

SWMK Consortium

LAND SOUTH WEST OF MILTON KEYNES

Interpretative Environmental Desk Study Report



70069442-11578 JUNE 2020

CONFIDENTIAL

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Interpretative Environmental Desk Study Report

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1 INTRODUCTION

1.1 TERMS OF REFERENCE

WSP were instructed by SWMK Consortium to undertake an assessment of contaminated land and associated liabilities and constraints to support an Environmental Impact Assessment of the site located south of Standing Way and east of Whaddon Road, approximately 6.5km to the south west of Milton Keynes at approximate postcode MK17 0EG.

The site location and current layout are presented as Figures 1 and 2 in Annex A.

To support an earlier Environmental Statement for the Proposed Development, Pell Frischmann Ltd prepared a desk study in 2014, reference South West Milton Keynes Phase 1 Geo-Environmental Desk Study Environmental Statement Appendix 16.1 dated October 2014.

Subsequently, GEG Ltd undertook an intrusive ground investigation, reviewed the Pell Frischmann Phase 1 report and prepared an interpretative ground investigation report, reference Phase I Review & Strategic Phase II Geo-Environmental Assessment dated December 2017.

This WSP Interpretative Environmental Desk Study Report updates and draws together the desk based assessments prepared by Pell Frischmann Ltd and GEG Ltd and the GEG ground investigation findings to support a new Environmental Statement prepared for the site.

1.2 CLIENT AIMS

Based on discussions and correspondence to date, we understand that SWMK Consortium proposes to develop the site for a mixed end use comprising residential properties, employment areas, a school, community facilities and public open space. The most recent development plan is presented as Drawing CSA-4857-100-K – Development Framework Parameters Plan in **Annex A**.

We understand that SWMK Consortium's aims are to:

- Support the Environmental Impact Assessment with respect to assessing the impact on the scheme of existing ground conditions including contamination.
- Understand any constraints associated with ground contamination at the site which may impact the proposed development.
- Consider the resulting implications of these in terms of the associated environmental requirements, risks and liabilities.

1.3 PROJECT SCOPE

To assist in meeting SWMK Consortium's aims as stated in Section 1.2, the scope of this desk study comprised:

- Public record database review (site specific Groundsure Insight Report);
- Review of contemporary and historical Ordnance Survey (OS) maps;
- Review of geological, hydrogeological and hydrological maps;
- Preliminary unexploded ordnance (UXO) assessment;
- Review of Site investigation carried out by GEG Ltd in 2017.
- Derivation of a preliminary site conceptual model;
- Assessment of the potential for statutory and third-party liability due to environmental risks; and



• Recommendations for further work required to support the planning application.

1.4 LEGISLATIVE CONTEXT AND GUIDANCE

The assessment was undertaken in the legislative context of:

- Part 2A of The Environmental Protection Act (1990)
- The National Planning Policy Framework (2012)

The following good practice and statutory guidance was considered, and the assessment was undertaken in general accordance with:

- Environment Agency 'Model Procedures for the Management of Land Contamination', CLR11 (2004). (It should be noted that CLR11 has been archived by the Environment Agency and updated guidance is due to be published shortly).
- NHBC 'Guidance for the Safe Development of Housing on Land Affected by Contamination', R&D66 (2008).
- CIRIA 'Assessing Risks Posed by Hazardous Ground Gases to Buildings', C665 (2007)
- British Standard 'Investigation of Potentially Contaminated Sites Code of Practice', BS EN 10175:2011.
- Defra 'Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance', PB13735 (2012).
- British Standard 'Guidance on Investigations for Ground Gas Permanent Gases and Volatile Organic Compounds (VOCs)' BS 8576:2013.
- British Standard 'Code of Practice for Ground Investigations', BS 5930:2015.

1.5 SOURCES OF INFORMATION

Various sources of information have been referred to when producing this report and are listed in the sub-sections below.

1.5.1 PUBLIC INFORMATION

- British Geological Survey (BGS) mapping (BGS Geoindex), accessed March 2020. Available via <u>http://mapapps.bgs.ac.uk/geologyofbritain/home.html</u>
- DEFRA MAGIC online portal, accessed March 2020. Available via: <u>https://magic.defra.gov.uk/</u>
- Google Earth Imagery, accessed March 2020. Available via <u>https://earth.google.com/web/</u>
- Zetica Unexploded Bomb Risk Map, accessed March 2020. Available via: <u>https://zeticauxo.com/downloads-and-resources/risk-maps/</u> (presented in Annex B alongside the Pre-Desk Study Assessment also undertaken by Zetica).
- The Coal Authority, Interactive Map Viewer, accessed: March 2020. Available via http://mapapps2.bgs.ac.uk/coalauthority/home.html
- Groundsure Limited Enviro Insight, report reference: GSIP-2020-10052-335, dated March 2020 (referred to as the 'Groundsure report') (presented in Annex D).

1.5.2 PREVIOUS REPORTS

WSP has been provided with the following reports for the site:

 Pell Frischmann Ltd (2014) Phase 1 Geo-Environmental Desk Study – South West Milton Keynes, dated October 2014 (referred to as 'Pell Frischmann 2014 report').



 Geo Environmental Group (GEG) Ltd (2017) Phase 1 Review and Strategic Phase 2 Geoenvironmental Assessment, dated December 2017 (referred to as 'GEG 2017 report') (presented in Annex C).

1.5.3 WSP WALKOVER

• WSP undertook a site walkover on 12 March 2020. Photographs and an accompanying map are presented in **Annex E**.

1.6 CONFIDENTIALITY

This report is addressed to and may be relied upon by SWMK Consortium.

This assessment has been prepared for the sole use of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of WSP. No responsibility will be accepted where this report is used in its entirety, on in part, by any other party.

Information provided by other is taken in good faith as being accurate. WSP cannot and will not accept liability for any deficiencies in third party information. General limitations are presented in **Annex F**.

2 SITE INFORMATION

2.1 SITE DESCRIPTION AND CURRENT USE

Pertinent site details are presented in Table 2-1.

Table 2-1.	Summary	of Site	Details
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ltem	Detail
Site address and access	 The site is located at the approximate postcode MK17 0EG. A site location plan is presented as Figure 1 in Annex A. The site is accessed from: Buckingham Road (B4034) in the northeast. Whaddon Road in the west - southwest. Weasel Lane orientated northeast to southwest (unrestricted, one-way access from Whaddon Road to Buckingham Road). An unnamed lane which runs along the northernmost boundary approximately east to west (gated access from Buckingham Road and bollards at Whaddon Road restrict vehicle access).
National Grid Coordinates	483257, 232690
Area	Approximately 145.31ha
Site location and setting	 The site is located in the Snelshall Priory area, at the southwestern periphery of Milton Keynes, approximately 6.5km to the south west of Milton Keynes town centre. The surrounding area is largely occupied by open agricultural field and residential properties, with the following immediate surrounding land uses: North: Standing Way (A421) and Buckingham Road (B4034) are to the immediate north, with Windmill Hill Golf Centre and industrial warehouses at Snelshall West (Suzuki GB, Cranswick Foods and DS Smith Packaging) and Snelshall East (DHL Supply Chain) located beyond. The Tattenhoe Valley Park (The Parks Trust) is located 0.3km to the north of the site boundary, with the largely residential housing area of Tattenhoe situated just beyond. East: Residential housing of Bletchley (including an allotment plot) is located to the immediate east of the site. The Milton Keynes Scotia Gas Networks (SGN) depot is located 0.4km southeast of the site boundary. A large landfill site, operated by FCC Recycling (UK) Ltd (at a former clay quarry) is located 1.5km to the southeast of the site, with the Blue Lagoon Nature Reserve located beyond (approximately 2km east of the site boundary). South: The disused Buckinghamshire Railway line is immediately adjacent to the southern boundary, with agricultural farmland and residential housing of Newton Longville situated just beyond (approximately 0.5km south of the site boundary). West: Whaddon Road is immediately adjacent to the western boundary, with a recycling centre (Pearce Recycling) and agricultural farmland beyond. A large designated ancient woodland area (approximately 45ha) is located to the immediate west of the site boundary, bordering the roundabout linking Standing Way (A421) and Whaddon Road.

ltem	Detail
Topography	The site topography is generally flat, lying at approximately 110m AOD (above Ordnance Datum) in the north, sloping up to the centre from the north peaking to 120m AOD along Weasel Lane and falling to 95m AOD in the south alongside the railway line.
General site description and current use	The site comprises a large area of open arable farmland, with hedgerows along its perimeters and field boundaries. In the northwest corner of the site, there is a small area of deciduous woodland, containing mature trees and shrubs. 'S' shaped ridge and furrow land is present in the north eastern corner of site, alongside Buckingham Road and around an existing property. The site is bisected by Weasel Lane. An aerial image showing the approximate site boundary in red is presented below as Insert 1 (extracted and modified from Google Earth Pro – aerial photograph dated May 2018).
	Insert 1. Site Layout Plan
Onsite buildings / structures	 There are three unoccupied stables / barn structures on site; The stable to the north of the site, is partially collapsed and in a deteriorated condition (Photographs 9, 10, 12 and 13). Intact and broken asbestos cement roofing material is present on the building structure itself and on the ground surface within the vicinity of the stable; Two large barns on the western site boundary, alongside Whaddon Road, appeared to be in average condition from the outside (no authorised access to the inside). A rusted oil drum was also observed at the north western most barn.
Services – overhead and underground	 A 'gas pipe / borehole monitoring well' was identified in the landscaped area in the northwest of the site, at the corner of the roundabout linking Standing Way and Whaddon Road (Photograph 4). Oil pipeline markers are present in the centre of the site on Weasel lane indicating a north to south orientation (Photographs 21 and 22); Two onsite pylons supporting overhead powerlines cross the northwestern area of



Item	Detail
	the site, from the north and offsite to the southwest.
Contamination and areas of potential concern	The March 2020 site walkover revealed the following areas of potential concern regarding potential current and historical sources of ground / groundwater contamination;
	 Fly tipping was observed along Weasel Lane in the centre of the site and adjacent to the northern site boundary, along the unnamed lane (accessed from Whaddon Road in the west and Buckingham Road in the north). The fly tipped waste consists mostly of mixed household waste (Photograph 17). A few gas canisters were also observed in the northwest of the site, again along the unnamed road, near its entrance from Whaddon Road in the west (Photograph 6). Earth bund, containing mixed debris including construction / demolition waste (concrete and brick gravel / cobbles), again along the unnamed road, near its entrance from Whaddon Road in the west (Photographs 1, 2 and 5); Asbestos / Asbestos Containing Materials (ACMs) was identified on the ground surface, in the form of corrugated asbestos cement roofing, and in the construction of a partially collapsed, old stable structure in the north of site (Photographs 9, 10, 12 and 13); Made Ground was observed on the access routes and at onsite structures (e.g. stables / barns). Black solidified, slag looking material was also observed on a farm trackway in the south of the site in the agricultural field (Photograph 24); Evidence of the disposal of waste by burning in the north of the site, within the vicinity of the old stable structure (Photograph 11); and Oil drum was identified at a barn located along Whaddon Road in the west (no photograph available).
Radon	The site lies within an area where less than 1% of properties are above radon action level. As such radon protection measures are not anticipated to be necessary for any new development.
Unexploded Ordnance	An Unexploded Ordnance (UXO) Bomb Risk Map and Pre-Desk Study Assessment (PDSA) completed by Zetica, dated March 2020, reviewed the potential UXO risk at the site and rated it as low. The Zetica UXO PDSA report is presented in Annex B . Zetica also addresses UXO hazard from other past military activity. No readily available records have been found to indicate that the site was bombed during World War I or World War II. No records of military activity on the site post-WWII have been found.

2.2 SUMMARY OF PERTINENT SITE FEATURES

The following features are considered pertinent to an assessment of soil and groundwater contamination:

- Onsite buildings (stable / barns) are likely to contain asbestos.
- Localised impact to shallow soils on site from-;
 - Fly tipped material (mixed wastes and earth bund);
 - Partially collapsed buildings constructed with ACMs;
 - Burning of waste (polycyclic aromatic hydrocarbons (PAHs) and heavy metals);
 - Potential historic leaks and spills from localised above ground liquid chemical / fuel storage;
 - Traffic related contaminants along Weasel Lane (Metals, PAHs, petroleum hydrocarbons etc)

- Made Ground within the vicinity of the onsite buildings and on trackways (although deep areas of Made Ground are not expected).
- Buried services including an oil pipeline.

3 SITE SETTING

3.1 GEOLOGY AND MINING

3.1.1 PUBLISHED GEOLOGY

BGS mapping indicates the underlying bedrock comprises mudstone of the Oxford Clay Formation, predominantly of the Stewartby Member, with a small area in the south comprising the Weymouth Member). No faults or linear features are present within the site boundary.

Superficial deposits predominantly comprise Glacial Till (silty, sandy, gravelly clay), with a narrow strip of alluvium (clay, silt, sand and gravel) in the northwestern corner. A very small area in the south east corner records no superficial deposits.

The extent of the superficial and bedrock geology beneath the site is illustrated by **Insert 2** (extracted and modified from the Groundsure report).



Insert 2. Extent of bedrock (left) and superficial (right) geology

3.1.2 BGS BOREHOLES

The BGS borehole log for borehole SP83SW256 — H8 A421-V1 MK1924A (NGR 482400,232715) is located on site along the northern most boundary (adjacent to Standing Way A421; client Milton Keynes Development Corporation). The log records firm, becoming stiff silty clay with some gravel and chalk fragments to 15.0m below ground level (m bgl). Rockhead was not encountered. This correlates with the published geology indicated in Insert 2 above.

3.1.3 MINING AND MINERALS

The Groundsure report indicates the site is not within an area which may be affected by non-coal and coal mining activity, as such there is no risk to development in relation to historic mining on site.

There is one BGS recorded mineral planning area within 0.5km of the site boundary, located 0.4km east of the site at Bletchley Brickworks for the extraction of clay via surface workings. Planning status and date are not available within the Groundsure report.

3.2 HYDROGEOLOGY

The Environment Agency (EA) classified the Glacial Till as a secondary undifferentiated aquifer and the alluvium deposits as a secondary (A) aquifer. The Oxford Clay Formation is classified as an unproductive aquifer, with low permeability mudstones that have negligible significance for water supply or river base flow.

Regarding groundwater vulnerability, soils on site are classified as having an intermediate leaching potential and therefore the superficial aquifer is classified as having a medium vulnerability to a pollutant discharge.

Many BGS boreholes within the vicinity of the site record no water strikes, deeming wells as 'dry'.

Concerning BGS Groundwater Flooding Susceptibility, the Groundsure report states that there is a moderate risk of groundwater flooding across the site, although there are no records of historic flood events from groundwater (from 1946 onwards) on site or within 0.25km of the site boundary.

There are no groundwater abstractions on site. The nearest groundwater abstraction is located 0.3km west of the site, at a well in Bletchley, for general farming and domestic use. The Groundsure report does not contain a licence expiry date for the groundwater abstraction point. However, the report describes its status as 'historical' and so it is likely that abstraction at this location is no longer practiced.

There are no licensed discharges to controlled waters on site. There are six locations with licenced discharges to controlled waters within 0.5km of the site, all relating to sewage effluent, most of which has been treated.

Additional information in relation to the hydrogeology is provided below:

- There is no source protection zone within 0.5km of the site boundary.
- There are no potable water abstraction licenses within 2km of the site.
- Regional groundwater flow is likely to be towards the north; towards the River Ouzel (a tributary of the River Great Ouse located 12km to the northeast of the site).

3.3 HYDROLOGY

The Groundsure report records four surface water features on site, relating to inland rivers; two in the northwestern corner and two in the south of the site. The rivers are permanent water courses (containing water year-round), not influenced by normal tidal action and are located on the ground surface. Groundsure also records an onsite water body relating to a lake, loch or reservoir on the southwestern boundary which is probably referring to a pond indicated on the 1970 historical map.

During the March 2020 site walkover, conducted by WSP, the inland rivers recorded in the Groundsure report were observed; photographs of the inland rivers in the northwest of the site are presented by photograph 3 & 14 in **Annex E**. The inland rivers in the northwest flowed off site to the north. Furthermore, it was noted during the walkover that drainage ditches containing standing water were present on most field boundaries, particularly alongside highways and Weasel Lane. According to the Groundsure report, there are two protected Water Framework Directive (WFD) surface water body catchments identified on site, which likely correspond to this observation; Newton Longville Brook and Loughton Brook which run parallel to Weasel Lane.



Waterlogging was also observed on most fields, particularly in the north of the site (photograph 10 in **Annex E**). The onsite water body noted by Groundsure in the southwest of the site was not observed, nor it is apparent on publicly accessible current and historical aerial photography.

There are no surface water abstraction points on site. The nearest surface water abstraction is located 1.8km to the south of the site, used for irrigation spray. The Groundsure report does not contain a licence expiry date for the surface water abstraction point, however the report describes its status as 'historical' and so it is likely that abstraction at this location is no longer practiced.

Concerning BGS Groundwater Flooding Susceptibility the Groundsure report states that there is a medium – high risk of flooding from rivers (and / or sea) in the far northwestern corner of the site. This area is located in a Flood Zone 2 & 3, with a high probability of flooding from rivers (and / or sea) and a high risk of surface water flooding from extreme rainfall events (1 in 100-year return period, with a depth greater than 1.0m).

There is a greater risk of surface water flooding in the south of the site as a result of extreme rainfall events; a 1 in 30 year return period has been determined, with a depth greater than 1.0m. The risk of surface water flooding across the site is illustrated by **Insert 3** (extracted and modified from the Groundsure report). Although there are no records of historic flood events from rivers or surface water (from 1946 onwards) on site or within 0.25km of the site boundary.



Insert 3. Surface water flooding

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

3.4 SENSITIVE LAND USES

There are 7 records of designated ancient woodland within 1km of the site boundary. As detailed in Section 2.1, a large designated ancient (replanted) woodland area, approximately 45ha in size, is located to the immediate west of the site boundary, bordering the roundabout linking Standing Way (A421) and Whaddon Road. This area is classified as deciduous woodland habitat of principal importance as named under Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006).

Areas of deciduous woodland located on site, particularly along the northern boundary, have also been classified as habitats of principal importance named under the NERC Act. As such, the act requires public authorities and government departments to conserve biodiversity, by enhancing, restoring or protecting a population or a habitat. No further consideration of the deciduous woodland habitat areas or other related habitat designations recorded within the Groundsure report has been undertaken in this report. Specialist ecological advice should be sought.

There are two nitrate vulnerable zones within the site boundary, relating to agricultural nitrate pollution designated under the EC Nitrate Directive (91/676/EEC) to surface waters draining into the River Great Ouse.

There are no other sensitive environmental designations within 1km of the site. There are no visual and cultural designations within 0.25km of the site.

3.5 GROUND STABILITY

The risk of potential geohazards have been ascertained from the Groundsure Report, and a summary is provided below:

Stability hazard	Risk level (on site)	Risk level (off site, if greater)
Potential for collapsible ground	Negligible – very low	-
Potential for compressible ground	Negligible - moderate	-
Potential for dissolution	Negligible	-
Potential for landslides	Very low	Low
Potential for running sands	Negligible - low	-
Potential for swelling or shrinking clay	Very low - moderate	-

Table 3-1. Ground Stability Information

Information contained within Table 3-1 indicates that the site is unlikely to experience natural ground subsidence, with the exception of swelling / shrinking clays in the southeast corner and compressible ground in the far northwestern corner of the site.

Furthermore, as detailed in Section 3.1 Geology and Mining, the Groundsure report indicates that the site is not within an area which may be affected by non-coal and coal mining activity. As such there is unlikely to be a risk to development in relation to ground instability from historic mining on site.

3.6 LANDFILLS, WASTE MANAGEMENT AND POLLUTION INCIDENTS

The Groundsure report lists the following landfills, waste management sites and pollution incidents in the vicinity of the site:

 One historic landfill (EA records) 449m to the east in Newton Longville. The landfill was active between 1969 – 1994 and operated by London Brick Land Development Limited, which historically accepted inert, industrial, commercial and household wastes.



- One licensed waste site (EA records) 109m south east of the site, relating to a co-disposal landfill site in Newton Longville. The site is operated by Shanks Waste Services Ltd and the licence was issued in 1983 (modified in 2002). No further information is provided.
- 42 waste exemptions on site, relating to storing waste, disposing of waste (including burning waste in the open), treating of waste and using waste (e.g. as a fuel, in construction, spreading for agricultural benefit etc) on farmland.
- 16 pollution incidents (EA records) within 0.5km of the site, five of which took place on the site itself. The incidents on site occurred between 2001 2003 and related to the fly tipping of mixed wastes including construction and demolition waste, tyres and other unrecorded pollutants. All five incidents recorded the following impacts; Category 4 (no impact to water and air) and Category 3 (minor impact to land). The pollution incidents surrounding the site generally involved the release of sewerage materials into local water courses and also fly tipping of agricultural material / waste.

3.7 SUMMARY OF PERTINENT INFORMATION

The environmental setting of the site is considered to be relatively low sensitively with regard to potential impacts of contamination to subsurface geology, groundwater and surface water.

Localised contamination is likely to be present on site associated with the historic and ongoing agricultural activities, onsite pollution incidents and fly tipping (mixed wastes and earth bund).

4 SITE HISTORY

A review of historical maps from the Groundsure report has been completed with details provided below in Table 4-1. The historical maps are provided as part of the Groundsure report in **Annex D**.

The historical review has identified that the use of the site has remained constant from circa 1881 until the present day, comprising open agricultural land. The surrounding land however, has undergone some significant development over the same period of time, as detailed in Table 4-1 below.

No potentially significant, historical contaminative land uses which could impact surface geology, groundwater and surface water have been identified from the historical map review.

Date	On-site	Off-site
1881 –1970	The site is predominantly shown as undeveloped open arable farmland, with hedgerows along its perimeters and field boundaries. Weasel Lane bisects the site, orientated approximately northeast – southwest, following a historical County and Civil Parish Boundary. Several small farm buildings are located across the site. A few footpaths are shown branching from Weasel Lane off-site to the north and south. Several small ponds appear to be present along field boundaries, particularly in the northwest of the site. By 1968, drains are now indicated where individual field boundaries were previously indicated.	Surrounding area is predominately arable farmland, with areas of woodland and parkland. Many farms and associated buildings / infrastructure are displayed, including Bletchley Leys Farm which is shown to the immediate west of the site. A track / road is shown along the northern and western site boundaries. A railway line, orientated northeast – southeast is immediately adjacent to the southern boundary.
1970 - 2000	Two onsite pylons, supporting overhead powerlines which cross the northwestern area of the site, from the north and offsite to the southwest appear on historical maps dated 1977. No other significant changes to the site are apparent.	 Surrounding area shows increased transport infrastructure and residential / commercial land use, particularly to east in Bletchley and southeast in Newton Longville; A small sewage works (circular structure) appears in the 1950s, approximately 200m to the south of the site, alongside Manor Farm. Appearance of Buckingham Road to the immediate north in 1973. Conversion of agricultural land into recreational space; golf course to the north of the site appears in 1976. The Milton Keynes SGN depot, located 400m

Table 4-1 – Historical Map Review



Date	On-site	Off-site
		southeast of the site boundary appears in 1977.
2000 - present	No significant changes to the site are apparent.	By 2001, the railway line at the immediate southern site boundary disappears from historical maps (assume no longer operational).
		Development of road networks and roundabouts is shown to the northwest of the site (including Bottle Dump Roundabout at the immediate northwestern corner of the site).
		The sewage works located to the south are no longer indicated on the maps and the area has been re- developed into 'recreational ground'.
		Snelshall West and East to the immediate north of the site appear by 2010.
		Development of residential housing to the immediate east of the site continues – back gardens currently broadening eastern site boundary.

5 GEG LTD GROUND CONDITIONS 2017

This Section summarises the findings of the Geo Environmental Group (GEG) Ltd October 2017 site investigation, reported within the GEG Ltd (2017) Phase 1 Review and Strategic Phase 2 Geoenvironmental Assessment, dated December 2017 (referred to as 'GEG 2017 report' and presented in **Annex C**).

WSP have not summarised Sections 1 to 6 as these re-iterate the Desk Study report findings and Section 9 is also not summarised as this deals with Geotechnical design and is therefore outside the scope of this WSP desk study report.

5.1 SUMMARY

5.1.1 INTRODUCTION – TERMS OF REFERENCE

The GEG 2017 report was prepared by GEG Ltd for the benefit of Hallam Land Management, Connolly Homes, Taylor Wimpey Strategic Land, William Davis Ltd and Bellcross Homes.

5.1.2 SCOPE

The intrusive investigation comprised:

- 7 window sample holes (five with gas and groundwater monitoring wells),
- 24 trial pits,
- 7 CBR (California bearing ratio),
- Collection of soil samples for geotechnical & environmental chemical testing (see details below),
- 8 infiltration tests,
- Gas and groundwater monitoring (2, 9 & 22 November 2019).

5.1.3 LABORATORY ANALYSIS

Geotechnical laboratory testing on soil samples comprised; natural moisture content, liquid & plastic limits, dry density / moisture content ratio, water soluble sulphate, soluble magnesium and pH.

Environmental chemical testing on soil samples comprised a combination of a range of contaminants commonly identified on brownfield sites, together with specific determinands based on the former and current site and adjacent site uses. Environmental testing included;

- Metals (including semi-metals and non-metals); cadmium, chromium (total, III and VI), copper, lead, nickel, zinc, mercury, antimony, arsenic, boron, selenium;
- Inorganic chemicals; cyanide (total and free), sulphate (soluble), sulphide;7
- Organics; total phenols, banded total petroleum hydrocarbons, (TPHs), speciated polycyclic aromatic hydrocarbons (PAHs), semi-volatile organic compounds (SVOCs) pesticide screen;
- pH; and
- Soil organic matter.

5.1.4 GROUND CONDITIONS

The ground investigation (GI) is reported to broadly confirm the published geology. No Made Ground was recorded. Topsoil was recorded to a maximum depth of 0.3m bgl. Beneath this, clay was recorded to at least 6.45m bgl. The underlying Oxford Clay bedrock was not encountered.

5.1.5 FIELD EVIDENCE OF CONTAMINATION IN SOIL

No visual or olfactory evidence of contamination was recorded.

5.1.6 GROUNDWATER CONDITIONS

Groundwater was encountered during the GI within the Glacial Till between 2.2m bgl and 6.45m bgl and varied from wet soil to slow seepage. During the post monitoring site works, groundwater varied from dry to 1.99m bgl.

5.1.7 LABORATORY ANALYSIS RESULTS

A generic human health risk assessment for a residential with home grown produce end use was undertaken by GEG. No elevated soil contaminants were identified.

5.1.8 GROUND GAS MONITORING RESULTS

Gas monitoring recorded methane up to 0.1%, carbon dioxide up to 1.9%, depleted oxygen down to 16.7%, no hydrogen sulphide and gas flow up to 0.7 litres per hour.

A gas risk assessment undertaken for low rise traditional housing indicates the residential areas of the site are characterised as National House Building Council (NHBC) 'Green'. Non-residential areas of the site are classified as Characteristic Situation 1. No special gas protection measures are therefore required.

5.1.9 ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

A revised conceptual site model is presented and concludes;

- No significant sources of contamination identified;
- No potential risks to human health;
- No potential risks to controlled waters;

Other conclusions are reported as follows;

- Arisings are likely to be classified as inert waste and as such arisings should be suitable for use as general fill on other development sites or for other infill / cover requirements on site.
- Topsoil is suitable for re-use.
- No specific remedial measures are required for human health or controlled waters.

GEG report that the exploratory holes are approximately 200m apart and consider it essential that further intrusive investigation is undertaken at detailed design stage in order to confirm the consistency of the strata and to delineate any very localised potential contamination sources between these locations.

6 CONCEPTUAL SITE MODEL

6.1 INTRODUCTION

Plausible source-pathway-receptor contaminant linkages have been defined in line with industry good practice (principally CLR11 and R&D66).

The potential risks from contamination within soil and groundwater are assessed according to the environmental setting / ground model, likely presence of potential sources of contamination and the proposed use of the site.

The source-pathway-receptor model forms the basis of the risk assessment. Potential risks are only considered to exist if there is a credible source (e.g. a chemical substance capable of causing harm); a pathway for migration of the source to a receptor; and a sensitive receptor that could be affected (e.g. nearby river or site user). A source-pathway-receptor contaminant linkage assessment is termed a conceptual site model (CSM). A preliminary CSM is produced prior to intrusive ground investigation and is refined following collection of site-specific data (if appropriate).

6.2 PRELIMINARY GROUND MODEL

The ground conditions across the site are anticipated to comprises low permeability, natural superficial deposits, principally of clay (Glacial Till), with a narrow strip of clay, silt, sand and gravel (Alluvium) in the northwestern corner.

Localised areas of shallow Made Ground / potential contamination may also be present on site associated with the following locations, although the GEG Ltd ground investigation in 2017 did not identify any contamination;

- Partially collapsed, relict stable and barn structures in the north of the site and along the western site boundary (likely constructed with ACMs);
- Evidence of fly tipping (mixed wastes and earth bund) observed during the site walkover
- Evidence of burning of wastes during the site walkover;
- Construction of trackways onsite from Buckingham Road (north) and Whaddon Road (south); and
- Buried services including an oil pipeline.

There is also the potential for site soils to have been impacted through historic leaks and spills from above ground liquid chemical / fuel storage.

Buried services including an oil pipeline are anticipated to cross the site, as identified during the site walkover.

Mudstone of the Oxford Clay Formation, classified by the Environment Agency as an unproductive aquifer with low permeability, underlies the site. No faults or linear features are present onsite.

As detailed in Section 3.1, BGS borehole SP83SW256 — H8 A421-V1 MK1924A, located on site along the northern most boundary, indicates silty clay with some gravel and chalk fragments to 15.0m bgl. No BGS exploratory hole locations are positioned within the vicinity of the relict stable and barn structures. As such, no Made Ground has been mapped by the BGS at these locations.

There is a network of drains / ditches on site, located on site along field boundaries. Minor inland rivers were also observed along field boundaries in the northwest of the site. Perched groundwater may be present within shallow soils and deeper groundwater.



High rainfall periods could mobilise contaminants from the onsite Made Ground materials (outlined above) into surface watercourses, which flow north, to off-site water receptors.

6.3 SOURCES, PATHWAYS AND RECEPTORS

The potential **sources**, **pathways** and **receptors** relevant to the proposed mixed development are identified below. The assessment assumes that no remedial measures are implemented to mitigate risks during or within any redevelopment.

POTENTIAL CONTAMINANT SOURCES

The potential sources of contamination are associated with the sites historical and current use as a farm, as summarised below in Table 6-1.

Contaminant source	Potential contaminants in soil and groundwater	
Potential on-site contaminants – as identified by the March 2020 site walkover		
Relict onsite buildings – stable / barns	Localised asbestos fibres and asbestos containing materials (ACMs) used in the construction of the structures (e.g. as corrugated asbestos cement roofing).	
 Made Ground; Fly tipped material – mixed wastes and earth bund Within the vicinity of the onsite buildings and on trackways 	Various including; asbestos, heavy metals, fuel / oil hydrocarbons, polyaromatic hydrocarbons, pesticides / herbicides, agricultural waste (e.g. used tyres, silage plastics, pallets), household waste (e.g. textiles, plastics, glass), construction / demolition waste (e.g. concrete, brick, glass). Hazardous ground gases (e.g. methane, carbon dioxide, hydrogen sulphide) from areas of deep putrescible Made Ground (not anticipated) and organic-rich alluvial superficial deposits.	
Fuel / chemical spills	Hydrocarbons (including diesel, heating oil, farm machinery lubricating oil), solvents and herbicides / pesticides.	
Disposal of waste by burning – Ash and charred waste remains	Polycyclic aromatic hydrocarbons (PAHs) and heavy metals (e.g. mercury, lead, arsenic).	
Traffic related contaminants along Weasel Lane	Metals, PAHs, petroleum hydrocarbons, oils / fuels.	
Potential off-site contaminants – as identified by r the current surrounding land use and site history.		
The disused railway line to the immediate south	Metals, PAHs, petroleum hydrocarbons, oils / fuels, solvents.	
Historic sewage works (circa 1950-2001) 200m south	Organic contaminants, wastewater treatment / water purification chemicals.	
Industrial warehouses to the immediate north	Various contaminants associated with industrial storage and distribution of wholesale food items, vehicles, packaging etc.	

Table 6-1. Potential contaminant sources

POTENTIAL RECEPTORS

The environmental setting of the site is considered to be relatively low sensitively with regard to potential impacts of contamination to subsurface geology, groundwater and surface water.

Based on development for a mixed end use, the primary potential receptors are considered to be as follows:

- People who may be exposed to soil dust during earthworks / re-development works including;
 - Ground workers.
 - Neighbouring site users / residents.

The following potential receptors could also be impacted by contamination in the soil / groundwater:

- Ground workers during redevelopment.
- Future site users (residents) and recreational site users.
- Future maintenance workers.
- Plastic potable water pipes and below ground infrastructure.

The following potential receptors could be impacted if there is significant mobile contamination within soil / groundwater (considered unlikely):

- Surface water (on-site inland rivers / drains / ponds) and down-gradient inland rivers to the north.
- Groundwater (underlying superficial and bedrock aquifers)

POTENTIAL PATHWAYS

Relevant potential exposure pathways are considered to include:

- Direct contact, ingestion or inhalation of soil bound contaminants / dust during redevelopment works or in landscaped areas following redevelopment.
- Migration of volatile compounds or hazardous ground gases followed by inhalation in confined spaces (e.g. excavations, ground floor rooms) during redevelopment works or following redevelopment.
- Migration of mobile/leachable contamination through soils / shallow groundwater to underlying aquifer or surface waters.

6.4 CONTAMINANT LINKAGE ASSESSMENT

Given the historical and current use of the site as a farm, the likelihood of gross and / or widespread contamination or hazardous ground gases / vapours being present onsite is very low, although localised hotspots of contamination within shallow soils, related to farming activities are anticipated.

The potential for future liabilities associated with soil and groundwater contamination at the site (i.e. due to adverse off-site effects/impacts) is also considered to be very low.

If complete contaminant linkages are present, these could be broken by undertaking some relatively basic remediation / mitigation works, e.g. removal of hot spots of contamination, appropriate re-use of materials, provision of barrier pipe for potable water supplies in affected areas and provision of gas mitigation measures in new properties.



6.5 PRELIMINARY CONCEPTUAL SITE MODEL

Table 6-2 below summarises the potential source-pathway-receptor linkages. The CIRIA risk classification matrices (presented in **Annex G**) were used to determine the probability, consequence and level of risk related to each potential linkage.



Table 6-2 - Preliminary Conceptual Site Model

Table 6-2 summarises the potential source-pathway-receptor linkages. The CIRIA risk classification matrices (presented in **Annex G**) were used to determine the probability, consequence and level of risk related to each potential linkage.

Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Consequence of Exposure	Discussion of Contaminant Linkage	Risk
Localised chemical contamination in soil and groundwater associated with historical use of site and surrounding sites. Localised chemical contamination associated with Made Ground materials.	Direct contact or ingestion of soil bound contaminants / dust.	Construction and future maintenance workers	Low	Minor	Workers are likely to come into direct contact with soil during construction / maintenance activities, although only for a short period of time	Very Low
		Future site users	Low	Medium	Future site users (i.e. residents) may be exposed via direct dermal contact with soil in gardens and landscaped areas over a long period of time. Ingestion of soil bound contaminants (via ingestion of potentially contaminated home-grown produce)	Low to Moderate
		Below ground infrastructure / services	Unlikely	Mild	Building foundations and service pipes may come into direct contact with Made Ground which could affect their integrity	Very Low
	Inhalation of soil bound contaminants / dust	Construction and future maintenance workers	Low	Medium	Workers may inhale contaminants / dust during construction / maintenance activities, although only for a short period of time	Low to Moderate
		Third parties (adjacent site users and residents)	Unlikely	Medium	Dust and fibres generated during construction activities have the potential to migrate offsite and impact adjacent site users (particularly to the east of the site)	Low
		Future site users	Low	Medium	Future site users (i.e. residents) may inhale contaminants / dust from gardens and landscaped areas over a long period of time	Low to Moderate

Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Consequence of Exposure	Discussion of Contaminant Linkage	Risk
	Leaching and migration of contaminants to wider environment	Surface waters (including inland rivers / drains / ponds)	Unlikely	Mild	The local surface water network involves a series of drains, some connecting with the wider river network. High rainfall periods could release contaminants from potential Made Ground to the ground surface as flood water	Very Low
	Mobile contaminant / free product / dissolved phase migration into wider environment.	Superficial aquifers – EA classified as 'undifferentiated' and 'secondary (A)' aquifers	Unlikely	Mild	Soils on site are classified as having an intermediate leaching potential and therefore the superficial aquifers are classified as having a medium vulnerability to a pollutant discharge	Very Low
		Superficial aquifers – EA classified as 'undifferentiated' and 'secondary (A)' aquifers	Unlikely	Mild	Soils on site are classified as having an intermediate leaching potential and therefore the superficial aquifers are classified as having a medium vulnerability to a pollutant discharge	Very Low
		Bedrock aquifer – EA classified as 'unproductive'	Unlikely	Minor	The underlying bedrock aquifer is confined by a potentially significant depth of low permeability, cohesive clay superficial deposits	Very Low
Localised asbestos containing material and / or dispersal of fibres associated with Made Ground (and relict building structures)	Inhalation of asbestos fibres.	Construction workers during redevelopment works	Likely	Severe	Possible if measures are not taken to clear derelict structures of potential asbestos to prevent the generation of dust during works. Possible if shallow soils contain asbestos fibres or ACM. Possible if asbestos in soils present at shallow depth beneath soft cover.	High
		Third parties (adjacent site users and residents)	Low	Severe		Moderate
		Future site users and maintenance workers	Low	Severe		Moderate



Source	Exposure Pathway	Potential Receptor	Probability of Exposure	Consequence of Exposure	Discussion of Contaminant Linkage	Risk
Hazardous ground gases associated with localised Made Ground and underlying natural strata (alluvium)	Migration and inhalation of gases / vapour. Explosion (methane)	Construction and future maintenance workers	Unlikely	Medium	Inhalation of hazardous ground gases associated with localised Made Ground and potentially organic-rich natural alluvium deposits.	Low
		Third parties (adjacent site users and residents)	Unlikely	Medium	Considered unlikely as no significant Made Ground has been identified.	Low
		Future site users	Unlikely	Medium		Low
		Property	Unlikely	Severe		Low to Moderate

* WSP's approach to the assessment of potential asbestos issues on a subject site takes into account the current guidance which recommends that there is no safe threshold of exposure to asbestos fibres. Consequently, WSP's findings present an assessment of the potential likelihood of exposure to asbestos based on our understanding of the prevalent site conditions. This should not be taken as an assessment of the associated potential risks to human health which may subsequently arise should such exposure occur; the presence, or suspected presence of an asbestos containing materials should be fully assessed by a qualified asbestos surveyor.

CONCLUSIONS AND RECOMMENDATIONS

6.6 RISKS FROM SOIL AND GROUNDWATER CONTAMINATION

The historical review has identified that the use of the site has remained the same from circa 1881 to present, comprising open agricultural land.

Localised impact to shallow soils on site is possible, associated with the historic and ongoing agricultural activities, onsite pollution incidents, the presence of partially collapsed unoccupied agricultural buildings which may contain asbestos, and fly tipping (mixed wastes and earth bund).

However, the anticipated significant depth of low permeability superficial deposits (comprising cohesive clay) which underlay the site, will limit the migration of potential mobile contamination to and from the surrounding hydrogeological system. Furthermore, the bedrock Oxford Clay Formation is classified as an unproductive aquifer (comprising low permeability mudstones) that have negligible significance for water supply or river base flow. As such, the environmental setting of the site is considered to be relatively low sensitively with regard to potential impacts of contamination to subsurface geology, groundwater and surface water.

A number of potentially complete contaminant linkages have been identified. Although the identified potential linkages have been assessed as having a risk varying from very low to high, the overall risk rating for the site based on risks to human health and other sensitive receptors is considered to be low. However, it should be noted that the potential exposure to asbestos containing materials (ACMs) and / or the dispersal of asbestos fibres leading to possible inhalation by human receptors, is rated high risk for some potential linkages and needs to be addressed.

If contamination is present on site and contaminant linkages are identified, it is considered that minor remedial action (e.g. removal of hot spots of contamination and appropriate re-use of materials) are likely to render the site suitable for the proposed mixed development end use.

6.7 **RECOMMENDATIONS**

It is recommended that further intrusive ground investigation is undertaken in addition to the information obtained by GEG Ltd in 2017, and should target the following:

- The presence/absence of Made Ground deposits at infilled ponds;
- The shallow soils profile;
- Chemical nature of topsoil and Made Ground (if present);
- The presence of groundwater contaminants;
- The ground gas regime; and
- Location of buried services, including the oil pipeline observed during the 2020 site walkover.
- Nature of material in bunds including the potential for the material to be contaminated.

The potential presence of asbestos at the location of the derelict buildings on site must be addressed as a priority to minimise the risk that could result from release of asbestos fibres impacting surrounding shallow soils.

If contamination is found to be present, a remediation strategy should be prepared and agreed with the regulators to identify mitigation measures appropriate to the proposed site development and to ensure protection to the surrounding environment.

Annex A

FIGURES

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Annex B

ZETICA UXO REPORTING

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Annex C

GEG LTD REPORT 2017

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Annex D

GROUNDSURE INSIGHT REPORT

Annex E

SITE WALKOVER PHOTOSHEET AND MAP

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Annex F

GENERAL LIMITATIONS

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Annex G

CIRIA RISK CLASSIFICATION MATRICES

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