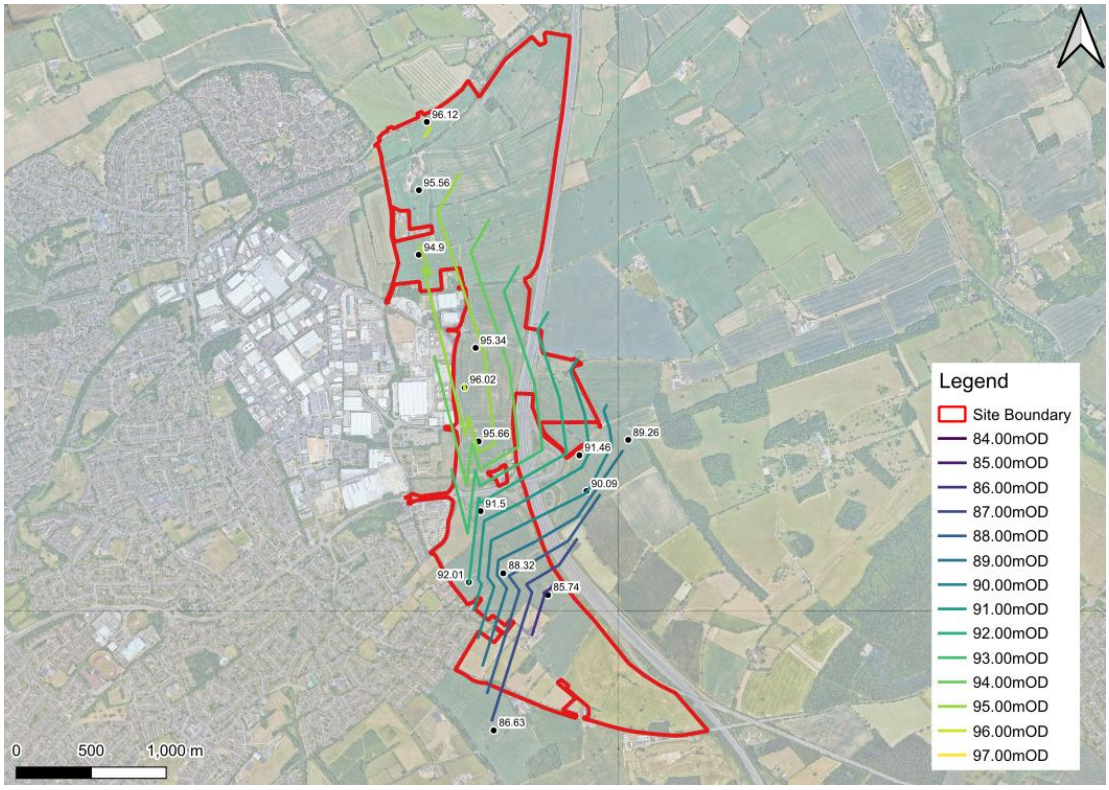


Figure 5.4 **A2SI groundwater elevation plots**

6. Geo-hazard Appraisal

6.1. Background

The key geo-hazard present at the Site relate to chalk dissolution features, but may also include Head Deposits and historical chalk mining.

Dissolution features in the Chalk Group develop where slightly acidic meteoric waters dissolve calcium carbonate along pre-existing joints, fissures, and bedding planes. During periglacial conditions, seasonal thaw-freeze cycles increased infiltration of meltwaters, promoting rapid enlargement of solution voids. Post-glacial hydrological regimes sustained dissolution and sometimes led to collapse or subsidence of near-surface chalk, creating irregular hollows, pipes, enlarged fissures, and pinnacled surfaces. Local contrasts in permeability, such as at the Chalk-Lambeth Group contact, focused groundwater flow and enhanced solutional activity.

The occurrence / prevalence of dissolution features may be summarised as follows:

- Shallow rockhead zones: Dissolution features are commonly found within a few metres of the Chalk surface, reflecting direct periglacial meltwater interaction.
- Valley slopes and interfluves: Concentrated groundwater pathways promoted the development of solution pipes and hollows.
- Lithological boundaries: Chalk-Lambeth Group contacts often host more pronounced solution features due to permeability contrasts – this may also be the case for the Chalk/Clay-with-flints Formation contact, depending in the lithology of the Clay-with-flints Formation.

Such features represent a post-periglacial modification of the Chalk surface, overprinting earlier weathering forms and producing a highly irregular rockhead morphology.

Chalk dissolution features pose several potential hazards, including:

1. Foundation instability: Solution hollows and pipes can create voids beneath the surface, increasing the risk of differential settlement or collapse.
2. Slope instability: Enlarged fissures and pinnacled surfaces may act as failure planes for shallow landslides or solifluction in post-glacial slopes.
3. Groundwater vulnerability: Solutional conduits can alter subsurface flow paths, affecting borehole stability, drainage, and contamination migration.

Periglacial and post-glacial dissolution features illustrate the dynamic response of the Chalk Group to hydrological and climatic forcing. Understanding their formation, distribution, and prevalence relative to the Chalk–Lambeth Group stratigraphy is essential for both geological interpretation and engineering risk assessment.

6.2. Digital Imagery Assessment

A digital imagery assessment has been undertaken to evaluate the distribution and orientation of dissolution-related features within the Site and the wider surrounding area. Aerial photographs/satellite images and LiDAR-derived digital terrain models (DTMs) were analysed to identify circular and sub-circular depressions in the landscape. These depressions are interpreted, under the working assumption, as the surface expression of infilled or partially collapsed sinkholes developed in response to chalk dissolution. Their occurrence is strongly influenced by the presence of prominent joint sets in the Chalk, which act as preferential pathways for groundwater circulation and zones of weakness susceptible to solutional enlargement.

The analysis sought to identify individual depressions, quantify their size and morphology, and examine their spatial arrangement. Where depressions occur in linear or curvilinear alignments, these are considered indicative of dissolution features guided by underlying joint networks. By “joining the dots” between aligned suspected sinkholes, it may be possible to infer both the orientation

and approximate spacing of the dominant joint sets. These orientations can then be compared with the trend of dry valleys, which are thought to have partially developed along the same structural planes of weakness, reinforcing the interpretation of joint-controlled geomorphology.

The outcome of the assessment is a framework for understanding how dissolution features are distributed relative to joint geometry. This may enable the identification of zones of greater susceptibility to subsidence or collapse. Areas with dense clusters of depressions, strong alignments, and spatial coincidence with valley axes are considered of higher concern. The mapping of such zones provides a targeted basis for follow-up investigation, directing geophysical surveys and intrusive ground investigation to locations where dissolution features are most likely to present engineering or hydrogeological risks.

By establishing the relationship between sinkhole frequency, joint orientation, and valley development, it is possible to characterise dissolution hazards more effectively and provide a robust evidence base for risk management in Chalk terrains.

The DTM for the Site and surrounding area is presented as Figure 6.1 – it is noted that numerous relatively smooth and circular surface depressions are present in the wider area, potentially representing the surface expression of dissolution features. These features are annotated on Figure 6.2 to show the approximate diameter of features. The features have been cross-checked against aerial images.

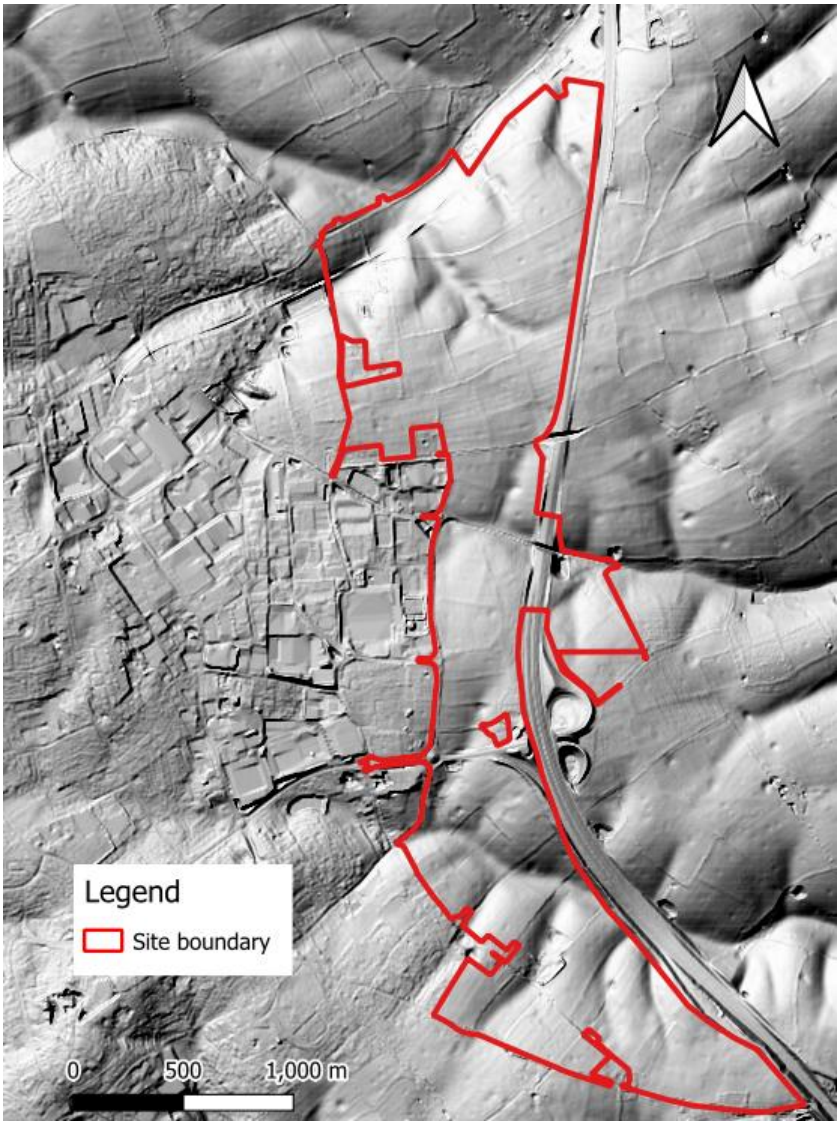


Figure 6.1 Hillshade map derived from LiDAR DTM (1m resoution) at 10x vertical exageration

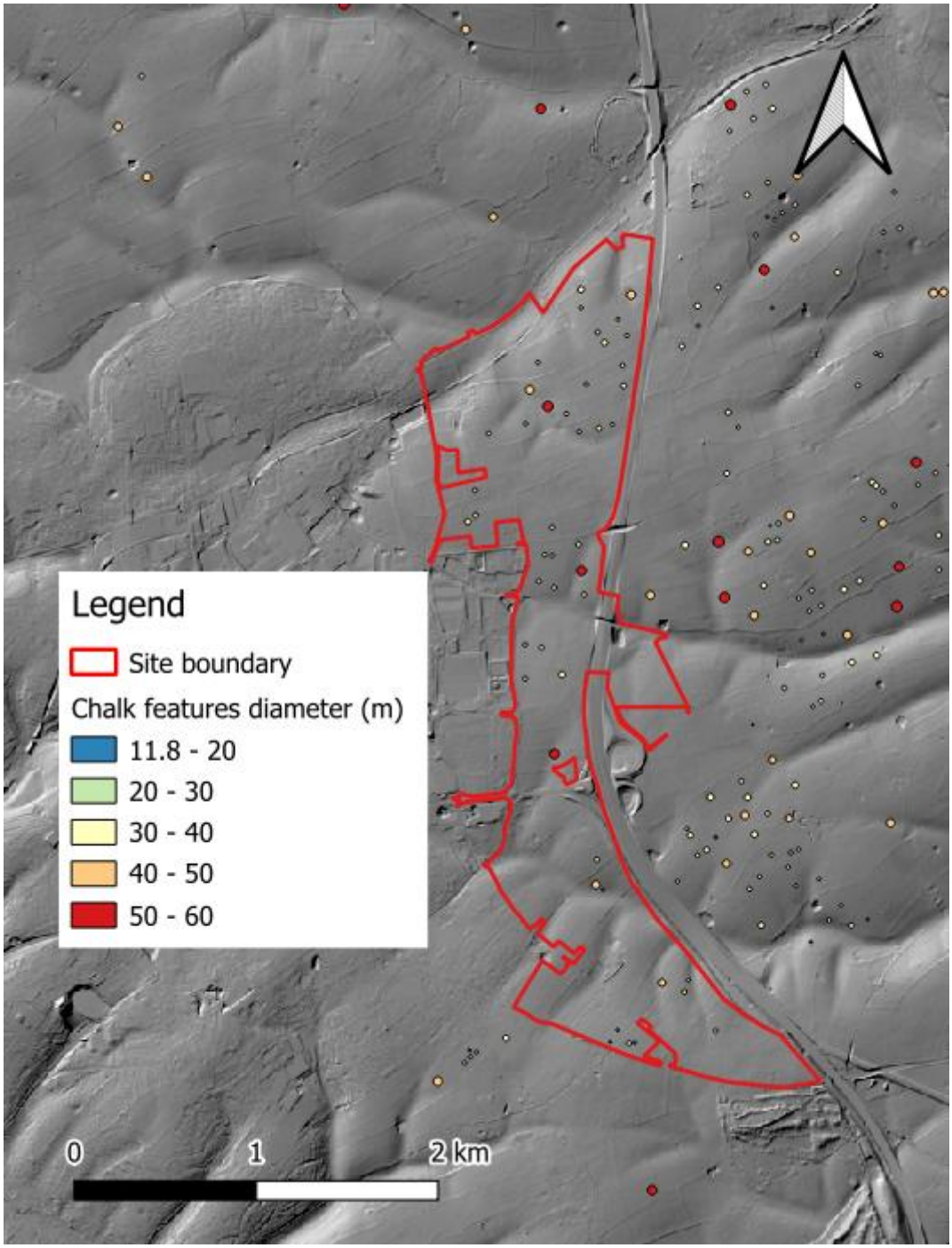


Figure 6.2 Annotated hillshade map derived from LiDAR DTM (1m resoution) at 10x vertical exageration

With reference to Figure 6.1 and Figure 6.2, chalk dissolution features do appear to align somewhat with the anticipated regional NW-SE and NE-SW mesofracture sets, corresponding to a NNW-SSE set and conjugate NNE-SSW set, however, alignment also appears to follow the trend of the principal dry valleys and to some extent the tributary dry valleys (apparent WSW-ENE and WNW-ESE sets). This suggests a complex fracture pattern in the area with potential for significant local variation. Overall, the density of suspect dissolution features in the area is quite high, but perhaps higher to the east of the Site than within the Site itself – features to the west of the Site are potentially obscured by the development of Hemel Hempstead, with no surface expression now present/visible.

The spatial distribution of suspected chalk dissolution features is shown for the northern, central and southern areas of the Site as Figure 6.3 to Figure 6.5, based on a hillshade map which has been overlain with the 1:50k digital geological map.

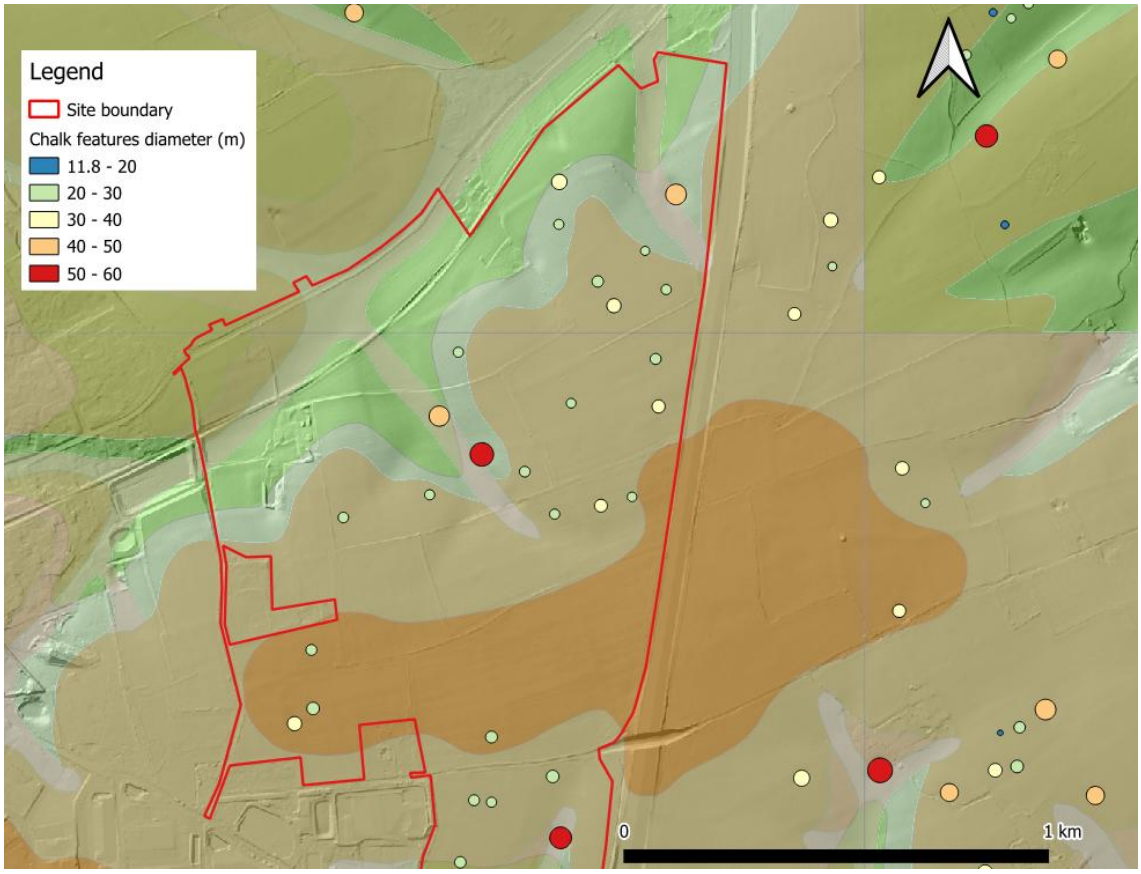


Figure 6.3 Chalk dissolution features (suspected): northern area

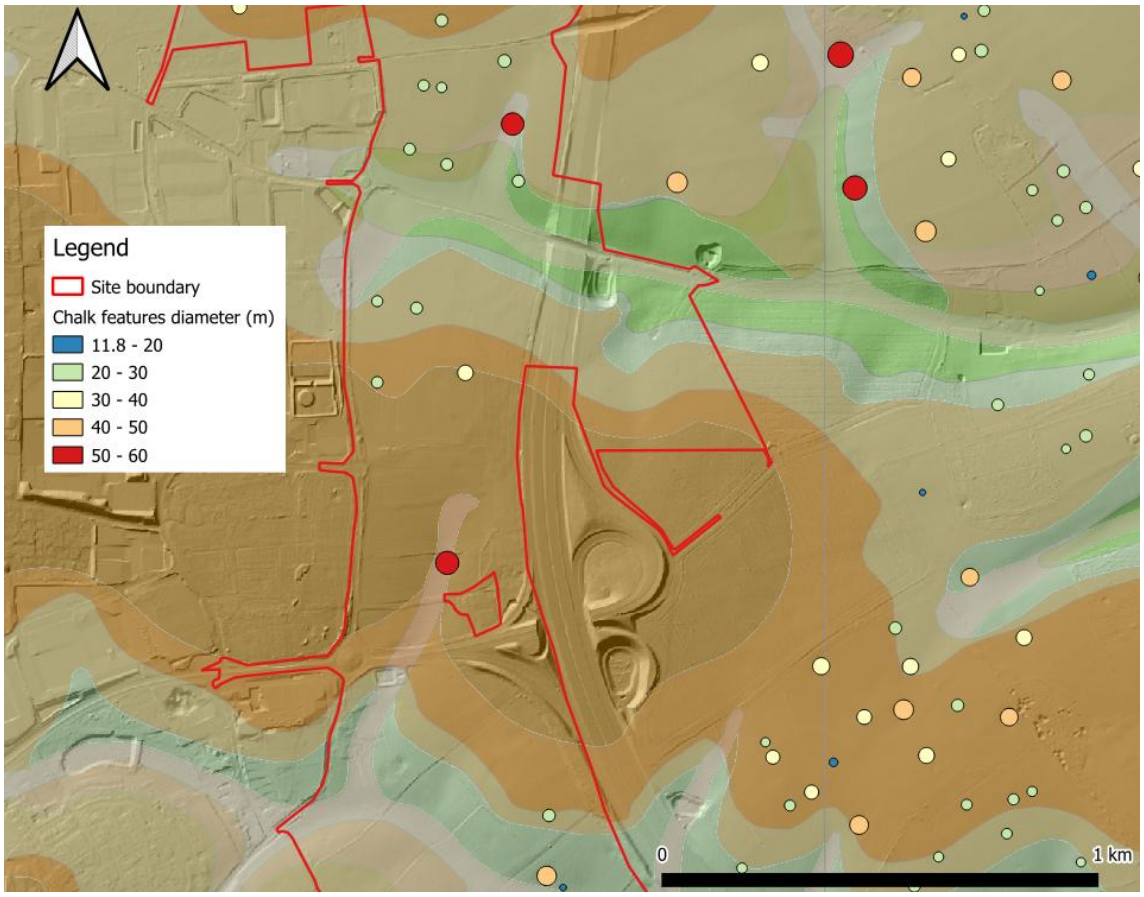


Figure 6.4 Chalk dissolution features (suspected): central area

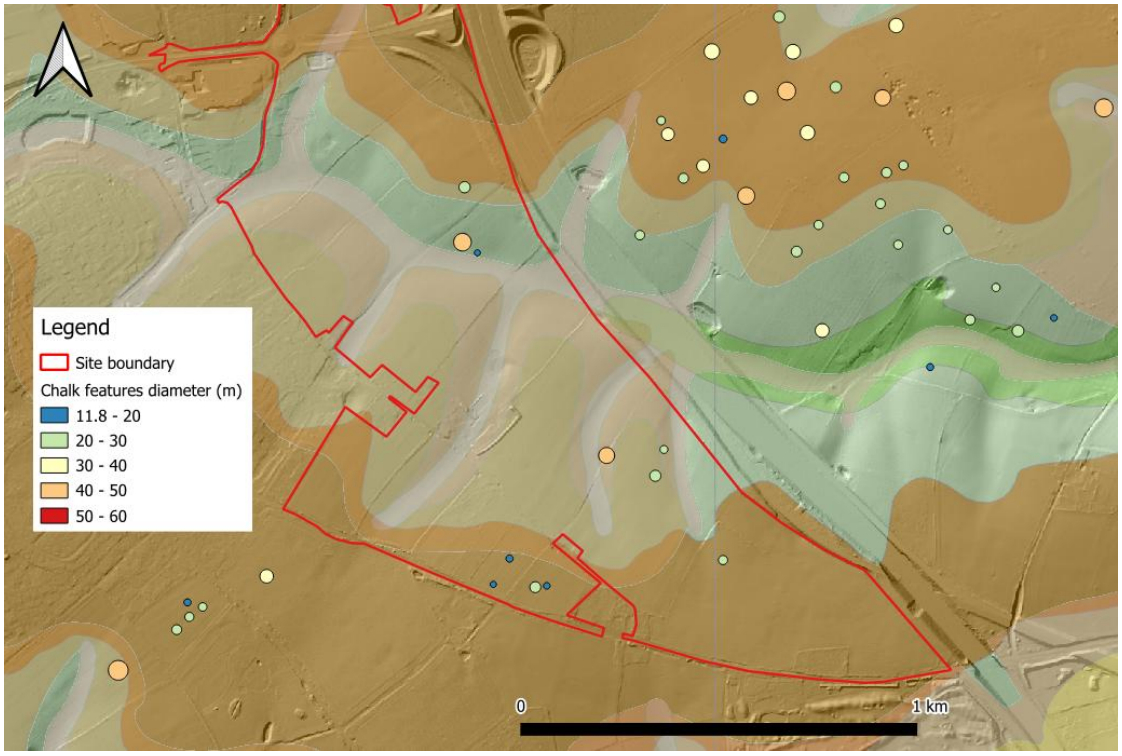


Figure 6.5 Chalk dissolution features (suspected): southern area

With reference to Figure 6.3 to Figure 6.5, it is noted that the larger diameter suspected chalk dissolution features are typically on the sides of the dry valleys. The smaller diameter suspected chalk dissolution features are more widespread and somewhat correlate to the later extent of the Clay-with-flints Formation. No notable trend with proximity to the margin of the Lambeth Group is observed, although it is possible that thicker cover above the Chalk (combined Clay-with-flints Formation and Lambeth Group) could have resulted in less surface expression.

The apparent depth of the surface expressions is typically less than 1m, although the larger features can exceed this, albeit over longer distances.

6.3. Ground Model

The depth to the top of the Chalk for the previous intrusive boreholes/trial pits is presented as Figure 6.6, overlain on the hillside and geological maps, with increasing symbol size corresponding to increasing depth to chalk – the drawing includes locations terminated in the overlying soils as lighter grey circles where these exploratory hole locations were terminated at depths greater than 5mbgl, these depths correspond to 'greater than' and are included to show a more complete ground model / highlight variation in chalk depth. It is noted that in the northern area, the depth of the Chalk is generally in good agreement with the mapped extent of superficial and bedrock geology, with a shallower depth to chalk where chalk is mapped as the shallowest stratum and an increasing thickness where the Clay-with-flints Formation is mapped to overly the Chalk and where the Clay-with-flints Formation overlies the Lambeth Group. However, there are exceptions to this locally in the northern area (with deeper depth to chalk where chalk is mapped as the shallowest stratum) and more broadly in the central and southern areas, where depth to the Chalk is not in agreement with the geological map.

The encountered ground conditions suggests that the dry valleys may have accumulations of Head Deposits (hillwash and/or soliflucted material derived from the Clay-with-flints Formation and/or Lambeth Group) and/or there are areas of infilled dissolution

features – with regards to the latter, there are notable significant increases in depth of the Chalk relative to exploratory hole locations located a short distance away.

There are cases where layers of soils were encountered within chalk, suggesting that the exploratory hole location intersected the irregular side of an infilled dissolution feature, as identified in Figure 6.6 as black dots and are typically present in the southern area of the Site. It is noted that these occurrences do not align with surface depressions identified in the LiDAR DTM, indicating that whilst surface depressions aide in the identification of potential dissolution feature, there is potential for features where surface depressions are not currently present. The prevalence of dissolution features is, therefore, expected to be more widespread that suggested in Section 6.2.

No voids or voided ground was reported during the ground investigation.

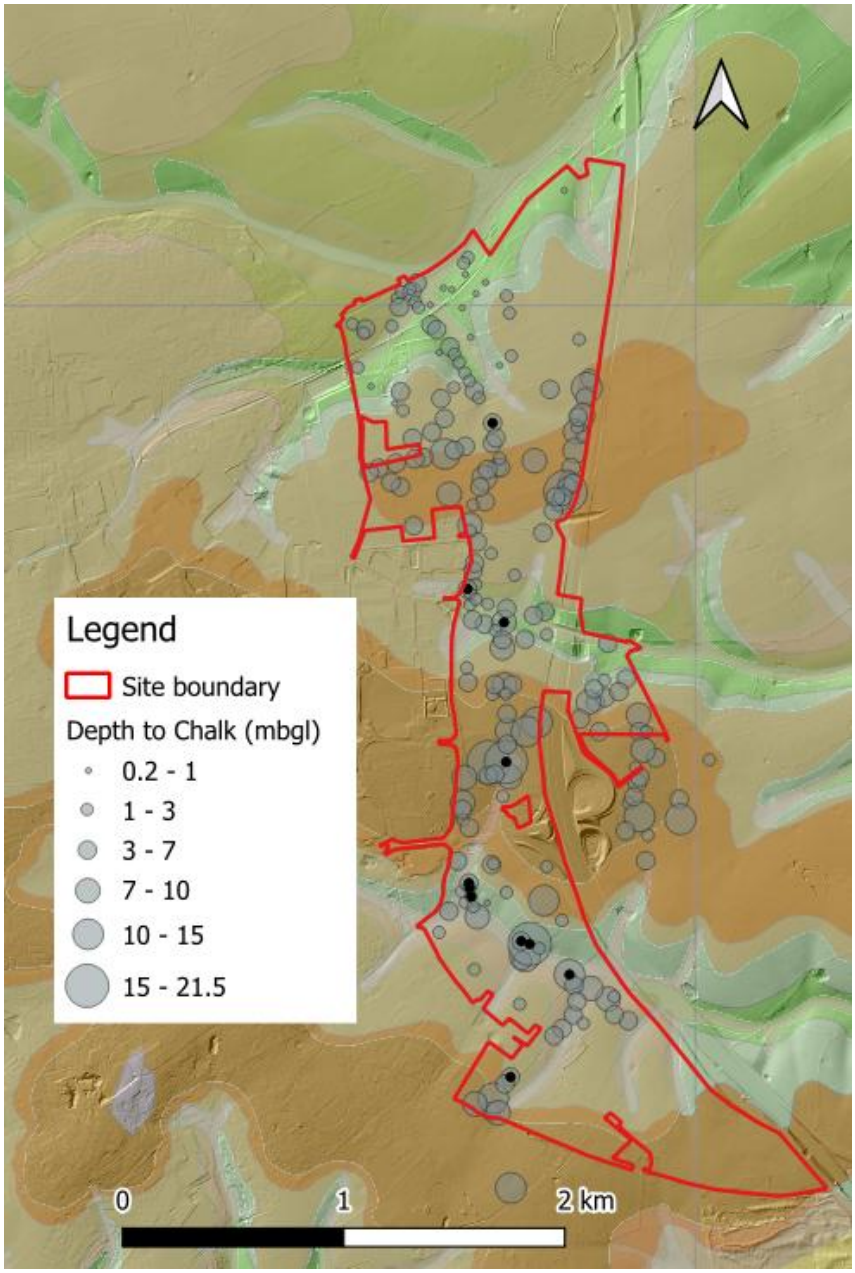
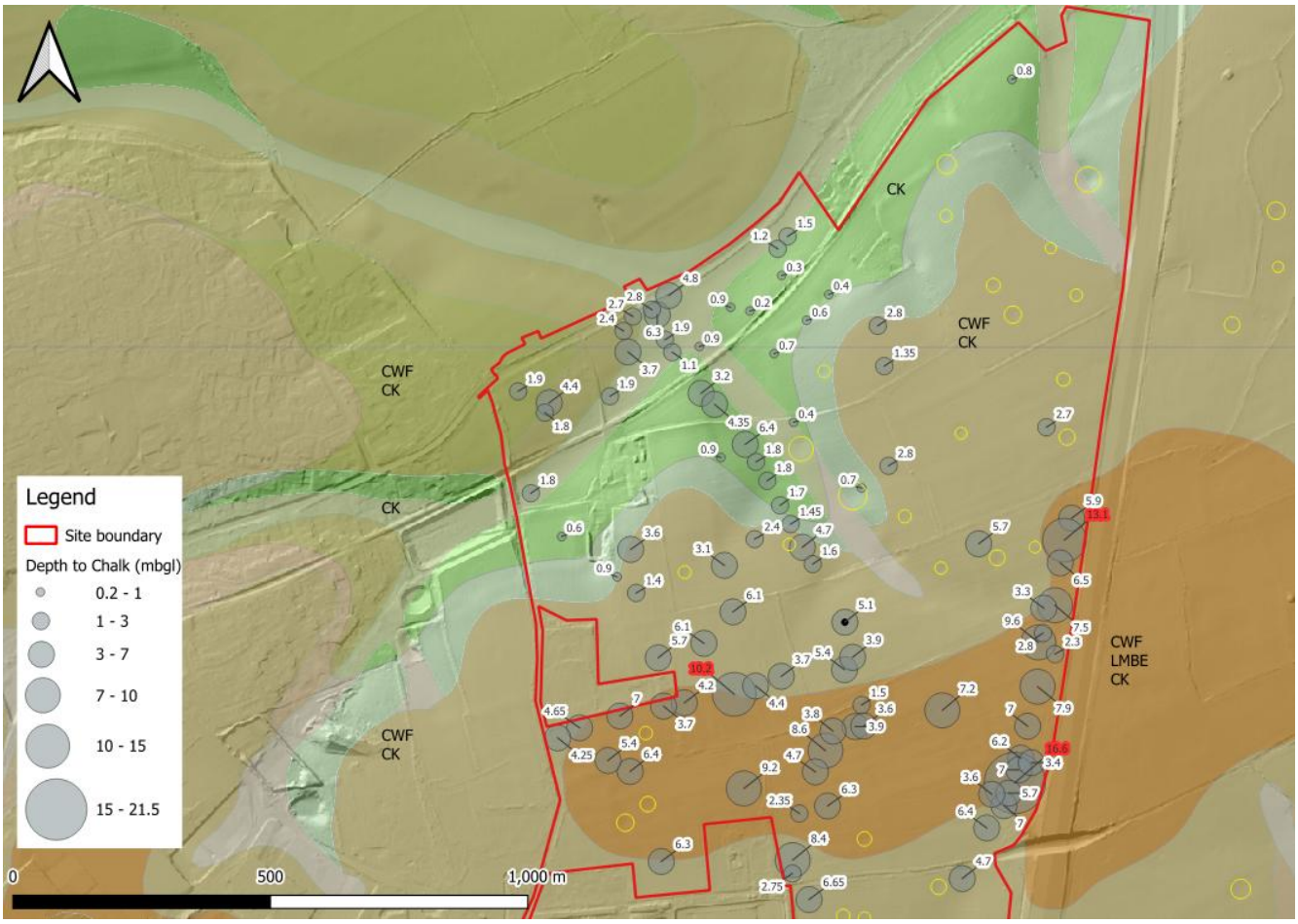


Figure 6.6 Depth to top of chalk (mbgl)

For ease of viewing, the depth to the top of the Chalk is also presented separately for the northern, central and southern areas of the Site as Figure 6.7 to Figure 6.9. These plots include data for locations where the chalk was not encountered as the exploratory holes were terminated in the overlying soils, expressed as '>' depths (limited to exploratory holes terminated at depths >5mbgl for clarity).

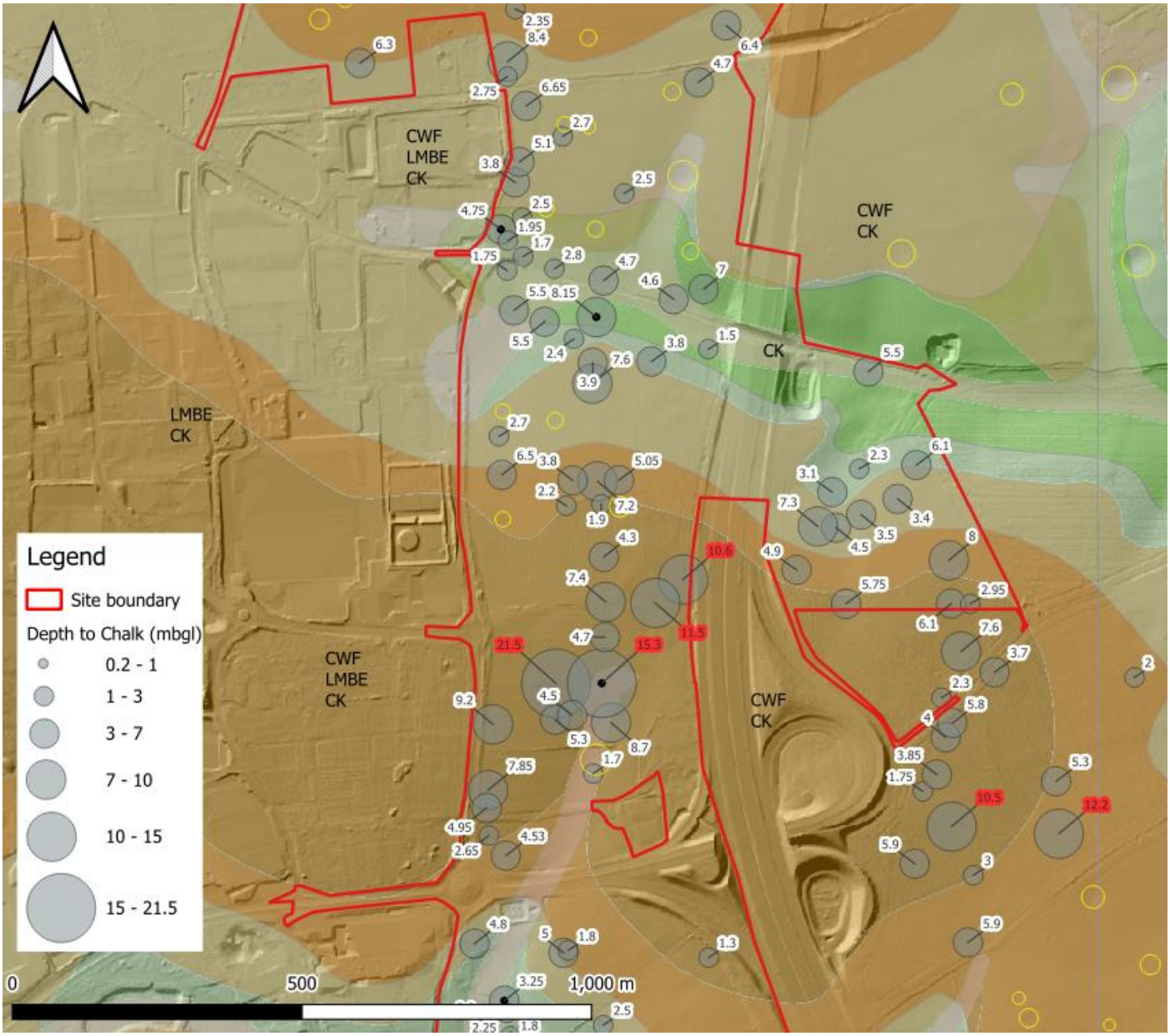


Notes: CWF = Clay-with-flints Formation; LMBE = Lambeth Group; CK = Chalk. Text annotations give geological sequence. Locations with '>' in labels represent locations terminated within the overlying soils which did not encounter chalk. Yellow circles indicate suspected dissolution features based on circular depressions noted in LiDAR DTM.

Figure 6.7 Depth to top of chalk (mbgl): northern area

As previously noted, the depth to the top of the Chalk in the northern area is generally in agreement with the published geological map, with deeper depth to Chalk in areas where the Clay-with-flints Formation overlies the Lambeth Group. Notwithstanding this, the depth to chalk bedrock is highly variable.

There are instances where the depth to Chalk increases significantly over relatively short distances, with depths >10mbgl highlighted with red text in Figure 6.7.



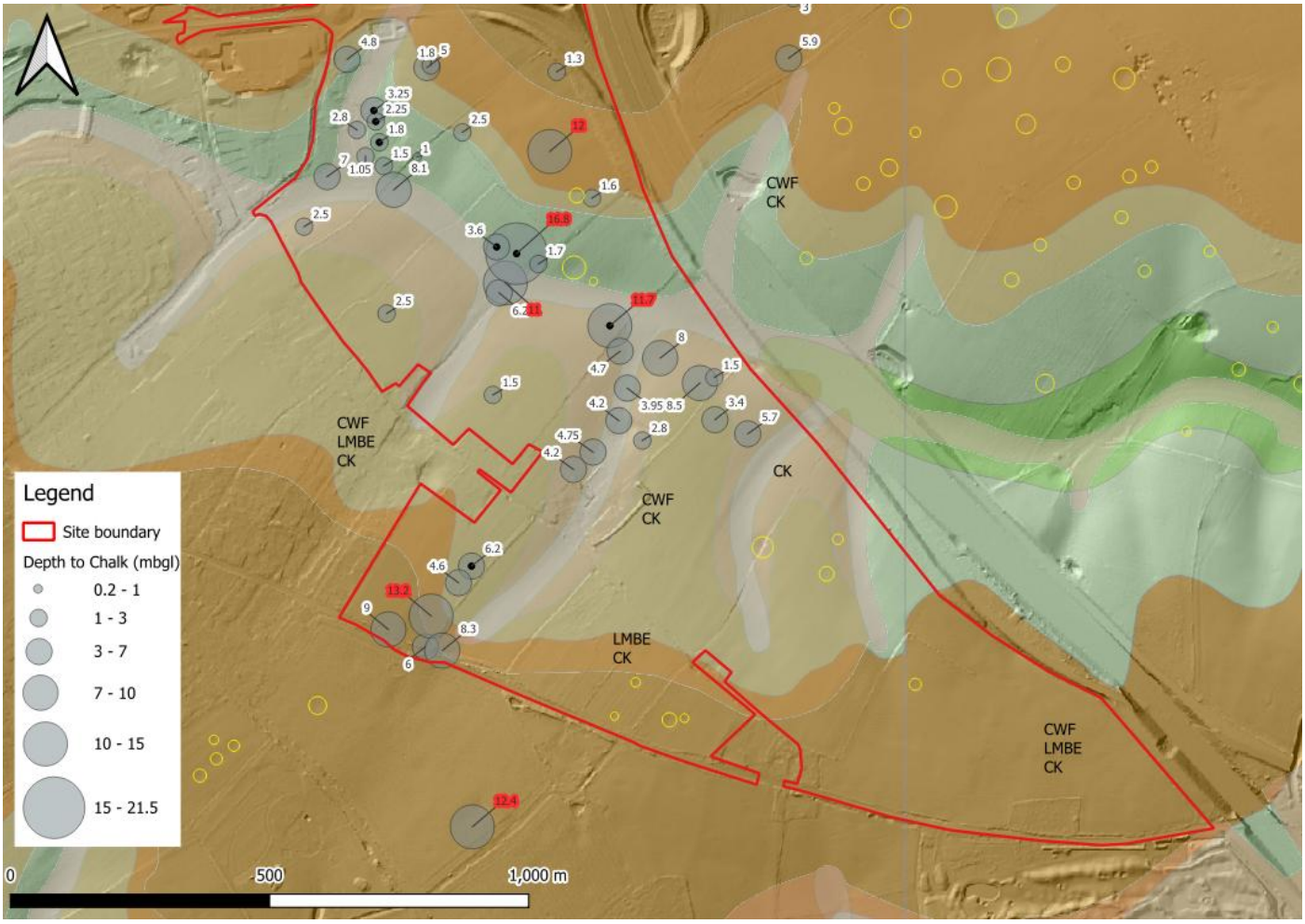
Notes: *CWF = Clay-with-flints Formation; LMBE = Lambeth Group; CK = Chalk. Text annotations give geological sequence. Locations with '>' in labels represent locations terminated within the overlying soils which did not encounter chalk. Yellow circles indicate suspected dissolution features based on circular depressions noted in LiDAR DTM.*

Figure 6.8 Depth to top of chalk (mbgl): central area

The depth to Chalk in the central areas is highly variable and does not agree with the published geological map, with no appreciable shallowing of the chalk outside of the mapped extent of the Clay-with-flints Formation (Lambeth Group is not mapped in this area).

There are a number of exploratory hole locations where the depth to chalk is >10mbgl, which likely represent infilled dissolution features – these depths are highlighted in red text in Figure 6.8

that did not encounter the chalk as they were terminated in the overlying soils. On inspection this does not appear to change the ground model in the majority of the central areas, however, one exploratory hole was terminated at 15mbgl within soil – this exploratory hole (CPBH1041) is located in the bottom



Notes: CWF = Clay-with-flints Formation; LMBE = Lambeth Group; CK = Chalk. Text annotations give geological sequence. Locations with '>' in labels represent locations terminated within the overlying soils which did not encounter chalk. Yellow circles indicate suspected dissolution features based on circular depressions noted in LiDAR DTM.

Figure 6.9 Depth to top of chalk (mbgl): southern area

Similar to the central area, the depth to Chalk in the southern areas is highly variable and is not generally in good agreement with the published geological map, with no appreciable shallowing of the chalk outside of the mapped extent of the Clay-with-flints Formation (where Lambeth Group is not mapped). Notwithstanding this, the depth to Chalk where the Clay-with-flints Formation overlies the Lambeth Group is typically deeper than outside the mapped extent of the Lambeth Group.

Further instances of significant depths to chalk are present in the southern area, with these depths highlighted in red text in Figure 6.9.

6.4. Risk Assessment

Based on the available information, the potential risks associated with mining cavities is generally considered to be low, with no known chalk mines within the Site boundary or within the immediate surrounding area – chalk mines where present within 1.5km of the Site, appear to have been open excavations and no records of deneholes have been identified near the Site (although there are records for such in the wider Hemel Hempstead area). No significant deepening of Made Ground, voids or voided ground has been encountered to date. Notwithstanding the generally low risk, a watching brief is recommended during future ground investigation and construction works.

The potential risks associated with chalk dissolution features is considered to be moderate and primarily relate to a highly variable depth to chalk bedrock and the presence of infilled dissolution features, which may locally be greater than 15m deep. The ground

investigation to date has not identified voids or voided ground, such that the potential risks to new structures and infrastructure is primarily due to potential for differential settlement, whereby the infill soils will consolidate and respond to loading differently to the surrounding chalk – the potential risk of sudden collapse settlement is relatively low, although this cannot be discounted at this stage. The distribution of suspected dissolution features at the Site is quite widespread and whilst they do appear to align with regional and local fracture sets in the Chalk, they also appear to be influenced by proximity to the principal dry valleys and tributary dry valleys.

The ground investigation to date has also encountered a thickness of soils in areas where Chalk is mapped as the shallowest stratum, including within the dry valleys which were expected to have been incised through the overlying soils and into the Chalk. This suggests that there are Head Deposits in these valleys. Head Deposits are typically poorly sorted, heterogeneous accumulations that have moved downslope under periglacial or colluvial processes. They represent potential risks to new structures and infrastructure (including roads) due to poor bearing capacity and differential settlement.

7. Contamination Appraisal

7.1. Approach

Soil and groundwater samples collected as part of the previous Wardall Armstong investigation and additional groundwater samples were recovered during A2SI works utilising the previous monitoring well network (where present and serviceable). These results have been reviewed against current guidance appropriate for assessing risk to both human health and controlled waters. The results of this review have then been used to help inform a CSM to assess potential risks from both potential on and off-site sources identified within the summary Desk Study (Section 3) so that an appropriate PRA can be produced. This CSM and PRA are discussed further in Section 8 of this report.

7.2. Soil Assessment

To provide an initial indication of potential contaminated soils present on site, the soil sample laboratory analytical results from the previous 2017 Wardell Armstrong Preliminary Ground Conditions Assessment investigation have been compared to human health GAC appropriate for assessing risks for the specifically Proposed Development for informative purposes. The selected human health GAC include the LQM/CIEH 'Suitable 4 Use Levels' (S4ULs). The S4ULs are based on Health Criteria Values that represent minimal or tolerable levels of risks to health as described in the Environment Agency's SR2 guidance, ensuring that the resulting assessment criteria are 'suitable for use' under Planning.

A total of 47no samples were scheduled for geo-environmental laboratory testing taken from all different material with 70% of samples taken from a depth <1mbgl. The samples were sent to Alcontrol Laboratories, a UKAS accredited laboratory and assessed for a range of contaminants including asbestos, cyanide, TPH, metals, PAH, pH, phenols, sulphate and sulphur along with common pesticides and herbicides.

For each chemical substance, S4ULs include individual GAC for 6no. generic land-uses (residential with home grown produce, residential without home grown produce, allotments, commercial and 2no. public open space land uses) and a range of Soil Organic Matter (SOM) contents. All toxicological and physical-chemical parameters used in the derivation of the S4ULs are presented and discussed in the source publication.

In some instances, selected human health GAC used in this report have been applied from the DEFRA 'Category 4 Screening Levels' (C4SLs), CL:AIRE GAC, Environment Agency (EA) Soil Guideline Values (SGVs) and Atkins AtRisk Soil Screening Values (SSVs). The human health GAC source reference used for each chemical determinant is presented in the GQRA screening tables included as Appendix F. C4SLs have been used preferentially where available.

The Proposed Development is yet to be finalised but includes various developments such as residential premises with gardens, commercial spaces and public open shared spaces. Therefore, a human health GAC has been applied to each chemical determinant based on the 'residential with home grown produce', 'commercial' and 'Public Open Space near residential land' (POSresi) generic land-use scenario. The selected GAC are based on 1.0% SOM.

The human health GAC for mercury assumes the presence of inorganic mercury as a conservative worst-case assumption based on the Site history.

There is no published human health GAC with respect to asbestos or asbestos containing materials (ACMs) in soil. Industry best practice document '*Asbestos in soil and made ground: a guide to understanding and managing risks', CIRIA C733, 2014*, indicates that soils containing asbestos concentrations of 0.001 % w/w may be able to liberate airborne fibre concentrations that exceed contemporary occupational exposure limits for nuisance dust. However, as detailed in other research, including publications such as the *CAR-SOIL Industry Guidance (2016)*, in circumstances where very low concentrations of asbestos are identified in soils, the associated risks are considered low. In this study an initial asbestos human health GAC of <0.001% is adopted i.e. mitigation or further

assessment is required if asbestos in soil is detected above <0.001 % w/w. Asbestos was identified in CPR05 with a concentration of <0.001% chrysotile and amosite.

All soil samples undergoing laboratory analysis for geo-environmental purposes were collected from Made Ground or the underlying natural soils. If the laboratory method detection limit is greater than the human health GAC then this is not recorded as an exceedance of the GAC.

The identified exceedances of the selected human health GAC are summarised in Table 7.1 and Table 7.2. No commercial exceedances were identified.

Table 7.1 Human Health GAC Exceedances Summary (residential with homegrown produce)

Contaminant	GAC Source	GAC (mg/kg)	Min recorded (mg/kg)	Max recorded (mg/kg)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
Nickel	LQM S4ULs	130	10.4	261	47	0	3	TP04 (1.5mbgl), TP15 (1.0mbgl) and TP29 at (2.5mbgl)

Table 7.2 Human Health GAC Exceedances Summary (POSresi)

Contaminant	GAC Source	GAC (mg/kg)	Min recorded (mg/kg)	Max recorded (mg/kg)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
Nickel	LQM S4ULs	230	10.4	261	47	0	3	TP15 (1.0mbgl)

Soil samples collected by Wardell Armstrong identified nickel as the only contaminant exceeding the assessment criteria, at three locations for the "residential with homegrown produce" scenario and at one location for 'POSresi' Scenario. Although these exceedances were recorded, they are associated with natural deposits of the Clay-with-flints Formation at depths greater than 1mbgl. As nickel is not a volatile heavy metal, it is unlikely that these concentrations are going to be exposed to future site users unless substantial amounts of cut are undertaken on site. Furthermore, the concentrations recorded are only marginal exceedances identified in a selective few samples and, based on statistical analysis, are not considered likely to pose an unacceptable risk to human health receptors.

The soil testing data generally indicates low contaminant concentrations, which would not be expected to be a significant source of contamination to groundwater. However, a sample from TP05 (0.3mbgl) recorded the presence of TPH concentration of 264mg/kg in addition, Made Ground at CPR05 was also concluded to potentially represent a second localised source of hydrocarbon contamination with a recorded concentrations of heavier hydrocarbons (total >C12-C44) at 1,342mg/kg. Risks to controlled waters have been assessed further in Section 7.4.

7.3. Ground Gas

During the previous 2017 Wardell Armstong Preliminary Ground Condition investigation at total of 5no monitoring wells were installed at the base of each of the cable percussive boreholes (CPR01-CPR05) from a depth of 1mbgl to a maximum depth of 10.15mbgl with response zones capturing the superficial deposits of the Clay-with-flints Formation and the White Chalk Subgroup.

These monitoring wells were installed by Wardell Armstong 2017 to capture potential ground gas generated by the natural chalk released during dissolution. A single round of ground gas monitoring was undertaken on the 23rd of December 2014, the results of which identified a maximum carbon dioxide (CO_2) reading of 1.1% (CPR03) with both readings of a steady flow rate and methane

(CH_4) being recorded below the equipment detection limit (< 0.1%). Based on these results, risks from potential ground gas were assessed as low, although, due to the limited number of monitoring rounds, Wardall Armstong stated that additional monitoring would be required to adequately characterise the Site.

Former site investigation across the entire site did not observe the presence of significant amounts of organic and/or degradable material such as Peat or significant amounts of Made Ground / infilled material on site. Furthermore, potential sources of off-site ground gas such as infilled pits as identified in Section 3.6 were infilled >100 years ago and therefore, if present, ongoing degradation of organic matter resulting in ground gas generation is not expected.

Based on the ground conditions and previous monitoring, although Wardall Armstong recommend additional ground gas monitoring, the Site is not anticipated to have sources with the potential to generate hazardous ground gas and for this reason, risks from potential sources of ground gas are assessed as low.

7.4. Groundwater Assessment

7.4.1. Wardell Armstrong 2017 Data

Groundwater samples were obtained during the three groundwater monitoring rounds undertaken between 27th February and 14th March 2017. Samples were obtained using low flow sampling methods (HydraSleeves), deployed just above the base of each borehole. The groundwater samples were sent to ALS Laboratories, a UKAS accredited laboratory and tested for PFOS, PFOA, VOC, SVOC, TPH, pH and BOD.

The groundwater monitoring recorded the presence of various contaminants above laboratory detection limits. In particular, elevated PFOS concentrations, elevated concentrations of heavier fuel hydrocarbons (>C12) and di(2-ethylhexyl) phthalate (DEHP).

To provide an initial indication of potential contaminated groundwater present on site, groundwater laboratory analytical results collected during the 2017 Wardell Armstrong Preliminary Groundwater Assessment investigation have been compared to generic assessment criteria (GAC) by A-squared appropriate for assessing controlled waters risks. Controlled waters GAC have been selected to assess risks to drinking water quality and the aquatic environment in surface waters.

The selected drinking water GAC are based on Drinking Water Standards (DWS) published by the UK and EU, as well as Guidance Values (GVs) published by the World Health Organisation (WHO) in addition to the environmental quality GAC based on freshwater Environmental Quality Standards (EQS) published by the UK and EU, and also operational targets published by the Environment Agency (EA).

Surrogate assessment criteria have been used for some determinants if there is not an appropriate published GAC in the source references listed above.

The environmental quality GAC and drinking water GAC used in this assessment are highly conservative for the manner used in this report, but technically robust for a GQRA.

The groundwater laboratory analytical results from samples collected from the White Chalk Subgroup are presented in a screening table comparing the detected chemical concentrations to the selected GAC in Appendix F. Where laboratory method detection limits are greater than the GAC this is not recorded as an exceedance. The results generally indicate low risk to controlled waters with concentrations not exceeding the selected GAC. Where exceedances of the GAC have been identified they are summarised in Table 7.3 and Table 7.4 for environmental quality and drinking water standards and respectively.

Table 7.3 EQS exceedances

Monitoring Round	Contaminant	GAC (µg/l)	Min recorded (µg/l)	Max recorded (µg/l)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
1	Aliphatic >C16-C21	20	10	21	24	22	1	C7
	Aromatics >EC16-EC21	0.1	10	45	24	15	9	A7, A8, A10, B1, C3, C6, C7, C9 and D2
	Aromatics >EC21-EC35	0.0002	26	792	24	4	20	A1 to A10, B1 to B3, C1, C3 to C7, C9 and D2
	PFOS	0.1	12.7	5,920	24	15	9	A6 to A11, B1, B2 and D1
2	Aliphatic >C16-C21	20	56	290	21	19	2	C3 and D1
	Aromatics >EC16-EC21	0.1	11	196	21	16	5	A10, B2, C1, C3 and C6
	Aromatics >EC21-EC35	0.0002	11	2,770	21	6	15	A3, A6 to A10, B1 to B3, C1 to C8 and D1
	PFOS	0.1	1.16	5,310	21	6	15	A3 to A11, B1, C1 to C6 and D1
3	Aromatics >EC16-EC21	0.1	19	60,900	22	16	6	C1 to C3, C6, C7 and D2
	Aromatics >EC21-EC35	0.0002	33	1,430,000	22	7	15	A3, A4, A6, A9, B2, B3, C1 to C3, C6 to C9, D1 and D2
	PFOS	0.1	3.79	6,350	22	12	10	A5 to A11, B1, C2, C4, C7 and D1

Table 7.4 DWS exceedances

Monitoring round	Contaminant	GAC (µg/l) [1]	Min recorded (µg/l)	Max recorded (µg/l)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
1	Aromatics >EC21-EC35	90	26	792	24	4	14	A1 to A3, A7 to A10, B1, B2, C3, C6, C7, C9 and D2
	PFOA	0.1	3.38	289	24	15	2	A11 and B1
	PFOS	0.1	12.7	5,920	24	15	6	A6 to A8, A10, A11 and B1
2	Aliphatic >C12-C16	300	56	290	21	19	1	D1
	Aromatics >EC16-EC21	90	11	196	21	16	2	A10 and C3
	Aromatics >EC21-EC35	90	11	2,770	21	6	5	A10, B2, C3, C6 and D1
	PFOA	0.1	0.825	338	21	9	2	A11 and B1
	PFOS	0.1	1.16	5,310	21	6	5	A6, A8, A10, A11 and B1
3	Aromatics >EC16-EC21	90	19	60,900	22	16	1	C1
	Aromatics >EC21-EC35	90	33	1,430,000	22	7	10	A4, A6, B2, C1, C3, C6 to C9 and D2
	PFOA	0.1	1.77	317	22	13	2	A11 and B1
	PFOS	0.1	3.79	6,350	22	12	4	A6, A8, A11 and B1

1- PFOS and PFOA do not have a respective GAC. Instead, the Drinking Water Inspectorate (DWI) follow a tiered approach with a guideline value of 0.1ug/l for the sum of 48 named PFAS for drinking water standards.

It was identified that elevated PFOS concentrations identified on the Site were generally closest to the Buncefield Site with the next greatest concentrations located to the north of the Buncefield Depot which is located up hydraulic gradient.

Heavier petroleum hydrocarbons (>C12) identified on site were noted to have varied by an order of magnitude between the monitoring rounds with no distinct material distribution. Wardall Armstong have stated that some concentrations encountered are relatively high and indicate which may indicate the presence of contamination outside the dissolved phase. As no hydrocarbon free product was identified during the monitoring rounds these concentrations could be related to sorbed contaminants on fine/suspended sediment particles, which can be liberated by pre-sampling extraction as part of standard laboratory testing techniques. However, suspended solids analysis was not undertaken so this theory could not be proven.

Concentrations of DEHP were identified within the southern region of the Site (EH South), however, no concentrations encountered were observed to exceed the relevant EQS and DWS GAC.

The contaminants tested for as part of the Wardell Armstong 2017 investigation were also tested for again as part of the 2025 A2SI investigation in order for a new baseline to be determined and to see the potential changes of contaminant concentrations with time. These has been discussed in Section 7.4.2 below.

7.4.2. A2SI 2025 Data

Groundwater results from the recent A2SI 2025 investigation round have been compared to the results of the 2017 Preliminary Groundwater Assessment in addition to the DWS and EQS GAC to establish a new groundwater baseline across the Site.

Only three of the samples that underwent TPH testing from the A2SI investigation (to match that of the previous Wardell Armstong 2017 investigation) had a total aliphatic & aromatics (>C5-35) concentration that exceeded the laboratory detection limit. These were borehole C3 with a concentration of 29.1µg/l, borehole D2 which had a concentration of 291µg/l and Dup2 (borehole C4) with a concentration of 82.2µg/l. This is a decrease since the last monitoring round, especially in regard to the locations of borehole C3 which previously had detected concentrations ranging from 749µg/l to 6,920µg/l.

Similar to the TPH concentrations, PFOS and PFOA concentrations are also generally observed to have decreased between the 2017 and 2025 investigations. For example, during the Wardell Armstrong 2017 investigation, PFOS concentrations in borehole B1 ranged from 5,000ng/l to 6,060ng/l, whereas in the 2025 A2SI investigation, the maximum concentration recorded was 746ng/l. Similarly, in borehole A8, concentrations previously ranged from 1,280ng/l to 1,480ng/l, but were recorded at 914ng/L during the A2SI investigation. Although the concentration of the A2SI investigation still follow the similar spatial distribution as that identified in the 2017 Preliminary Groundwater Assessment (greater PFOS and PFOA at locations adjacent to the Buncefield Oil Depot and in the northern portions of the Site), there overall is a decline in concentration. However, it is important to note that locations previously identified as having high concentration of PFOA and PFOS could not be located during the recent investigation, such as borehole A7 and boreholes A9 to A11. For this reason, the potential PFOA and PFOS contributions in these areas remain unknown. Additionally, it is noted that the monitoring well network does not cover the whole site, particularly the eastern part of EH North (formerly Area A) and southern part of EH South (formerly Area C). A temporary comparison between concentrations of PFOS cis presented as Figure 7.1 below.

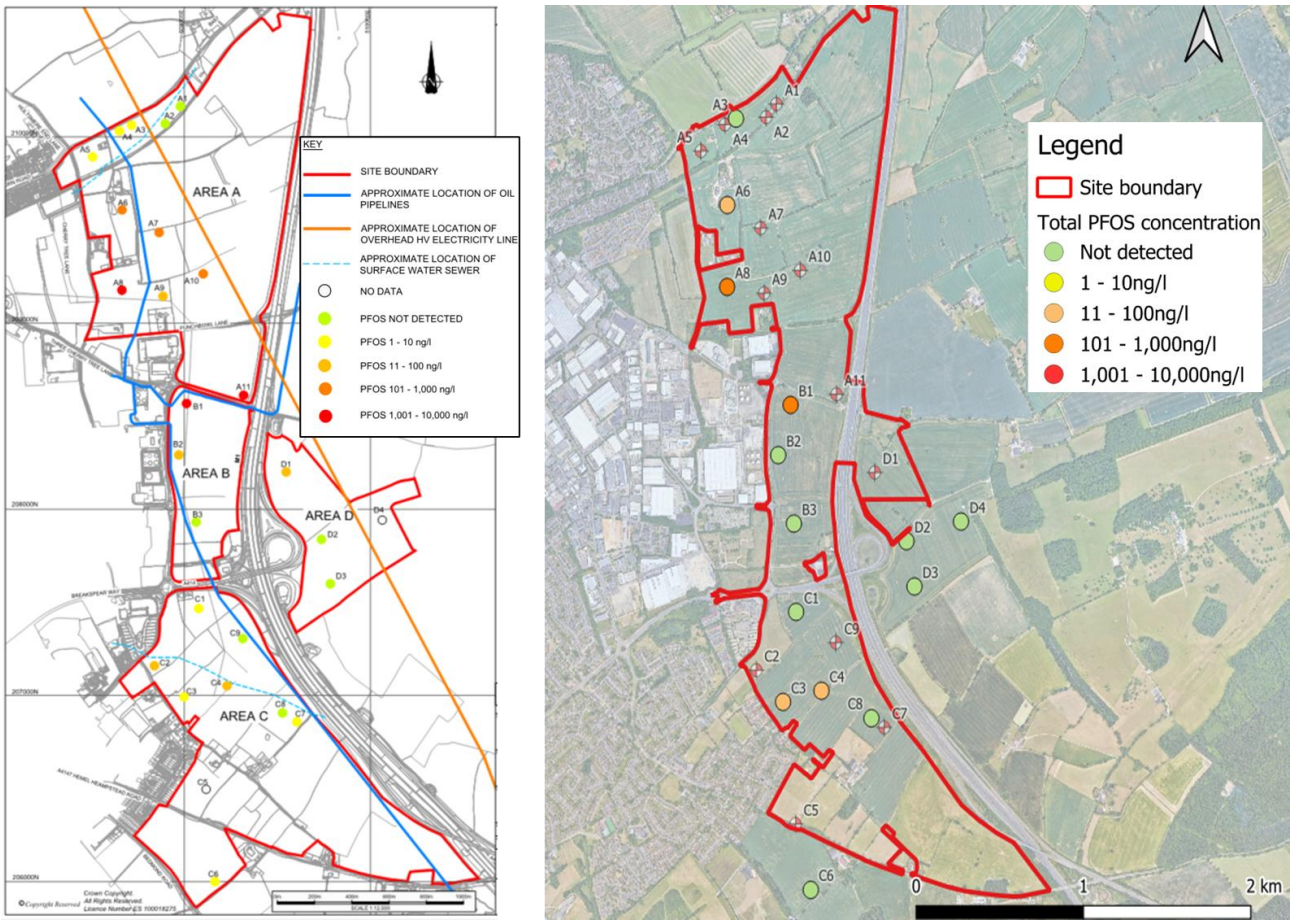


Figure 7.1 Comparison of Wardell Armstrong 2017 (left) and A2SI 2025 (right) concentrations

SVOC and VOC testing (inclusive of DEHP) was undertaken as part of the A2SI sampling round in order to compare the results to the Wardell Armstong investigation. Findings of the recent A2SI data found all VOC and SVOC contaminants below their laboratory limit of detection indicating a decrease in concentration over time.

As discussed in Section 3.11, the EA stated that there is potential for fertilisers, pesticides, insecticides, and herbicides to have impacted the Site due to the Sites predominant use as agricultural field. For this reason, groundwater sampling undertaken as part of the 2025 A2SI monitoring included sampling for fertilisers, pesticides, insecticides, and herbicides such as aldrin, trifluralin and alpha, beta and gamma-hexachlorocyclohexane. None of the sample groundwater samples collected had fertilisers, pesticides, insecticides, and herbicides that exceeded the laboratory limit of detection. Therefore, this indicates that agricultural uses are not likely to have significantly adversely impacted groundwater across the Site.

Similar to the previous Wardall Armstong investigation, A-squared have reviewed the latest groundwater samples against the DWS and EQS GAC criteria and where appropriate, surrogate assessment criteria if there is not an appropriate published GAC. The exceedances identified as part of the 2025 investigation can be observed as Table 7.5 and Table 7.6 with full screening supplied as Appendix G.

Table 7.5 Drinking Water Standards exceedances

Contaminant	GAC (µg/l) [1]	Min recorded (µg/l)	Max recorded (µg/l)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
TPH Aromatics >C21-35	90	29.1	291	20	18	1	D2
PFOA Perfluorononoctanoic acid	0.1	6.49	93.2	24	14	8	A6; A8; B1; C3; C4; DUP1; DUP2; D2
PFOS Linear Perfluoro-1-octanesulfonate	0.1	5.71	436	24	14	7	A6; A8; B1; C3; C4, DUP1; DUP2
Total PFAS DWI 47	0.1	132	2940	24	17	8	A6; A8; B1; C3; C4; DUP1; DUP2; D2

1- PFOS and PFOA do not have a respective GAC. Instead, the Drinking Water Inspectorate (DWI) follow a tiered approach with a guideline value of 0.1ug/l for the sum of 48 named PFAS for drinking water standards.

Table 7.6 Environmental Quality Standard exceedances

Contaminant	GAC (µg/l)	Min recorded (µg/l)	Max recorded (µg/l)	No. Samples analysed	No. Samples <LOD	No. Samples exceeding GAC	Locations
Copper	1	0.32	1.73	20	7	2	C4; D2
Zinc	10.9	1.78	18.3	20	3	1	C4
Benzo(a)pyrene	0.0002	0.00305	0.00737	20	17	3	A3 A6 C6
Benzo(b)fluoranthene	0.0002	0.00601	0.013	20	19	2	A3; A6
Benzo(k)fluoranthene	0.0002	0.00565	0.00565	20	19	1	A3
Fluoranthene	0.0063	0.00648	0.0194	20	15	3	A3, A6; C8
Indeno(1,2,3-cd)pyrene	0.0002	0.00504	0.00567	20	18	2	A3; A6
TPH Aromatics >C21-35	0.0002	29.1	291	20	18	3	C3; DUP2, D2
Bis(2-ethylhexyl)phthalate	1.3	2.59	2.59	20	19	1	TB3
PFOS Linear Perfluoro-1-octanesulfonate	0.00065	5.71	436	24	14	7	A6; A8, B1; C3; C4; DUP1; DUP2

The only exceedances of the DWS were for TPH Aromatics >C21–35, and PFOS and PFOA, which contributed to exceedances of the Total DWI 47criterion for the sum of 47 PFAS compounds (0.1µg/l). The locations in which the sum of PFAS exceeded the Total DWI 47 (0.1µg/l) were boreholes A8, B1 and C4, and sample Dup 1 (from borehole C3), all of which are in close proximity to the Buncefield Oil Depot with concentrations decreasing down gradient the hydraulic gradient from the depot. However, it is noted that that the concentrations in sample Dup 1 and borehole C4 were significantly lower than those recorded in boreholes A8 and B1.

The data suggests that the PFAS plumes in groundwater are moving radially away from the Buncefield Oil Depot, and locally potentially against the general groundwater flow direction, potentially through prominent joints in the chalk which act as preferential pathways for contaminant transport. Monitoring in the northeast corner of the Site could not be undertaken, including in areas previously identified as having high concentrations of PFOS (boreholes A7, A10 and A11), and therefore, the full extent of the PFAS plumes arising from the Buncefield incident in the northeast portion of the Site are unknown; this represents a data gap in the northeast corner of the Site. The distribution of PFAS (Total DWI 47) can be observed as Figure 7.2.

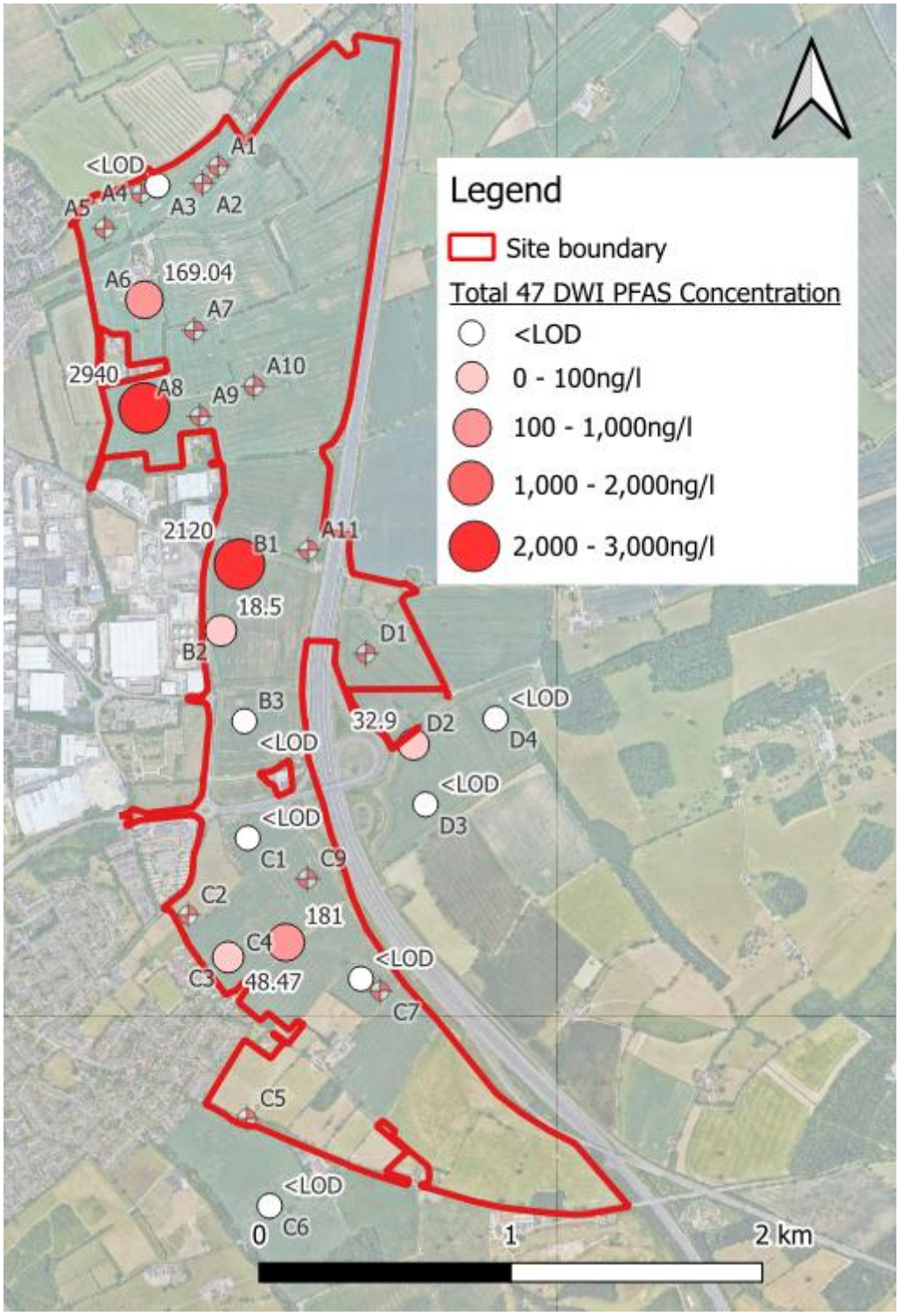


Figure 7.2 Total PFAS (DWI 47) concentration distribution across the Site

TPH Aromatics >C21–35 concentrations were only found to exceed the respective GAC criteria in the sample from borehole D2 and are, therefore, is considered to be localised. During the previous Wardell Armstrong investigation TPH Aromatic C21-C35 concentrations ranged from 792µg/l (round 1) to 279µg/l (round 3). The concentration detected in the sample from borehole D2 during the Wardell Armstong investigation (round 3) were similar to the detection during the A2SI investigation. Following the Wardall Armstong investigation suspended soils testing was completed and noted that the sample from borehole D2 contained a relatively high suspended solid concentration of 3,180mg/l (the highest of analysed samples). These suspended solids may contain elevated levels of sorbed, low-solubility hydrocarbons, which could influence the overall sample concentration. Overall, as these exceedances

were only encountered within one location the contamination encountered is not considered widespread. The distribution of TPH Aromatics >C21–35 can be observed as Figure 7.3.

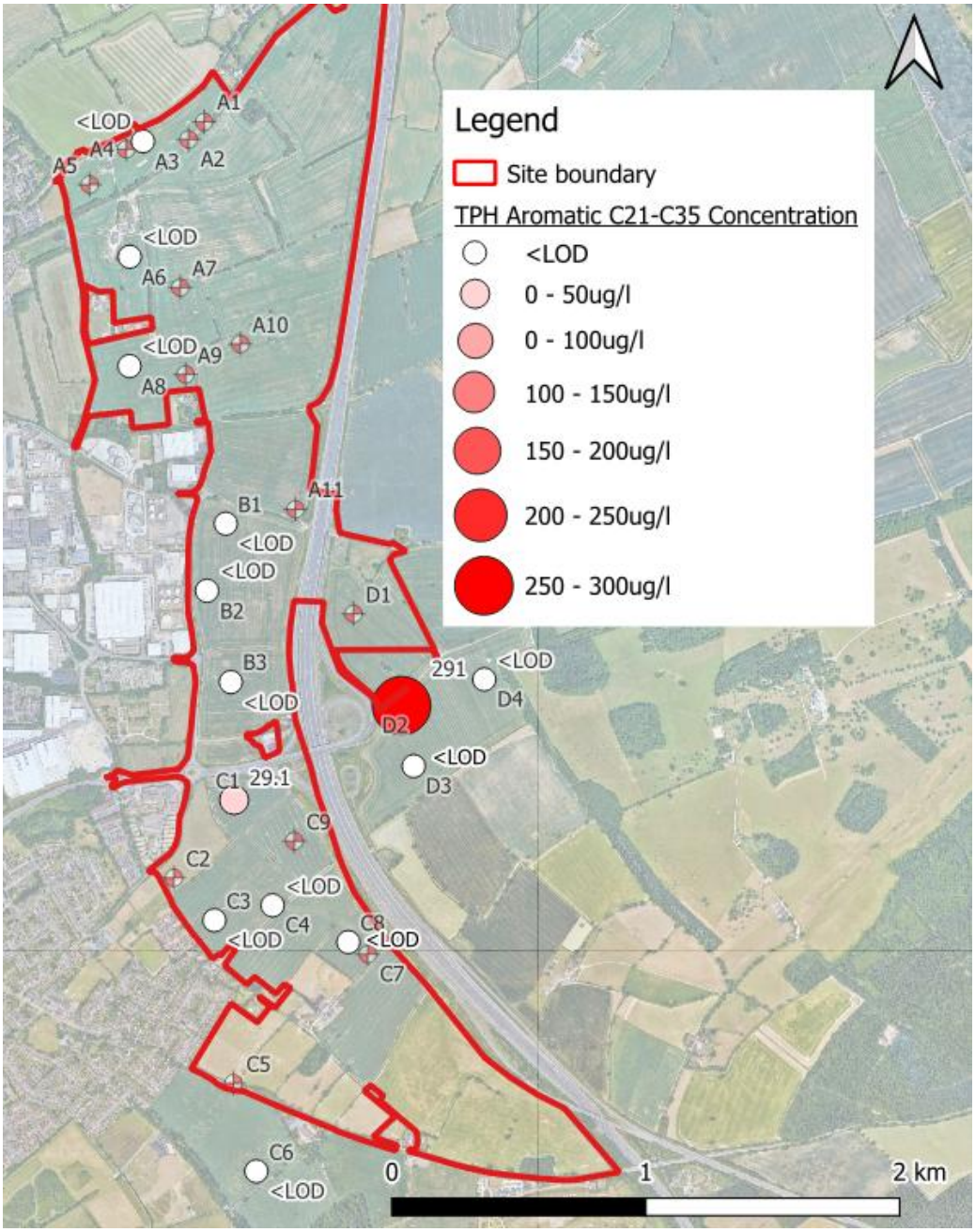


Figure 7.3 TPH Aromatic C21-C35 concnetration distribution across the Site

EQS exceedances were identified for heavy metals (copper and zinc), PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene, and indeno(1,2,3-cd)pyrene), TPH (Aromatic C21–C35), and PFOS. However, given the depth at which groundwater was encountered, it is unlikely that the groundwater tested onsite is hydraulically connected to the shallow surface water features identified in Section 3.3. For this reason, although these exceedances are present, they are unlikely to impact surface water receptors. It is also important to note that an exceedance of bis(2-ethylhexyl)phthalate was observed; however, this was only detected in a Trip Blank sample and is therefore not considered representative of site conditions.

Based on the above lines of evidence, the new groundwater conditions of the Site indicate sustained relatively high concentration of PFAS in selected areas (predominantly adjacent to the Buncefield site), with other contaminants showing decreasing concentrations since 2017 to levels in which are not anticipated to poses as a potential risk to drinking water supplies or surface water receptors.

Importantly, it is noted that the contamination in groundwater is not derived from site-specific sources and that the environmental impact of the Buncefield incident is well known to the regulators and under long-term monitoring.

The potential risks to receptors at the Site are not considered to be unacceptable given the depth of groundwater and, therefore, absence of credible exposure pathways. The Proposed Development is unlikely to adversely impact the existing groundwater contamination given that future groundworks (including cut and fill exercises) and new foundations are not likely to interact with groundwater in the Chalk additionally, concentrated deep infiltration is not proposed. Options for sustainable drainage systems, such as permeable paving, filter drains and some infiltration through attenuation pond bases, shall be considered as the development progressive, subject to additional investigation and risk assessment with regards to risks to groundwater (i.e. to ensure that existing plumes are not mobilised) and in consultation with the EA

8. Conceptual Site Model (CSM) and Preliminary Risk Assessment (PRA)

A CSM for the Proposed Development is set-out below in consideration of the information detailed in the earlier sections of this report and represents the characteristics of the Site influencing the possible relationships between identified potential contaminant sources, pathways and receptors. The PRA is undertaken based on the CSM for each potentially complete source-pathway-receptor linkage (potential contaminant linkage).

Should any changes be made to the Proposed Development compared to the details presented herein, or should any new information become available, then the PRA should be reviewed and updated, as appropriate.

8.1. Potential Sources

The relevant potential on- and off-site contamination sources are summarised in this section. Off-site potential sources of contamination within 100 m of the Site boundary are identified and considered further, as well as potential sources of contamination within 250 m of the Site boundary where the anticipated groundwater flow direction towards the northeast in the northern portion of the Site and southeast in the southern portion indicates a pathway to the Site may be present.

Current and former residential land-uses, retail units, offices and other general commercial uses (non-industrial) are not considered potential sources of contamination unless stated otherwise.

Naturally occurring radon risks are discussed separately in Section 3.5.

It should be noted that due to the nature of historical records mean, not every potential source of contamination may be detailed in the available documents. Therefore, there is potential for additional sources of contamination to be present.

8.1.1. On-Site Sources

- Made Ground (localised) associated with current and former on-site developments may be a potential source of contaminants including heavy metals and metalloids, acids / alkalis, PAHs, TPHs, and asbestos (such as within borehole CPR05 of the former investigation). Due to the Site history and as indicated as part of previous investigations on site, the Made Ground present is likely to be very limited and unlikely to contain putrescible/significant organic content. For this reason, Made Ground is not considered to be a viable source of significant ground gas
- Former site uses of a historical railway line may be a potential source of contaminants including heavy metals and metalloids, acids / alkalis, PAHs, TPHs, and asbestos. Environmental testing is limited in the areas of these potential sources during the previous investigation and therefore their impact to site are currently unknown.

The construction of the M1 motorway, along with potential fuel spills and leaks, may represent a possible source of contaminants such as TPHs, BTEX, and MTBE. In addition, plans provided in previous Wardell Armstrong reporting indicate the presence of fuel pipelines crossing the Site, both towards and away from the Buncefield Oil Depot, which may also represent potential sources of similar contaminants (although the likelihood of this leaking without being noticed is quite low). Although these features (M1 and fuel pipeline) are potential sources of contamination, environmental testing from previous investigations undertaken within these areas has not identified evidence of former spills or leaks. Furthermore, logs from the previous intrusive investigations did not record visual or olfactory evidence of contamination that would indicate leakage. For this reason, works associated with the M1 and potential leaks from the fuel pipelines across the Site associated with Buncefield Oil Depot are not considered further as potential sources of contamination with the potential to cause unacceptable risks to human health receptors or the environment.

Natural Strata encountered on site potentially has elevated concentrations of the heavy metal nickel indicated by the results of previous on-site (see Section 7.2) and off-site (see Section 3.10.1) investigation. However, given the depth and concentrations of

nickel previously assessed within the natural strata, the underlying natural strata is not considered further as posing as an unacceptable risk to human health or controlled water receptors.

Agricultural Land use may be a potential source of contaminants including fertilisers, pesticides, insecticides and herbicides. However, previous site investigation undertaken by Wardell Armstong undertook soil testing for common pesticides and herbicides and concentrations were below the limits of laboratory detection. Furthermore, groundwater testing undertaken as part of the A2SI investigation did not identify common fertiliser, pesticides or herbicides above the limit of laboratory detection. For this reason, the use of the Site as agricultural land has not been assessed further as posing as an unacceptable risk to human health or controlled water receptors.

Based on the Site history and previous investigation data, significant hydrocarbon contamination such as the presence of NAPL is unlikely to be present on site. For this reason, 'gross contamination' is not expected to be encountered.

Asbestos containing materials (ACMs) may be present in the current building fabric. Mitigation measures for potential asbestos in the current building fabric are described below separate to the ground-based risks in Table 8.1.

A potential on-site source location plan is included as Figure 8.1.

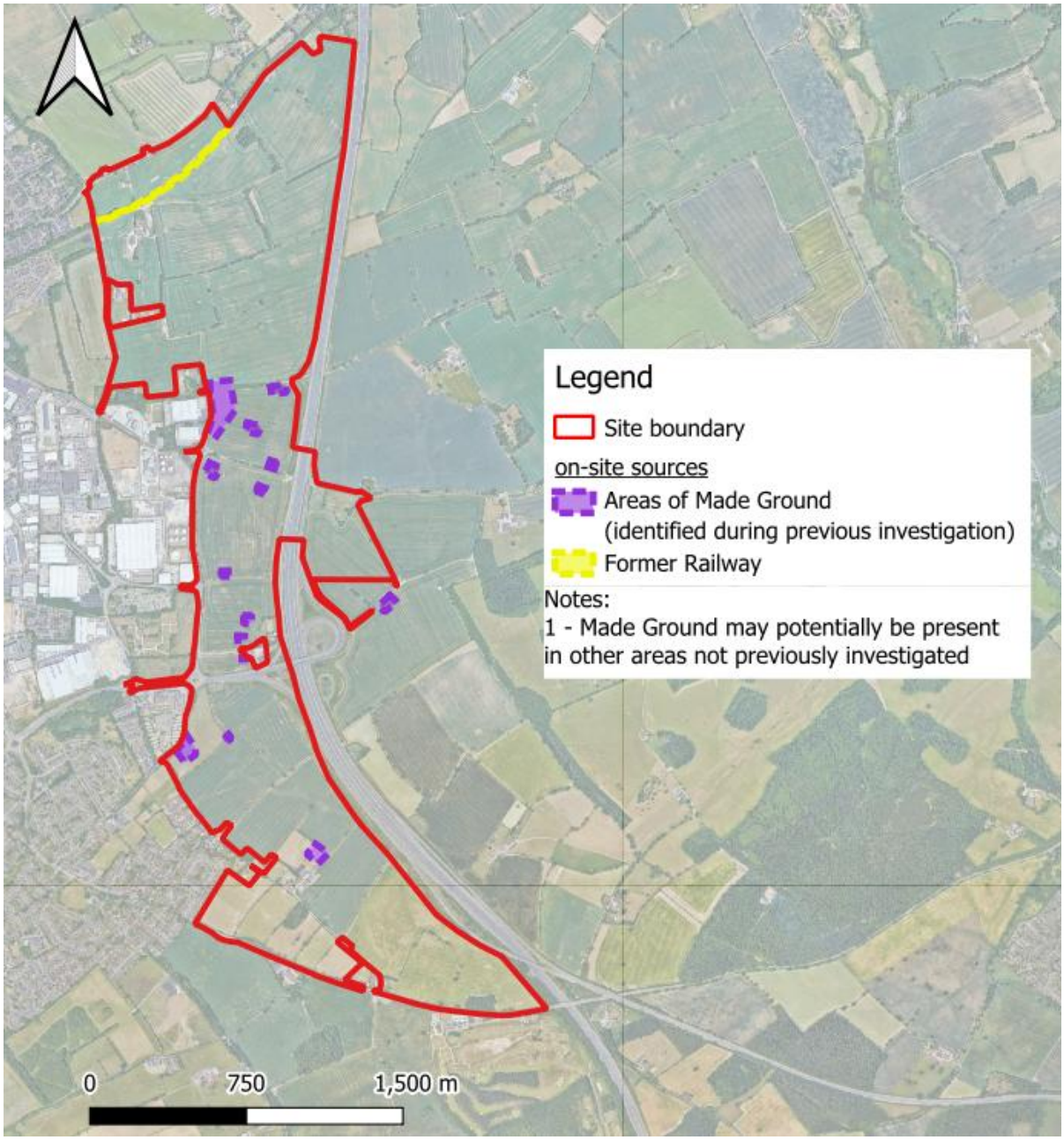


Figure 8.1 Potential on-site contamination sources

8.1.2. Off-Site Sources

- The Buncefield Oil Depot, located west of the Site, is a potential source of off-site contamination. However, previous shallow soil sampling in this area, undertaken by Wardell Armstrong, did not identify elevated levels of contaminants. Furthermore, the latest groundwater sampling indicates that the presence of DEHP and TPH has decreased over time since the Wardell Armstrong investigations. For this reason, the only contaminant associated with the Buncefield site that is assessed further is the presence of PFAS.
- Transport Depot located in the central region of the Site is a potentially a source of heavy metals and metalloids, acids / alkalis, PAHs and TPHs.

Asbestos has not been indicated for potential off-site sources as there is no relevant pathway for asbestos to migrate through the ground towards the Site.

A potential off-site source location plan is included as Figure 8.2.

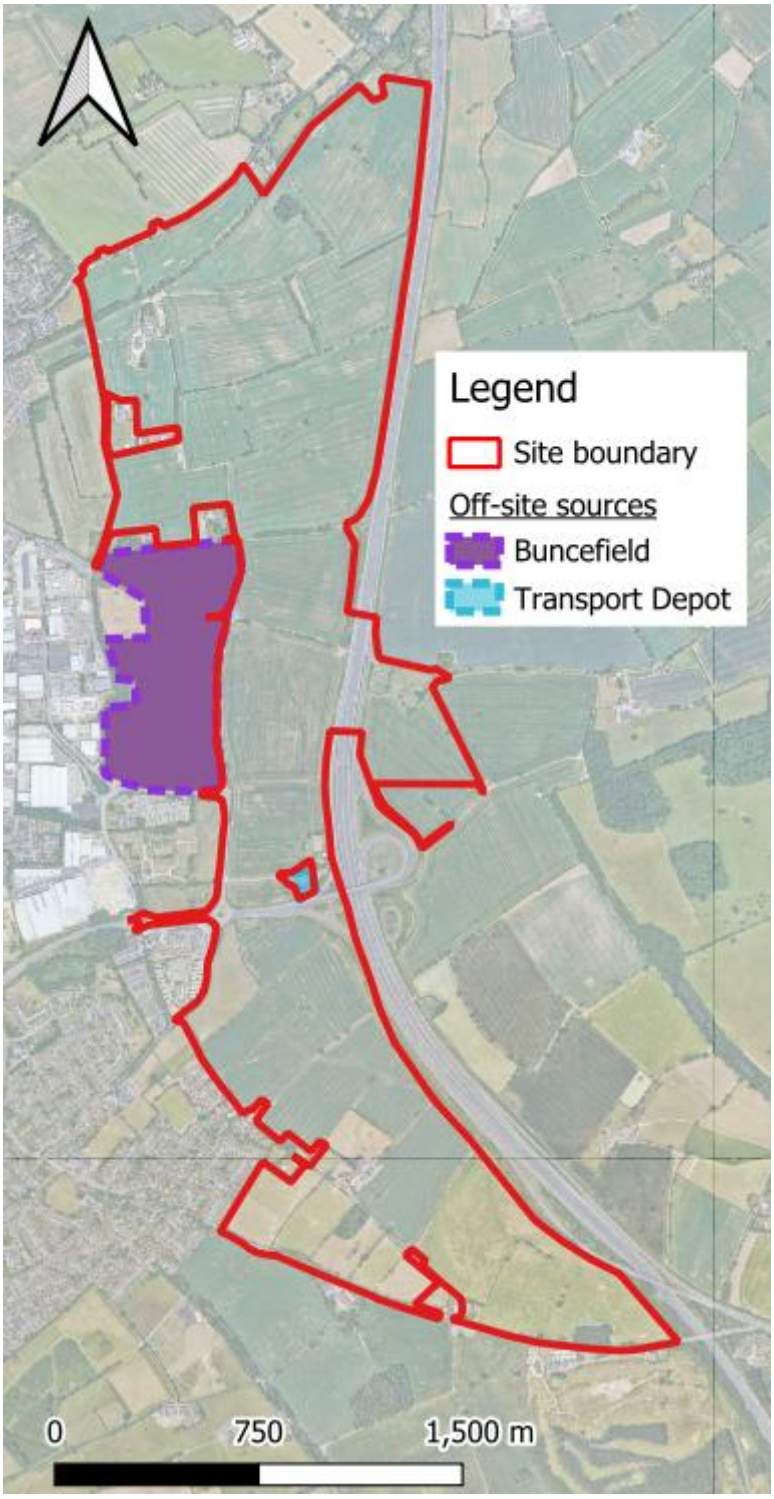


Figure 8.2 Potential off-site contamination sources

8.2. Potential Pathways

The potential pathways relevant to the identified sources/receptors include:

- Dermal contact with soil (indoors and outdoors).
- Direct ingestion of soils and/or dust derived from soil (indoors and outdoors).
- Inhalation of dust derived from soil (indoors and outdoors).
- Root uptake and possible ingestion and possible ingestion.

- Permeation into pipes & Ingestion: via new water supply pipes compromised by contamination in the surrounding soils (e.g. permeation of TPH leaching from soils into the pipes).
- Migration and accumulation of ground gases and vapours or mobile contaminants through permeable soils (if present).
- Leaching and migration of contaminants in contaminated soils (if present) via infiltration of precipitation and rise and fall of groundwater.
- Mobilisation of contaminant plumes beneath the Site caused by development design such as deep infiltration drainage

Due to the anticipated absence of 'gross' hydrocarbon contamination, the pathway of permeation into pipes & ingestion of future site users has not been assessed further.

It is anticipated that as part of the geotechnical design, an appropriate concrete class is to be used as part of the building foundations. For this reason, sulphate attack on buildings and underground structures (such as foundations) have not been assessed further as a potential pathway.

8.3. Potential Receptors

Potential receptors identified as part of this assessment include:

- Human health (long term, chronic) of proposed site end users (residential and commercial).
- Human health (long term, chronic) of neighbouring off-site users.
- Human health (short-term, acute) of construction workers.
- Plant growth in proposed soft landscaping on-site.
- Controlled Waters – White Chalk Subgroup (Principal Aquifer) with associated SPZ 1 to SPZ3

Although the Lambeth Group defined as a Secondary A Aquifer is present across the Site, previous investigation indicates a deeper groundwater elevation associated with the White Chalk Subgroup. For this reason, the White Chalk Subgroup has been assessed further as the key controlled water receptor.

As no sensitive surface water bodies are present on site, and although there are a few inland rivers adjacent to the M1 and the A414 (likely associated with drainage) and ponds they are unlikely to be connect to groundwater on the Site given the depth at which it has previously been encountered. In addition, the nearest sensitive surface water receptor being the River Ver located approximately 1.5km to the northeast of the Site. For these reasons, on and off-site surface water features have not been assessed further as potential controlled water receptors.

Risks to site workers and the environment (from potential land contamination) during the construction phase of the proposed redevelopment can be appropriately managed by successful implementation of construction phase risk assessments and method statements (RAMS). The associated construction phase risks from potential contamination are considered further in this document, but should be appropriately considered and mitigated by the Principal Contractor in their preparation and implementation of construction phase RAMS and Construction Phase Plan (CPP).

8.4. Summary of Potential Contaminant Linkages

There are some potentially complete contaminant linkages based on the identified sources, pathways and receptors. Table 8.1 presents a PRA for contaminant linkages relevant for the Proposed Development. Qualitative risk classifications are provided in accordance with *CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001)* (see summary in Appendix H). Where there is no potentially complete contaminant linkage then no risk classification is provided. The PRA is applicable to current climatic conditions and those that may be expected in future due to human induced climate change.

Table 8.1 Preliminary Risk Assessment (PRA)

Potential Source	Potential Pathway	Potential Receptor	Severity	Probability	Risk Rating
Localised Made Ground (heavy metals, acids / alkalis, PAHs, TPHs, and asbestos)	Dermal contact with soil (indoors and outdoors)	Future users (residential)	Medium	Low likelihood	Low to Moderate
		Future users (commercial)	Medium	Unlikely	Low
	Direct ingestion of soils and/or dust derived from soil (indoors and outdoors)	Future users (residential)	Medium	Low likelihood	Low to Moderate
		Future users (commercial)	Medium	Unlikely	Low
		Off-site users[1]	Medium	Unlikely	Low
	Inhalation of dust derived from soil (indoors and outdoors)	Future users (residential)	Medium	Low likelihood	Low to Moderate
		Future users (commercial)	Medium	Unlikely	Low
		Off-site users[1]	Medium	Unlikely	Low
	Root Uptake and possible ingestion	Future users (residential)	Medium	Unlikely	Low
		Flora and Fauna (soft landscaping in the Proposed Development)	Mild	Unlikely	Very Low
	Inhalation of vapours (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low
	Leaching and migration of contaminants	Principal Aquifer (White Chalk Subgroup) with associated SP1 to SP3	Medium	Unlikely	Low
Former site uses of historic railway (heavy metals and metalloids, acids / alkalis, PAHs,	Dermal contact with soil (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low
	Direct ingestion of soils and/or dust derived from soil (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low

Potential Source	Potential Pathway	Potential Receptor	Severity	Probability	Risk Rating
TPHs, and asbestos)	Inhalation of dust derived from soil (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low
		Off-site users[1]	Medium	Unlikely	Low
	Inhalation of vapours (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low
	Root Uptake and possible ingestion	Future users (residential)	Medium	Unlikely	Low
		Flora and Fauna (soft landscaping in the Proposed Development)	Mild	Unlikely	Very Low
	Leaching and migration of contaminants	Principal Aquifer (White Chalk Subgroup) with associated SP1 to SP3	Medium	Unlikely	Low
Buncefield Oil Depo (PFAS in shallow soils, if present)	Dermal contact with soil (indoors and outdoors)	Future users (residential)	Medium	Low Likelihood	Low to Moderate
		Future users (commercial)	Medium	Unlikely	Low
	Direct ingestion of soils and/or dust derived from soil (indoors and outdoors)	Future users (residential)	Medium	Low Likelihood	Low to Moderate
		Future users (commercial)	Medium	Unlikely	Low
	Inhalation of vapours (indoors and outdoors)	Future users (residential)	Medium	Unlikely	Low
		Future users (commercial)	Medium	Unlikely	Low
	Root Uptake and possible ingestion	Future users (residential)	Medium	Unlikely	Low
		Flora and Fauna (soft landscaping in the Proposed Development)	Mild	Low Likelihood	Low
Buncefield Oil Depo (PFAS in groundwater)	Remobilisation of potential contamination plume through development design such as soakaways - although no concentrated deep infiltration drainage is proposed.	Principal Aquifer (White Chalk Subgroup) with associated SP1 to SP3	Medium	Low Likelihood	Low to Moderate

Potential Source	Potential Pathway	Potential Receptor	Severity	Probability	Risk Rating
Department of Transport Depot (heavy metals and metalloids, acids / alkalis, PAHs and TPHs.)	Dermal contact with soil (indoors and outdoors)	Future users (residential) immediately adjacent to depot	Medium	Low Likelihood	Low to Moderate
		Future users (commercial) immediately adjacent to depot	Medium	Unlikely	Low
	Direct ingestion of soils and/or dust derived from soil (indoors and outdoors)	Future users (residential) immediately adjacent to depot	Medium	Low Likelihood	Low to Moderate
		Future users (commercial) immediately adjacent to depot	Medium	Unlikely	Low
	Inhalation of vapours (indoors and outdoors)	Future users (residential) immediately adjacent to depot	Medium	Low Likelihood	Low to Moderate
		Future users (commercial) immediately adjacent to depot	Medium	Unlikely	Low
	Root Uptake and possible ingestion	Future users (residential) immediately adjacent to depot	Medium	Low Likelihood	Low to Moderate
		Flora and Fauna (soft landscaping in the Proposed Development) immediately adjacent to depot	Mild	Unlikely	Very Low
	Remobilisation of potential contamination plume through development design such as soakaways - although no concentrated deep infiltration drainage is proposed.	Principal Aquifer (White Chalk Subgroup) with associated SP1 to SP3	Medium	Unlikely	Low

The PRA has identified potential contaminant linkages with a maximum 'low to moderate' risk classification. Therefore, it is recommended that appropriately targeted ground investigation is undertaken for geo-environmental purposes to enable a refinement of the CSM and geo-environmental assessments for the specifically identified unacceptable risks. The next stage of geo-environmental assessment should include a generic quantitative risk assessment (GQRA). The recommended ground investigation and assessments should be undertaken and presented in a geo-environmental interpretive report in accordance with *BS10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice* and *LCRM* guidance.

9. Closing Remarks

9.1. Conclusions

A-squared Studio Engineers Ltd (A-squared) has been engaged by Expedition Engineering Limited (Expedition) to prepare a Land Condition Report for the Proposed Development at East Hemel, Hemel Hempstead, HP2 4UE. The Proposed Development can generally be described as the construction of numerous residential and commercial buildings in addition to large open communal spaces.

The majority of the Site is located within the administrative St Albans City and District Council however, a small area of the proposed highways and infrastructure works along the western extent of the Site are located within the administrative area of Dacorum Borough Council (1.3% of the total Site area). The Site currently includes several large undeveloped agricultural fields separated by a road network and boarded to the east by the M1 (which also cuts through the centre of the Site) and to the west by Buncefield Oil Depot. Although it is not within the Site boundary, a depot used by the Department of Transport is also observed to be located within the centre of the Site.

The ground conditions at the Site indicate the presence of Topsoil and limited areas of Made Ground underlain by the superficial deposits of the Clay With Flints Formation. These superficial deposits are then underlain by the Bedrock of either the Lambeth Group or the White Chalk Subgroup. Where superficial deposits are absent, these bedrock formations underly the Topsoil and/or Made Ground. Groundwater data from previous site investigation undertaken on site indicates groundwater elevations ranging from 84.56mOD to 132.6mOD within the White Chalk Subgroup.

Geo-hazards have been identified at the Site, notably chalk dissolution features and Head Deposits which represent a moderate risk to future development. These geo-hazards will require further investigation and consideration in design, but do not affect the viability of the development as a whole. Such additional investigation may be undertaken on a development phase basis, tailored to the geotechnical requirements for each development phase/type.

The potential risks to identified receptors (e.g. human health, water supply pipes, flora and fauna) are currently considered to be relatively low across the majority of the Site, with potentially unacceptable risks where Made Ground is locally present. However, the impact to the shallow soils from the Buncefield incident have not been established and soil testing for PFAS is required (PFAS from firefighting foams/water may impact the shallow soils on site associated with water run-off and spray). Additionally, further investigation in the areas of potentially contaminative land uses (historical railway line and existing off-site transport depot) is required.

The potential risks to controlled water receptors from on-site sources (Made Ground and previous/current land uses) is generally considered to be low. The risks to on-site receptors associated with contamination in groundwater arising from the Buncefield incident (predominantly relating to PFAS) is also low, as credible exposure pathways do not exist. The Proposed Development is unlikely to adversely affect the plumes of contamination associated with the Buncefield incident as earthworks/groundworks are unlikely to interact with groundwater; piled foundations, where/if necessary, are not generally expected to reach groundwater, although a foundation works risk assessment may be required once the foundation strategy is progressed. Options for sustainable drainage systems, such as permeable paving, filter drains and some infiltration through attenuation pond bases, shall be considered as the development progressive, subject to additional investigation and risk assessment with regards to risks to groundwater (i.e. to ensure that existing plumes are not mobilised) and in consultation with the EA

Based on the available information, it is considered that the development is viable with regards to land contamination and further investigation / assessment may be secured with planning conditions.

The identified data gaps, further investigation and outline remedial / material re-use requirements are set out below.

9.2. Data Gaps

The following data gaps have been identified as part of the current CSM and PRA:

- Previous investigations have been undertaken on site; however, as part of this work only limited investigation and soil testing was carried out in areas associated with the identified on-site source of the former railway now referred to as the 'Nickery Line'.
- Made Ground has locally been identified on site, but its lateral extent remains unknown. It also underwent only limited soil testing, with some samples, such as at borehole CP05, containing asbestos fibres and elevated concentrations of TPH, indicating these contaminants may be present elsewhere if Made Ground is present.
- Only limited investigation and testing has been undertaken in proximity to the Transport Depot surrounding the Site. As a result, there is potential for localised spills or leaks associated with the depot that may not have been assessed.
- During the A2SI investigation, several previous boreholes could not be located or were found to be damaged. This includes borehole A7, which had previously recorded elevated concentrations of PFOS. As these locations could not undergo additional testing, the baseline conditions could not be confirmed, and the potential lateral extent of the PFAS plume migrating northwards in the northeast corner of the Site remains unknown.
- The existing monitoring borehole network does not include locations in the eastern area of EH North or the southern area of EH South – although potential risks to (non-groundwater) on-site receptors from contaminants in groundwater and potential impacts to contaminants in groundwater (e.g. remobilisation) are considered to be low.

9.3. Further Investigation

Based on the CSM, PRA and the data gaps identified in Section 9.1, the following additional investigation is recommend:

- Shallow soil sampling targeting the former railway line in the northern portion of the Site. The samples collected from these locations should undergo acids / alkalis, PAHs, TPHs, and asbestos laboratory analysis.
- Shallow soil sampling targeting the areas of formally identified Made Ground to identify its composition and lateral extension. The samples collected from these locations should undergo heavy metals and metalloids, acids / alkalis, PAHs, TPHs, and asbestos laboratory analysis.
- Shallow soil sampling and shallow monitoring well installation followed by soil vapour monitoring rounds in areas of the Site adjacent to the Transport Depot not previously investigated should be undertaken. This is to monitor and better assess the potential migration of contaminants (including volatiles) onto site from the depot.
- Redrilling of locations of high PFOS and POFA concentrations previously identified in the Wardell Armstong investigation that could not be sampled as part of the A2SI investigation. This includes the location of A7 and A9 to A11.
- Drilling of locations located where the existing monitoring network is absent, e.g. eastern area of EH North or the southern area of EH South, to further assess the extent of plumes of contamination in groundwater arisings from the Buncefield incident.
- Further groundwater sampling and laboratory testing to address potential laboratory equipment errors and differences in RPD QA checks. This additional sampling should be of previous and newly installed monitoring wells. This groundwater sampling should undergo PFAS analysis as these were the contaminants previously identified across the Site which exceeded the relative drinking water standards as the CSM identifies the White Chalk Subgroup (SPZ1 to SP3) as a potential receptor. In addition, the sampling should account for seasonal and hydrological variations. This will provide a more robust and reliable dataset for the current monitoring well network.
- Further assessment and investigation in relation to the different options for alternative sustainable drainage systems.

It is considered that the additional investigation may be undertaken post-planning approval as the existing investigation is sufficient to demonstrate viability of the development with regards to land contamination.

9.4. Remediation

Based on the available information and current CSM/PRA, it is anticipated that the need for remediation at the Site will be limited to areas where Made Ground is present (this is expected to be localised) and potentially in areas of potentially contaminative land uses (historical railway and current transport depot). The remediation would likely take the form of conventional development phase mitigation measures, e.g. clean cover layers in gardens / soft landscaped areas and/or provision of protection water supply pipework where Made Ground is present.

The need for specific ground gas protection measures is not currently anticipated, although this requirement will require assessment on a development phase approach. Basic radon protection measures are expected to be required.

It is understood that the current approach to groundwater contamination associated with the Buncefield incident is long-term monitoring. Based on the development proposals, and notably the absence of concentrated deep infiltration drainage, the Proposed Development is very unlikely to adversely impact existing plumes of contamination in groundwater. Options for sustainable drainage systems, such as permeable paving, filter drains and some infiltration through attenuation pond bases, shall be considered as the development progressive, subject to additional investigation and risk assessment with regards to risks to groundwater (i.e. to ensure that existing plumes are not mobilised) and in consultation with the EA

9.5. Material Re-use

It is anticipated that earthworks will be required to provide development platforms and for landscaping, including cut and fill to achieve levels. It is expected that that the majority of the Site -won arisings will be suitable for re-use, although specific testing (chemical and geotechnical) will be required to confirm this.

The re-use of soil at the Site will require a Materials Management Plan (MMP) in accordance with the CL:AIRE Definition of Waste: Code of Practice (DoWCoP) and/or an environmental permit – the latter may provide greater flexibility for material re-use.

Appendix A: Groundsure Report

Groundsure LOCATION INTELLIGENCE

Enviro+Geo Insight

Marylands, Hemel Hempstead

Order Details

Date: 05/03/2024

Your ref: GIS_2024_0303

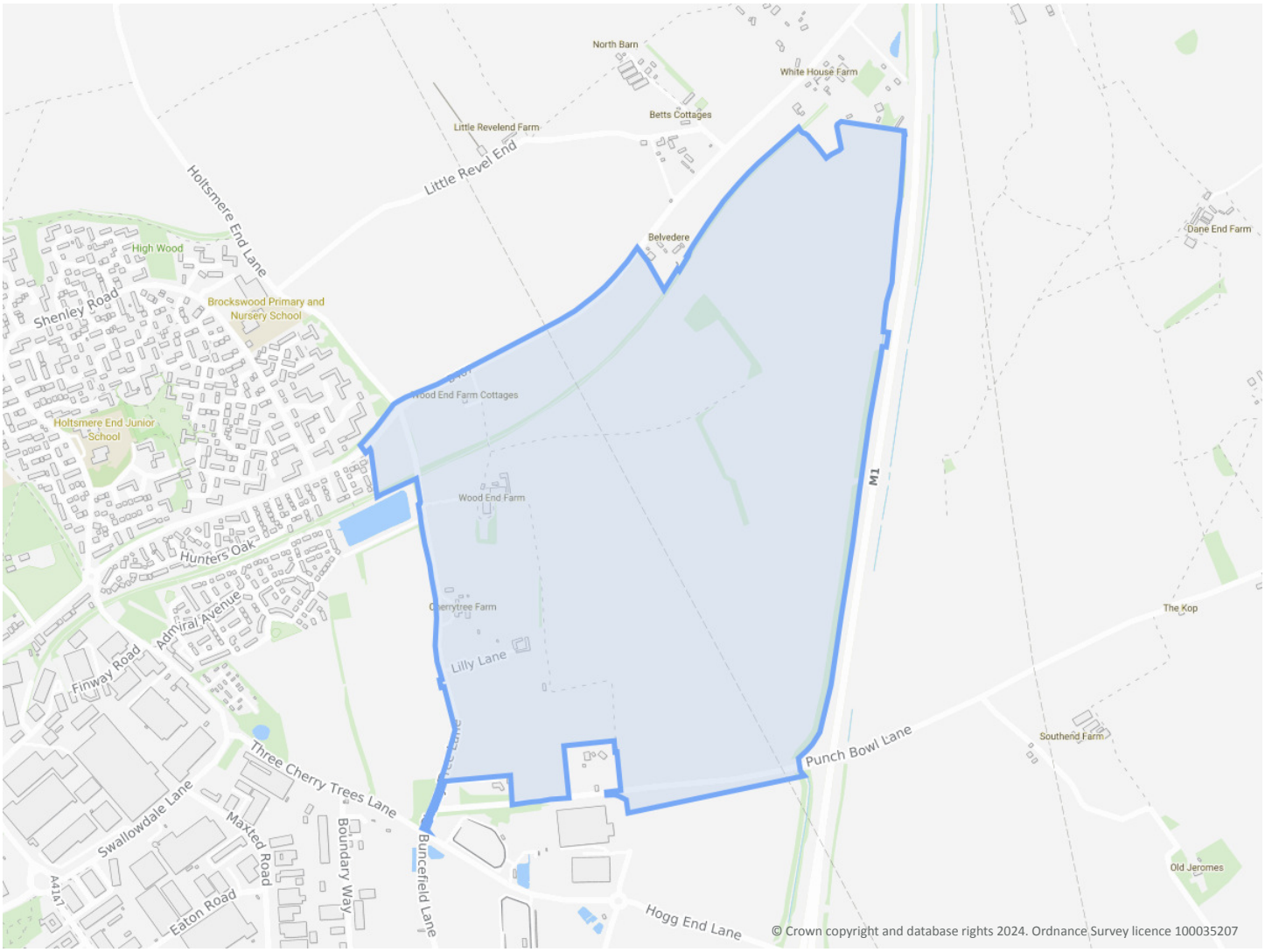
Our Ref: GSIP-2024-14652-17634_A

Site Details

Location: 508964 209726

Area: 150.73 ha

Authority: Dacorum Council ↗, St Albans City and District Council ↗



Summary of findings p. 2 >

OS MasterMap site plan N/A: >10ha

Aerial image p. 9 >

groundsure.com/insightuserguide ↗

Contact us with any questions at:
info@groundsure.com ↗
01273 257 755

Certified B Corporation

Summary of findings

Page	Section	Past land use >	On site	0-50m	50-250m	250-500m	500-2000m
14 >	1.1 >	Historical industrial land uses >	9	5	38	54	-
18 >	1.2 >	Historical tanks >	0	0	28	21	-
20 >	1.3 >	Historical energy features >	0	0	5	15	-
22	1.4	Historical petrol stations	0	0	0	0	-
22	1.5	Historical garages	0	0	0	0	-
22	1.6	Historical military land	0	0	0	0	-
Page	Section	Past land use - un-grouped >	On site	0-50m	50-250m	250-500m	500-2000m
23 >	2.1 >	Historical industrial land uses >	10	7	52	85	-
29 >	2.2 >	Historical tanks >	0	0	31	39	-
32 >	2.3 >	Historical energy features >	0	0	14	30	-
34	2.4	Historical petrol stations	0	0	0	0	-
34	2.5	Historical garages	0	0	0	0	-
Page	Section	Waste and landfill >	On site	0-50m	50-250m	250-500m	500-2000m
35	3.1	Active or recent landfill	0	0	0	0	-
35	3.2	Historical landfill (BGS records)	0	0	0	0	-
36	3.3	Historical landfill (LA/mapping records)	0	0	0	0	-
36 >	3.4 >	Historical landfill (EA/NRW records) >	0	0	1	0	-
36	3.5	Historical waste sites	0	0	0	0	-
36	3.6	Licensed waste sites	0	0	0	0	-
37 >	3.7 >	Waste exemptions >	3	0	9	24	-
Page	Section	Current industrial land use >	On site	0-50m	50-250m	250-500m	500-2000m
40 >	4.1 >	Recent industrial land uses >	3	4	25	-	-
42	4.2	Current or recent petrol stations	0	0	0	0	-
42	4.3	Electricity cables	0	0	0	0	-
43	4.4	Gas pipelines	0	0	0	0	-
43	4.5	Sites determined as Contaminated Land	0	0	0	0	-

43 >	4.6 >	Control of Major Accident Hazards (COMAH) >	1	5	0	0	-
44	4.7	Regulated explosive sites	0	0	0	0	-
44 >	4.8 >	Hazardous substance storage/usage >	0	0	1	10	-
46	4.9	Historical licensed industrial activities (IPC)	0	0	0	0	-
46 >	4.10 >	Licensed industrial activities (Part A(1)) >	0	0	0	12	-
48 >	4.11 >	Licensed pollutant release (Part A(2)/B) >	0	0	0	3	-
48 >	4.12 >	Radioactive Substance Authorisations >	0	0	0	3	-
49 >	4.13 >	Licensed Discharges to controlled waters >	0	0	2	1	-
50	4.14	Pollutant release to surface waters (Red List)	0	0	0	0	-
50	4.15	Pollutant release to public sewer	0	0	0	0	-
50	4.16	List 1 Dangerous Substances	0	0	0	0	-
50	4.17	List 2 Dangerous Substances	0	0	0	0	-
51 >	4.18 >	Pollution Incidents (EA/NRW) >	2	4	1	3	-
52	4.19	Pollution inventory substances	0	0	0	0	-
52	4.20	Pollution inventory waste transfers	0	0	0	0	-
52	4.21	Pollution inventory radioactive waste	0	0	0	0	-

Page	Section	Hydrogeology >	On site	0-50m	50-250m	250-500m	500-2000m
54 >	5.1 >	Superficial aquifer >	Identified (within 500m)				
56 >	5.2 >	Bedrock aquifer >	Identified (within 500m)				
58 >	5.3 >	Groundwater vulnerability >	Identified (within 50m)				
62 >	5.4 >	Groundwater vulnerability- soluble rock risk >	Identified (within 0m)				
63 >	5.5 >	Groundwater vulnerability- local information >	Identified (within 0m)				
64 >	5.6 >	Groundwater abstractions >	0	0	4	1	3
66 >	5.7 >	Surface water abstractions >	0	0	0	0	1
67 >	5.8 >	Potable abstractions >	0	0	0	0	1
67 >	5.9 >	Source Protection Zones >	1	0	0	0	-
68	5.10	Source Protection Zones (confined aquifer)	0	0	0	0	-

Page	Section	Hydrology >	On site	0-50m	50-250m	250-500m	500-2000m
69 >	6.1 >	Water Network (OS MasterMap) >	1	1	7	-	-

70 >	6.2 >	Surface water features >	1	3	9	-	-
71 >	6.3 >	WFD Surface water body catchments >	1	-	-	-	-
71 >	6.4 >	WFD Surface water bodies >	0	0	0	-	-
71 >	6.5 >	WFD Groundwater bodies >	1	-	-	-	-

Page	Section	River and coastal flooding	On site	0-50m	50-250m	250-500m	500-2000m
73	7.1	Risk of flooding from rivers and the sea	None (within 50m)				
73	7.2	Historical Flood Events	0	0	0	-	-
73	7.3	Flood Defences	0	0	0	-	-
74	7.4	Areas Benefiting from Flood Defences	0	0	0	-	-
74	7.5	Flood Storage Areas	0	0	0	-	-
75	7.6	Flood Zone 2	None (within 50m)				
75	7.7	Flood Zone 3	None (within 50m)				

Page	Section	Surface water flooding >	
76 >	8.1 >	Surface water flooding >	1 in 30 year, Greater than 1.0m (within 50m)

Page	Section	Groundwater flooding >	
78 >	9.1 >	Groundwater flooding >	Low (within 50m)

Page	Section	Environmental designations >	On site	0-50m	50-250m	250-500m	500-2000m
79	10.1	Sites of Special Scientific Interest (SSSI)	0	0	0	0	0
80	10.2	Conserved wetland sites (Ramsar sites)	0	0	0	0	0
80	10.3	Special Areas of Conservation (SAC)	0	0	0	0	0
80	10.4	Special Protection Areas (SPA)	0	0	0	0	0
80	10.5	National Nature Reserves (NNR)	0	0	0	0	0
81	10.6	Local Nature Reserves (LNR)	0	0	0	0	0
81 >	10.7 >	Designated Ancient Woodland >	0	0	0	0	8
81	10.8	Biosphere Reserves	0	0	0	0	0
82	10.9	Forest Parks	0	0	0	0	0
82	10.10	Marine Conservation Zones	0	0	0	0	0
82 >	10.11 >	Green Belt >	1	0	0	0	1
82	10.12	Proposed Ramsar sites	0	0	0	0	0