



UNIVERSAL DESTINATIONS & EXPERIENCES UK PROJECT

Former Kempston Hardwick Brickworks
and adjoining land, Bedford

Environmental Statement Volume 3

Appendix 11.4 - Outline Land Remediation Strategy

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1 INTRODUCTION

1.1 AUTHORISATION AND PURPOSE OF THE ASSESSMENT

- 1.1.1 WSP was commissioned by UDX to prepare an Outline Land Remediation Strategy for the construction and operation of an Entertainment Resort Complex (ERC) and associated development located southwest of Bedford, Bedfordshire (the 'Site').
- 1.1.2 The Outline Land Remediation Strategy has been prepared to support the Environmental Statement (ES) for the Proposed Development, providing a high-level framework upon which to prepare detailed remediation strategies, for the phases where there are areas of known contamination and require remediation works, as detailed design become available. The Outline Land Remediation Strategy is provided for the entire site; however, it is noted that the main identified contaminant sources and the focus of this Outline Land Remediation Strategy is the landfill areas identified within the Lake Zone. Landfill areas can be seen in **Annex 4 of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**.
- 1.1.3 The Site is located broadly to the east of the A421 and west of the Midland Main Line. The Site also contains the former Kempston Hardwick brickworks and agricultural land. The Proposed Development is divided into four main land areas referred to as the Core Zone, Lake Zone, West Gateway Zone, and East Gateway Zone. The development within these zones comprises a theme park and related uses including retail, dining, entertainment, visitor accommodation and conference facilities, together with transport infrastructure to connect the Site to the road and rail network (including expansion of a railway station, safeguarding land for a potential new railway station, a slip road off the new A421 junction, local roadway improvements and active travel (foot and cycle) connections).
- 1.1.4 A Site Location Plan and Zonal Plan are presented as **Figure 1: Site Location Plan** and **Figure 2: Zonal Plan** in **Annex 1: Figures**.

1.2 DESCRIPTION OF DEVELOPMENT

- 1.2.1 See **Chapter 2: Description of the Proposed Development (Volume 1)** of the ES for the Description of the Development.

1.3 SOURCES OF INFORMATION

- 1.3.1 The following sources of information have been referred to in the preparation of this Outline Land Remediation Strategy:
- **Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**; and
 - Groundsure Report (Ref: GSIP-2024-14754-18113-(A-C). Dated March 2024, provided in **Annex 4: Groundsure Report of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**.

1.4 OBJECTIVES

- 1.4.1 The objective of this report is to prepare an Outline Land Remediation Options Appraisal and Land Remediation Strategy in accordance with LCRM (Land Contamination Risk Management)¹ guidance to address the pollutant linkages identified across the Site. This will include the following:
- Review of background information;
 - Summary of relevant pollutant linkages as identified through development of a Conceptual Site Model (CSM) and the Generic Quantitative Risk Assessment;
 - Remediation Objectives and Requirements;
 - Options Appraisal;
 - Land Remedial Strategy (including Materials Management Plan); and
 - Land Remediation Validation Requirements.
- 1.4.2 Further ground investigations are to be carried out to provide refined assessments of ground risks as described in Section 3 below. A detailed Land Remediation Strategy based on this outline document will be developed following the completion of the additional ground investigations following completion of the detailed design stage. All relevant information shall be collected during each phase of remediation works and a series verification reports compiled on completion, for submission to the Ministry of Housing, Community and Local Government to demonstrate compliance.

1.5 LEGISLATIVE CONTEXT

- 1.5.1 This work has been conducted in line with current practice and has been undertaken in the legislative and policy context of:
- Part IIA of *The Environmental Protection Act (1990)*²;
 - The Environment Agency document *LCRM (2023)*¹; and
 - The *National Planning Policy Framework (2024)*³.
- 1.5.2 The following good practice and statutory guidance was considered, and the assessment was undertaken in general accordance with:
- Relevant Pollution Prevention Guidance;
 - The Environment Agency document *LCRM (2023)*¹; and
 - Construction Industry Research and Information Association '*Contaminated land risk assessment. A guide to good practice (C552)*' (2001)⁴.

¹ Environment Agency (2023) *Land contamination risk management (LCRM)*. Available at: <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm> [Accessed: 11 June 2025].

² HM Government (1990) *Environmental Protection Act 1990, Part IIA*. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/part/IIA> [Accessed: 11 June 2025].

³ Ministry of Housing, Communities and Local Government (2024) *National Planning Policy Framework*. Available at: https://assets.publishing.service.gov.uk/media/67aaf8f3b41f783cca46251/NPPF_December_2024.pdf [Accessed: 11 June 2025].

⁴ Construction Industry Research and Information Association (2001) *Contaminated land risk assessment. A guide to good practice (C552)*. UK: Construction Industry Research and Information Association.

- 1.5.3 The assessment undertaken is based on the **Parameter Plans - Entertainment Resort Complex Land Use (Document Reference 1.10.0)** available at the time of writing this report and the existing information.

2 SUMMARY OF SITE INFORMATION

2.1 SITE DESCRIPTION AND CURRENT USE

2.1.1 Site location and Zonal plans are presented in **Figure 1: Site Location Plan** and **Figure 2: Zonal Plan** in **Annex 1: Figures**. **Table 2-1** provides a summary of the Site's details.

Table 2-1 - Site Details

Detail	Comment
Name and Address of Site	Lake Zone, East Gateway Zone, Core Zone, West Gateway Zone, Kempston Hardwick, (Former Kempston Hardwick Brickworks and adjoining land, Bedford MK43 & MK45.
National Grid reference	TL 02963 44516
Site Description	<p>The Site extends to 268ha and is divided into the four main Zones of land (refer to Figure 2: Zonal Plan in Annex 1: Figures) comprising:</p> <ul style="list-style-type: none"> Core Zone; West Gateway Zone; Lake Zone; and East Gateway Zone.
Area	The total Site area is 268ha.
Site Setting and Surrounding Land Uses	<p>The Site is located in an area broadly defined on all four sides by existing road and rail infrastructure (Figure 1: Site Location Plan in Annex 1: Figures). The A421 passes from northeast to southwest along the western side of the Site, with local access provided by Woburn Road running in parallel on the A421's eastern edge. Ampthill Road runs from north to south to the eastern edge of the Site. Broadmead Road connects from Woburn Road, running west to east along the southern edge of the Site.</p> <p>The Marston Vale Railway Line bounds the western edge of the Lake Zone and Core Zone and bisects the Site (north to south) between the Core Zone and West Gateway Zone. The Midland Main Railway Line runs from north to south to the east of the Site, parallel to and west of Ampthill Road.</p> <p>Elstow Brook, a tributary of the River Great Ouse, follows the line of Marston Vale Railway Line along the western boundary of the Lake Zone, then diverges slightly to cross through the West Gateway Zone. Existing waterbodies bound the Site to the north, east and southeast, while warehouse units bound the Site to the northwest. The Site is primarily surrounded by agricultural land and open fields to the west and south.</p> <p>The Site is situated in a semi-rural location, split by Manor Road which connects the village of Kempston Hardwick to Woburn Road on the west and Ampthill Road to the east. There are a small number of residential properties with direct frontage along Manor Road, in addition to the CEMEX Bedford Concrete Plant and BCA Bedford car auction site.</p> <p>The Lake Zone is located to the north of Manor Road, part of which is a brownfield site whose former uses include brickworks, clay pits and an electrical substation. The Lake Zone also currently comprises an area of unused hard standing, associated with the former Kempston Hardwick Brickworks along with stockpiles of former demolition</p>

Detail	Comment
	<p>waste. The previous clay extraction pits are now either in-filled or flooded semi-permanent waterbodies. The Lake Zone also includes areas of grass scrub and arable farmland used to grow crops.</p> <p>The Core Zone, located to the south of Manor Road comprises primarily arable fields, hedgerows and drainage ditches.</p> <p>Three public rights of way (PRoWs) cross the Site:</p> <ul style="list-style-type: none"> PRoW 1 links up the eastern end of Manor Road to the C94 Woburn Road just south of the CP Farm site. This PRoW crosses the Marston Vale Line at a footpath level crossing near the centre of the Site (Wootton Village level crossing); PRoW 2 runs in a north-south direction between PRoW 1 and Broadmead Farm, linking back to Broadmead Road; and PRoW A1/8 runs along the northern boundary of the Site connecting the B530 Ampthill Road to the Woburn Road Industrial Park, under the A421 and across the Marston Vale Line.
Topography and Ground Cover	The Site sits between 30 metres above ordnance datum (m AOD) and 36m AOD and is roughly flat with the majority of the Site at approximately 33m AOD.

2.2 SITE HISTORY

2.2.1 ON-SITE

2.2.2 From the earliest mapping dated circa 1882, the West Gateway Zone was shown as mostly undeveloped agricultural land with the London Western Railway Cambridge running along the eastern edge of the zone. The London Western Railway Cambridge extended along the western boundary of the Core Zone, which was mostly undeveloped agricultural land with multiple trackways running throughout. Buildings were noted in the northeast corner of the Core Zone and were likely residential properties and ancillary farm buildings. Racemeadow Farm was noted in the northern section of the Lake Zone, which, like the rest of the Site, comprised undeveloped agricultural land, with the exception of an unnamed trackway spanning the eastern boundary from south to north and Elstow Brook flowing north from the southwest corner. The London Midlands and Scottish Railway ran through the centre of the East Gateway Zone, extending from south to north. A stream was noted in the centre of the West Gateway Zone, running south to north.

2.2.3 The mapping from 1938 showed the development of the Kempston Brickworks in the southern portion of the Lake Zone, along with a large lake that was present by 1948 to the east of the brickworks. The brickworks comprised multiple buildings, structures, heaps (unspecified) and tanks (unspecified), as well as clay pits surrounding the works. By 1948, the unnamed trackway spanning the eastern boundary of the Lake Zone had been noted as the A418 and was later, in 1987, noted as the B530. In the East Gateway Zone, railway tracks associated with the London Midlands and Scottish Railway had been constructed by 1948, which branched off the main track to the southeast, toward a small industrial area east of the Site. Ancillary sections of the London Midlands and Scottish Railway were noted as dismantled in the 1980 mapping. The London Midlands and Scottish Railway is now part of the Thameslink line, with the London Western Railway Cambridge line on the western edge of Site now part of the West Midland Railway line.

- 2.2.4 By 1968, an electrical substation had been constructed on the southern edge of the Lake Zone and can be seen in mapping up until 1993. Part of the large lake adjacent to the Kempston Brickworks was infilled by 1972, and later, in 1991, a large clay pit was noted north of the lake on the eastern boundary of the Site. By 1989, Elstow Brook had been diverted from its original course through the undeveloped agricultural land in the north of the Lake Zone to running adjacent to the Marston Vale railway line. It is understood that the old section of the Elstow Brook was then infilled and repurposed for agricultural farming. In 2001, an electrical substation was noted on the southern boundary of the Site in the East Gateway Zone. The 2001 mapping referred to the B350 as Bedford Road.
- 2.2.5 By 2010, the Kempston Brickworks had been largely demolished, with the Site comprising a network of roads and old foundations demarcating where former structures and buildings had been located. Much of the surrounding clay pits had been infilled or flooded.
- 2.2.6 No significant land use changes were noted in the Core Zone, which has remained undeveloped agricultural land from 1882 until the present day.

2.2.7 OFF-SITE

- 2.2.8 **Table 2-2** below highlights off-Site pertinent historical information summarised. All distances are approximate.

Table 2-2 - Summary of Off Site Pertinent Historical Information

Date	Details
1882 (1:10,560)	Brick fields and associated kilns were present immediately adjacent to the southwest tip of the West Gateway Zone. Vicarage and Hoo Farms were noted adjacent to the southwest tip of the West Gateway Zone. The Elms Farm was present immediately adjacent to the north of the West Gateway Zone. Marshleyes Farm was present immediately adjacent to the west of the Lake Zone Elstow Hardwick Farm was noted immediately adjacent to the east of the East Gateway Zone. Wooten Broadmead Farm was noted immediately adjacent to the south of the Core Zone Kempston Hardwick Halt (later Kempston Hardwick Station) was noted immediately adjacent to the northwest corner of the Core Zone.
1900 (1:10,560)	Harwickhill Brickworks was noted immediately adjacent to the east of the Lake Zone. Elstow Brickworks was noted approximately 100m east of the Lake Zone and approximately adjacent to the East Gateway Zone.
1924 (1:10,560)	A clay pit, tramway and tanks were noted to the northeast of the Elstow Brickworks, approximately 250m east of the Lake Zone.
1938 (1:10,560)	Brickworks were constructed immediately east of the Core Zone.
1946-1948 (1:10,560) 1959-1960 (1:10,000)	A large pit was noted south of the Brickwork adjacent east of the Core Zone. The Bedford Brickworks was expanded to east of the Lake Zone, with more pits visible. An unnamed works was noted 250m south of the West Gateway Zone with several tanks present.

Date	Details
	Railway sidings were noted 250m south of the West Gateway Zone Two reservoirs and multiple tanks were noted over 250m east of the East Gateway Zone.
1972 (1:10,000) 1980-1982 (1:10,000) 1989 (1:10,000) 1987-1992 (1:10,000)	A disused pit was present immediately south of the West Gateway Zone. Randall's Farm was noted adjacent to the southeastern corner of the West Gateway Zone, north of Broadmead Road. An electrical substation was noted adjacent to the southwest tip of the West Gateway Zone and immediately adjacent to the east of the Core Zone. Elstow Brickworks was noted as disused. A clay pigeon shooting range was noted 100m east of the northeast tip of the Lake Zone. A Storage Depot was noted adjacent to the southeast of the East Gateway Zone, with multiple additional Storage Depots located approximately 100m to the east of the East Gateway Zone. A sewage works was present approximately 250m south of the West Gateway Zone. The brickworks to the east of the Core Zone was expanded with a conveyor present. The pit adjacent to the works was marked as disused.
1989-1993 (1:2,500)	A refuse tip was marked in the same location as the disused pit immediately south of the West Gateway Zone. The storage depot adjacent to the east of the East Gateway Zone was removed.
2001 (1:10,000)	An electrical substation was noted immediately south of the East Gateway Zone.
2010 (1:10,000)	A depot was noted adjacent to the southwest tip of the West Gateway Zone. Marsh Leys business park was constructed to the west of the Lake Zone. The brickworks to the east of the Core Zone was replaced by Coronation Business Park.
2024 (1:10,000)	Multiple lakes were present immediately north of the Lake Zone and 50m south of the Core Zone.

*Denotes infilled dates.

2.3 PUBLISHED GEOLOGY

2.3.1 The following published geological information was obtained from a review of Geological Survey Online Map Viewer⁵ and Geological Survey of England and Wales, Sheet 203 Bedford, 1:50,000, 2010⁶.

MADE GROUND

2.3.2 Available records indicate Made Ground to be present in the southern and eastern portions of the Lake Zone and is described as artificial deposits of Made Ground and infilled ground. Records indicate

⁵ British Geological Survey (n.d.) *BGS Geology Viewer*. Available at: <https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/> [Accessed: 11 June 2025].

⁶ British Geological Survey (2010) *1:50 000 Sheet 203 Bedford (Bedrock and Superficial)*. Available at: <https://webapps.bgs.ac.uk/data/MapsPortal/series.html?series=E50k&collection=PMAP&filter=203&page=1&pageSize=100> [Accessed: 11 June 2025].

that an area of worked ground is present in the Core Zone. Made Ground is indicated to be present in the south of the East Gateway Zone and an isolated pocket of Worked Ground is present in the northernmost point of the East Gateway Zone, west of the London Midlands and Scottish Railway line. Due to the developed nature of some areas of the Site it would be expected that Made Ground would be encountered in areas around the A421, and the trainline.

SUPERFICIAL DEPOSITS

- 2.3.3 The majority of the Site is indicated by British Geological Society (BGS) to be underlain by superficial deposits, covering the west, north and east area of the Site. From the northern portion of the Site, superficial deposits taper towards the western edge of the Site, following the route of the on-Site stream. A narrow strip of superficial deposits follows the route of an on-Site stream to the south and from west to east beneath Manor Road. The superficial deposits comprise Head deposits across most of the area with the soils adjacent to the stream comprising Alluvium. The Head Deposits comprise clay, silt, sand and gravel. The Alluvium comprises clay and silt.

BEDROCK

- 2.3.4 The bedrock beneath the Site is indicated by BGS to comprise the Peterborough Member Mudstone. This is reported to consist of “*brownish-grey, fissile, organic-rich (bituminous) mudstones. [...] Subordinate beds of pale-medium grey, blocky mudstone. Several bands of cementstone nodules/concretions*”⁷. The stratigraphy below the Peterborough Member Mudstone comprises: the Kellaways Formation (Sand and Clay members), the Cornbrash Formations, the Forest Marble formation, the Blisworth Formation and the Ruthland Formation.

STRUCTURAL GEOLOGY

- 2.3.5 Three faults have been identified on Site. Two faults cross the West Gateway Zone, trending approximately east-west with a southerly downthrow and one fault runs from the west into the centre of the Site trending northwest to southeast with the downthrow to the southwest. The other fault is located in the Lake Zone, running northwest to southeast with a downthrow to the southwest.

2.4 EXPLORATORY HOLE RECORDS

- 2.4.1 Previous investigation was completed in the former Kempston Brickworks (southern extent of the Lake Zone) by SLR in 2016⁸ and within the Lake Zone and Core Zone by Arcadis in 2023⁹. A summary of encountered ground conditions is provided below.

Made Ground

- 2.4.2 Made Ground up to 3.0m in thickness was only encountered locally within exploratory holes positioned within the undeveloped fields within the Lake Zone TP02, TP05 & TP06 – Arcadis Parcel A1). Organic rich soils (black) and accompanying organic odours were noted within positions targeting the infilled

⁷ British Geological Survey (n.d.) *The BGS Lexicon of Named Rock Units — Result Details, Peterborough Member*. Available at: <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=PET> [Accessed: 11 June 2025].

⁸ SLR Consulting (2016) *Former Kempston Brickworks Phase 1 and 2 Site Investigation – Phase 1 Report (Appendix B)*. Available at: <https://edrms.bedford.gov.uk/OpenDocument.aspx?id=U9VG7%2b1rh2kecUK9r4og5g%3d%3d&name=18+02940+EIA+VOL+3+P3-P4+Appendix+11+GROUND+CONDITIONS.pdf> [Accessed: 11 June 2025].

⁹ Arcadis (2023) *Project 320 - Kempston Hardwick - Phase 2 Preliminary Geoenvironmental Ground Investigation Interpretive Report*.

section of the Elstow Brook. Topsoil (0.2m to 0.4m) overlying natural deposits was more typically encountered in this area of the Site.

- 2.4.3 Although exploratory holes positioned within Arcadis' Parcel A3 mostly sit outside the current boundary of interest (i.e., to the east of the Lake Zone), it is worth noting that similar recovered thicknesses of Made Ground were noted in this area (2.8m – 3.0m).
- 2.4.4 A thicker and more spatially continuous layer of Made Ground (1.7 m to 5.0 m) was encountered within exploratory holes positioned about the location off the former brickworks (Arcadis Parcel A2). Frequent inclusions of brick/concrete cobbles and gravel were generally noted within Made Ground recovered in this part of the Site. An infilled basement structure was also encountered at TP23 (1.0m – 2.5m below ground level (bgl)).
- 2.4.5 Very limited recovery of Made Ground was recorded across the Core Zone (Arcadis Parcel B), varying in thickness between 0.2m (TP37) and 0.6m (CP08) across only two exploratory hole locations.

Natural Ground

- 2.4.6 Made Ground or topsoil was encountered at the surface overlying either superficial deposits of Alluvium or Head Deposits (where present). Alluvium was encountered in general accordance with the footprint of BGS mapped exposures. The subsequent Peterborough Member (Oxford Clay Formation) was noted to initially comprise an upper weathered zone, overlying a non-weathered deposit. The Kellaways Formation, present beneath the Oxford Clay Formation, comprised both sand and clay members, the latter of which was noted to be absent locally.
- 2.4.7 The strata underlying the Kellaways Formations was only encountered within the rotary follow-on boreholes (CP04, CP07, CP10 and CP14) and comprised the Cornbrash Formation, the Forest Marble Formation, the Blisworth Formation (divided into the Blisworth Clay Member and the underlying Blisworth Limestone Member) and the Rutland Formation.
- 2.4.8 The Forest Marble Formation was generally described to comprise a very stiff dark grey fissured clay with frequent to absent fossilised shells. The Blisworth Clay Formation was described as a very stiff yellow to black fissured clay with fossilised shells and as an extremely weak dark grey mudstone (CP14 only).
- 2.4.9 The underlying Blisworth Limestone Formation was described as a strong light grey limestone. The Rutland Formation was encountered in all rotary follow-on boreholes (except CP04) underlying the Blisworth Limestone Formation and was generally described as a very stiff dark grey fissured clay with pockets of organic matter and peat.

Groundwater Conditions

- 2.4.10 Groundwater strikes encountered during the ground investigation indicated the presence of:
 - A shallow perched and discontinuous groundwater table between 1.0 m to 2.0 m bgl within the superficial Alluvium and Head Deposits or in continuity with the Made Ground;
 - A deeper aquifer within the Peterborough Member (Oxford Clay Formation) was encountered in seven boreholes between 3.9m bgl (TP30) and 12.9m bgl (CP11); and,
 - A confined groundwater body within the Kellaways Sand Member (i.e., significant rises noted after 20 minutes of up to 5.5m within cable percussion exploratory hole CP07).

- 2.4.11 It was noted that similar conditions were anticipated within the deeper limestone strata, but it was not possible to confirm this during the ground investigation due to the ‘masking’ of groundwater strikes with the addition of rotary flush water.

2.5 HYDROGEOLOGY

Aquifer Status

- 2.5.1 The Alluvium Deposits are classified by the Environment Agency as a Secondary A Aquifer defined as *“permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers”*¹⁰.
- 2.5.2 The Head Deposits are classified by the Environment Agency as a Secondary Undifferentiated Aquifer defined as *“where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type”*¹⁰.
- 2.5.3 The bedrock of the Peterborough Member Mudstone is classified by the Environment Agency as an unproductive aquifer defined as *“these are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow”*¹⁰.
- 2.5.4 The bedrock of the Kellaways Sand Member is classified as a Secondary A Aquifer and Kellaways Clay Member is classified as unproductive aquifer.
- 2.5.5 The Cornbrash Member is classified as a Principal Aquifer.
- 2.5.6 The Groundsure Report (**Annex 4: Groundsure Report of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**) indicates that groundwater residing in the superficial aquifers is of medium to high vulnerability. Groundwater held within the underlying bedrock is less vulnerable due to the classification as an unproductive aquifer. However, it is noted that an unconfined aquifer was encountered within the Kellaways Sand Member during previous ground investigation.
- 2.5.7 No areas of the Site are located within a published groundwater Source Protection Zone (SPZ).

Groundwater Abstractions

- 2.5.8 There is one historical groundwater abstraction located on-Site in the eastern portion of the Lake Zone. The abstraction is associated with London Brick Co and is dated from 1967. The licence’s expiry date is not noted. An off-Site historical groundwater abstraction is noted approximately 91m southeast of the Lake Zone associated with Supreme Concrete.
- 2.5.9 There are no active groundwater abstractions within 500m of the Site recorded within the Environmental Database Reports.

¹⁰ British Geological Survey (2023) *Aquifer Designation Data – Customer Information Note (England)*. <https://www.bgs.ac.uk/download/aquifer-designation-data-customer-information-note-england/> [Accessed: 11 June 2025].

2.6 HYDROLOGY

Surface Water Features

- 2.6.1 There are a number of surface water features noted by both the Groundsure Report (**Annex 4: Groundsure Report of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**) and Ordnance Survey mapping present on and around the Site's areas of interest.
- 2.6.2 The Groundsure report (**Annex 4: Groundsure Report of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**) highlights the presence of an unnamed stream, running through the West Gateway Zone from south to north, along the western boundary of the Core Zone and Lake Zone. This stream is known to be the Elstow Brook, which is tributary of the River Great Ouse.
- 2.6.3 Minor field drains are noted throughout the whole Site. A series of unnamed lakes/ponds are noted on-Site throughout the Lake Zone. A narrow unnamed stream runs through the Core Zone to an unnamed lake in the Lake Zone. A large unnamed Lake is noted adjacent to the east of the Lake Zone.
- 2.6.4 The closest off-Site water feature comprises an unnamed lake immediately to the east of the Lake Zone.
- 2.6.5 The Site lies across two surface water catchments, the Elstow Brook (US Shortstown) (Water body ID: GB105033038050) and the Harrowden Brook (Water body ID: GB105033038010). The hydromorphological designation for both catchments are "*heavily modified*"¹¹.
- 2.6.6 The Elstow Brook surface water catchments, as defined on the Environment Agency Catchment Data Explorer¹² interactive map, has historically been assessed with a "*moderate*" ecological rating and a "*good*" physico-chemical quality (Cycle 3, 2022); in (Cycle 3, 2019) the water body had a failing chemical quality¹¹. The chemical status in 2019 was reported as a "*fail*" due to the presence of priority hazardous substance Polybrominated diphenyl ethers (PBDEs)¹¹. No chemical status was provided for 2022.
- 2.6.7 The Harrowden surface water catchments, as defined on the Environment Agency Catchment Data Explorer¹² interactive map, has historically been assessed with a "*bad*" ecological rating and a "*good*" physico-chemical quality¹³. The chemical status in 2019 was reported as a "*fail*" due to the presence of priority hazardous substances Perfluorooctane sulphonate and PBDEs¹³. No chemical status was provided for 2022.

Surface Water Abstractions and Discharges

- 2.6.8 There are four historical licensed surface water abstractions recorded on-Site in the Lake Zone. There are no active surface water abstractions recorded within 500m of the Site.

¹¹ Department for Environment Food and Rural Affairs and Environment Agency (n.d.) *Elstow Brook (US Shortstown) Water Body*. Available at: <https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033038050> [Accessed: 11 June 2025].

¹² Environment Agency (n.d.) *Explore Catchment Data*. Available at: <https://environment.data.gov.uk/catchment-planning/> [Accessed: 11 June 2025].

¹³ Department for Environment Food and Rural Affairs and Environment Agency (n.d.) *Harrowden Brook Water Body*. Available at: <https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033038010> [Accessed: 11 June 2025].

- 2.6.9 The Groundsure Report (**Annex 4: Groundsure Report of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**) notes 36 licensed discharges to controlled waters on-Site. Thirty-one of the on-Site records relate to sewage discharges to Elstow Brook, a seasonal soakaway, to land and to an unknown tributary. Three records are associated with trade discharges to Elstow Brook. The two remaining discharges are associated with unspecified agriculture to unknown tributary and a miscellaneous discharge to Elstow Brook. Twenty-three of the licenses are listed as having been revoked.

2.7 HYDROGEOLOGICAL MODEL

- 2.7.1 Previous ground investigation completed within the Lake and Core Zones has confirmed the presence of Made Ground at varying thicknesses with a maximum layer of 10.8 m encountered below the former Kempston Brickworks at the southern extent of the Lake Zone. Ground investigation completed across the wider area of the Lake Zone, beyond Kempston brickworks, encountered Made Ground up to 3.0m in thickness. Very limited recovery of Made Ground was recorded across the Core Zone, with a maximum thickness of 0.6m recorded.
- 2.7.2 The Peterborough Member of the Oxford Clay Formation was typically encountered immediately below the Made Ground with exception to where Alluvium or Head Deposits were present within the Core Zone.
- 2.7.3 The Kellaways Formation was encountered beneath the Peterborough Member at a thickness of approximately 5.0m to 5.5m, which in turn was sitting above the Cornbrash Formation, encountered at depths between 17.25m and 19.55m bgl.
- 2.7.4 Groundwater was observed to be in hydraulic connection with Made Ground and underlying natural deposits (water strikes were encountered between 1.3m and 3.2m during trial pitting within the Kempston Brickworks). Where superficial Alluvium and Head Deposits were encountered, a shallow groundwater table between 1.0m to 2.0m bgl that was in continuity with the Made Ground was observed.
- 2.7.5 A deeper aquifer within the Peterborough Member (Oxford Clay Formation) was encountered between 3.9m and 12.9m bgl. A confined groundwater body was recorded within the Kellaways Sand Member, which was evidenced by a significant rise in the groundwater level within a cable percussion borehole of 5.5m after 20 minutes.
- 2.7.6 It is expected that the local groundwater at the Site is flowing northwards towards the Elstow Brook and then into the River Great Ouse.

2.8 OTHER INFORMATION

- 2.8.1 Zetica Limited was commissioned to carry out a detailed Unexploded Ordnance (UXO) Desk Study and Risk Assessment.
- 2.8.2 Between 1940 and 1946, Royal Ordnance Factory (ROF) Elstow was located adjacent to the east of the Site. No records have been found to indicate that ROF Elstow encroached on the Site and no sources of UXO hazard associated with ROF Elstow have been identified on the Site.
- 2.8.3 The Zetica risk assessment was undertaken by assessing the Probability of Encountering an UXO coupled with the Probability of Detonation to provide the likelihood of encountering and denoting UXO during construction.

- 2.8.4 To assess overall risk, the likelihood of encountering and denotating UXO during construction was assessed against the severity of risk construction workers.
- 2.8.5 Based on the above the risk of UXO was assessed as Low, defined as “*no positive evidence that UXO is present, but its occurrence cannot be totally discounted*” (see **Annex 5: Unexploded Ordnance of Appendix 11.1: Contaminated Land Preliminary Risk Assessment (Volume 3)**).

2.9 PREVIOUS INVESTIGATIONS AND RISK ASSESSMENTS

A summary of the previous investigations and risk assessments completed at the Site are presented in **Annex 3**.

3 DATA GAP ANALYSIS AND UNCERTAINTIES

- 3.1.1 Further of ground investigations will be undertaken to inform data gaps; to provide preliminary design; and provide further characterisation to de-risk the Site to assist in a Design and Build tender exercise.
- 3.1.2 Based on a review of the available intrusive investigation records available the following residual data gaps or uncertainties remain which require further consideration in the context of the Proposed Development across the Site:
- Neither phase of historic ground investigation included the East Gateway Zone.
 - There is therefore residual uncertainty with regards to the actual ground conditions and/or risks posed from land contamination within this area of the Site; and
 - Boundary groundwater and ground gas conditions should be established by the installation of monitoring wells in these areas of the Site.
 - There is an absence of deep borehole records and/or monitoring wells positioned towards the east of the Lake Zone (i.e., Arcadis Area A3).
 - There may be some residual uncertainty with regards to the ground conditions beyond 3.00m depth (typical depth of trial pit);
 - There may also be some residual uncertainty in the groundwater and ground gas conditions within this area of the Site; and
 - Both factors may influence the risks posed to future structures/infrastructure proposed within this location (eastern fringe of the Lake Zone).
 - The monitoring dataset (gas, surface water and groundwater) available to review (Arcadis 2023) is incomplete and there are residual uncertainties as highlighted below:
 - The interpretation of data made in the 2023 Arcadis report has been based on a limited dataset (i.e., one round of gas monitoring data and one round of surface water and groundwater sampling is missing) which does not cover the entire Site;
 - The potential migration of groundwater/surface water contamination from an off-Site source has been noted in the north-eastern corner of the Site; however, although identified, it has not been fully investigated; and
 - The collection of supplementary data in context of the revised Site boundary and based on historical findings should be undertaken to enable the completion of a Site-specific robust risk assessment.
 - There is residual uncertainty in the gas monitoring data and associated gas risk assessments presented for areas of the Site.
 - The accuracy of the existing gas monitoring datasets for limited areas of the Site is constrained by the flooding of the on-Site monitoring well network and atmospheric conditions recorded (i.e., all rounds completed during high pressure conditions and thus not reflective of worst case atmospheric conditions);
 - The quality of the most recent datasets (rounds 4 and 5 of the Arcadis 2023 investigation) may be compromised due to the poor condition of the monitoring wells described on available records (i.e., missing bungs/taps in numerous locations);
 - Anomalous yet elevated gas monitoring readings have been noted that may not be fully understood/explained; and

- The collection of supplementary data in context of the revised Site boundary and based on historical findings should be undertaken. This will assist with better understanding historic datasets and enable the completion of a Site-specific robust ground gas risk assessment.
- There has only been very limited investigation of the infilled Elstow Brook river channel located within the Lake Zone (on-Site source of contamination).
 - Only three trial pits (TP02, TP04 and TP06) were advanced targeting the characterisation of material placed within the footprint of the former Elstow Brook river channel. There was limited sample recovery and a lack of ground gas information where >3m thickness of Made Ground has been encountered locally;
 - There is therefore residual uncertainty with regards to the actual ground conditions and/or risks posed from land contamination within these areas of the Site; and
 - Supplementary investigation of this on-Site source by additional sampling and the installation of targeted gas monitoring wells should be completed to facilitate the completion of a robust risk assessment.
- Areas of landfill have not been fully delineated which may impact future design/material re-use opportunities.
 - There is limited ground investigation cover within areas of identified landfill. Based on a review of the available information, it is possible that the spatial extents of the landfilled areas could be refined (e.g., exclusively natural soils encountered within TP17 of the Arcadis 2023 ground investigation positioned within a landfill area); and
 - Greater coverage across the Site, specifically within historically landfilled areas is required in order to refine the resolution/understanding of the Lake Zone's ground model. This would enable efficiency in terms of cost and logistics in terms of future soil re-use opportunities.
- No waste characterisation assessments of soils have been undertaken to date.
 - The identification of landfill waste soils on-Site could present a potential cost/logistical liability during construction.

3.1.3 Once proposed earthwork and/or engineering details (i.e., any significant cut and fill) in-light of the Proposed Development are better understood a waste characterisation assessment will be undertaken. This would ensure any materials generated by construction that are either unsuitable for use or surplus to requirement are disposed of appropriately.

4 CONCEPTUAL SITE MODEL

4.1 INTRODUCTION

- 4.1.1 This section summarises the findings of the previous studies summarised in Section 2.9 for the wider Site, the key receptors identified in the CSM and provides the plausible linkages identified at the generic/detailed assessment level.
- 4.1.2 The CSM is based upon the environmental conditions of the Site as described in the previous sections. The methods used in this assessment followed a risk-based approach with the potential environmental risk assessed qualitatively using the 'source-pathway-receptor' contaminant linkages concept introduced in the guidance document (principally the Environment Agency's *LCRM Guidance*¹) on the practical implementation of the *Environmental Protection Act 1990*².
- 4.1.3 Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependant on Site usage and environmental conditions.
- 4.1.4 The environmental risk assessment has been carried out identifying and evaluating the significance of the following:
- **Potential Sources of Contamination:** these include any actual or activities of concern, located either on or in the vicinity of the Site;
 - **Potential Pathways:** these are the routes or mechanisms by which Contaminants of Concern (CoC) may migrate from the source to the receptor; and
 - **Potential Receptors:** these include current or future land users, activities or persons at the Site that could be harmed by CoC.

4.2 POTENTIAL SOURCES OF CONTAMINATION

- 4.2.1 **Table 4-1** provides a summary of the potential sources of contamination that may be present at the Site, as well as the likely distribution of such sources.

Table 4-1 - Potential Sources of Contamination

Potential Source	Potential Contaminants of Concern	Likely/Anticipated Distribution
ON-SITE		
Made Ground associated with infilled Elstow Brook river channel, former brickworks (including above-ground storage tanks (ASTs) and underground storage tanks (USTs)), clay pits, infilled land, spoil heaps, historical landfill sites and surrounding on-Site roads and railway	Inorganics, Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPHs), metals, asbestos, Volatile Organic Compounds (VOCs), Benzene Toluene Ethylbenzene Xylene (BTEX), Semi Volatile Organic Compounds (SVOCs) and ground gases/vapours.	Lake Zone, East Gateway Zone, West Gateway Zone

Potential Source	Potential Contaminants of Concern	Likely/Anticipated Distribution
Electrical Substations	Polychlorinated biphenyls (PCBs), mineral oils and Asbestos Containing Materials (ACMs).	Southern boundary of East Gateway Zone.
Structurally bound asbestos within the fabric of remaining buildings.	ACMs.	Site wide
Agricultural Practices and use of pesticides and herbicides	Petroleum hydrocarbons, PAHs, BTEX, oils, fertilisers, herbicides and pesticides.	Northern area of Lake Zone, Core Zone and West Gateway Zone
OFF-SITE		
Made Ground	Asbestos fibres, metals, PAHs, TPH, BTEX, VOCs, SVOCs fuel oils, ground gases (methane and carbon dioxide).	All directions
Railway sidings	Asbestos, metals, inorganics, PAHs, TPHs, BTEX compounds, VOCs, hazardous ground gases (methane and carbon dioxide) and vapours.	All directions
Disused pits converted to landfill	Mercury, cadmium, arsenic, chromium, copper, iron, lead and nickel	Immediately south of the Site
Cement Plants	Inorganics, metals, TPH, PAHs, SVOCs and VOCs.	Between the Core Zone and Lake Zone and on the eastern boundary of the Lake Zone.

4.3 POTENTIAL PATHWAYS

4.3.1 In the context of the Proposed Development of the Site as an ERC and associated development, the following potential exposure or migration pathways associated with the identified potential source(s) have been identified:

- Pathways to Human Health receptors:
 - Dermal contact with soils and groundwater;
 - Ingestion of dusts/soil particles;
 - Inhalation of dusts and fibres (on and off-Site receptors); and
 - Inhalation of hazardous ground gases/vapours (on and off-Site receptors).
- Pathways to Controlled Water receptors:
 - Overland flow to on-Site and off-Site surface water features;
 - Leaching of contaminants through the unsaturated zone and subsequent impact to groundwater within the underlying aquifers; and
 - Lateral migration of contaminants within groundwater and subsequent impact of surface water receptors.

- Pathways applicable to Site infrastructure:
 - Direct contact with contaminants (e.g., sulphates and hydrocarbons) in the soil and groundwater with below ground structures (underground potable water pipes and buried concrete); and
 - Accumulation of hazardous gases within below ground structures in the future development (explosive risk).
- Pathways applicable to future flora within soft landscaping:
 - Direct contact with contaminants in the soil, groundwater and surface waters.

4.4 POTENTIAL RECEPTORS

4.4.1 In the context of the Proposed Development, the following potential receptors were identified:

Human Health

- Future Site Users; and
- Third party neighbours.

Controlled Waters

- Superficial Head deposits (Secondary Undifferentiated Aquifer);
- Superficial Alluvium deposits (Secondary A Aquifer);
- Kellaways Sand Member (Secondary A Aquifer);
- Cornbrash Formation (Principal Aquifer);
- Elstow Brook;
- On-Site drains/ditches; and
- Multiple lakes throughout the Lake Zone.

Services and Building Fabric

- Future below ground services (e.g. potable water supply pipes); and
- Future building structures.

4.4.2 The bedrock of the Peterborough Member (Oxford Clay Formation) has been excluded as a receptor as the Environment Agency classifies this bedrock as unproductive strata. The Kellaways Formation (Sand and Clay members), the Cornbrash Formations, the Forest Marble formation, the Blisworth Formation and the Ruthland Formation are confined by the above Peterborough Member Mudstone. However, ground investigation by others has proven that a confined groundwater body is present within the underlying sands of the Kellaways Formation. The Kellaways Sand Member is a Secondary A Aquifer, and the underlying Cornbrash Formation is a Principal Aquifer. These are therefore included as controlled waters receptors within the CSM.

Receptors excluded from assessment

- 4.4.3 Construction and maintenance workers are not included as potential human health receptors within this assessment as potential risks will be covered with appropriate work control procedures. These are legal requirements under *The Construction (Design and Management) Regulations 2015* (hereafter referred to as the '*CDM Regulations 2015*')¹⁴ to ensure suitable health and safety controls are in place during construction works.

4.5 CONCEPTUAL SITE MODEL

- 4.5.1 The CSM identifies the potential contamination sources, receptors, and the exposure pathways by which they may be linked. A Source-Pathway-Receptor linkage (SPRL) is present if a viable pathway exists between a potential source and an identified receptor. Based on the available information, a Preliminary CSM has been prepared with respect to the Proposed Development and produced as **Table 4-2**.

Construction Phase Contaminated Land Risk Assessment

- 4.5.2 Mitigation procedures during construction will be implemented in accordance with the **Appendix 2.3: Outline Construction Environmental Management Plan (OCEMP) (Volume 3)**.
- 4.5.3 Construction and maintenance workers are not included as potential human health receptors within this assessment as potential risks will be covered with appropriate work control procedures. These are legal requirements under the *CDM Regulations 2015*¹⁴ to ensure suitable health and safety controls are in place during construction works.

¹⁴ HM Government (2015) *The Construction (Design and Management) Regulations 2015*. Available at: <https://www.legislation.gov.uk/uksi/2015/51/contents> [Accessed: 11 June 2025].

Key

HH1 – Third party neighbours

HH2 – Future Site users

CW1 – Secondary A Aquifer in superficial deposits

CW2 – Confined bedrock aquifers (Kellaways Sands Secondary A Aquifer; Cornbrash Formation Principal Aquifer)

CW3 – Elstow Brook and on-Site drains

CW4 – Off-Site surface water features

B1 – Future below ground services

AF1 – Aquatic Flora and Fauna

Table 4-2 - SPRLs Based on Proposed End Use

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
On-Site					
SPRL1	Made Ground associated with infilled river channel, former brickworks (including ASTs and USTs), clay pits, infilled land, spoil heaps, historical landfill sites, lake bed sediments and surrounding on-Site roads and railway.	Inhalation of dusts and fibres; Dermal contact; and Ingestion.	HH1 HH2	Moderate Risk (Likely/Medium)	The generation and mobilisation of dusts/fibres is most likely to occur during the Construction Phase. Occupants of neighbouring land are considered to be at a Moderate Risk from fugitive dust and fibres in areas adjacent to the Lake Zone and Moderate/Low Risk in the remaining areas of the site. During the Construction Phase, potential risks posed to receptors will be managed by the Principal Contractor by applying appropriate health and safety measures as per <i>CDM Regulations 2015</i> ¹⁴ .

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
					<p>Appendix 2.3: OCEMP (Volume 3) would mitigate against the creation of potential pollution pathways during the project's construction such as mud being transported onto local roads from construction plant/vehicles.</p> <p>As such, the risk posed to third party neighbours and future Site users would be reduced to Low.</p> <p>Asbestos fibres may be present within the lake bed sediments within the Lake Zone and if they are undisturbed, they will present a Low Risk to future site users however, if they are dredged to be re-used or stored for the development of the Site or be exported to another construction Site the risk from fugitive dust and fibres is considered to be Moderate. Sufficient additional testing will be required to mitigate for the risk from asbestos fibres becoming airborne.</p> <p>Cement bound asbestos was noted in the demolition rubble stockpiles located in the Lake Zone and is considered to be at a Moderate to High Risk to future site users.</p>
SPRL2		Inhalation of hazardous ground gases/vapours	HH1 HH2	Moderate/Low Risk (Likely/Medium)	<p>Ground gas and vapours have the potential to accumulate in confined spaces and may pose a risk of asphyxiation. Limited ground gas assessment has been completed for the Site to date. The risk from ground gas and vapours to future Site users, workers and visitors is considered Moderate in the Lake Zone and Moderate/Low in the remaining areas of the Site.</p>

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
SPRL3		Overland flow to on-Site and off-Site surface water features; Leaching of contaminants through the unsaturated zone and subsequent impact to groundwater within the underlying aquifers; Leaching of contaminants from the lake bed sediments into the groundwater bodies; and Lateral migration of contaminants within groundwater and subsequent impact to surface water receptors.	CW1 CW2 CW3 CW4	Moderate Risk (Likely/Medium)	Previous ground investigation by others have detected leachable concentrations of metals in the Made Ground and have indicated that groundwater bodies are present within the Made Ground and superficial deposits along with a deeper groundwater body within the Peterborough Member and the Kellaways Sand Member confined aquifer. Vertical migration of contaminants from shallow groundwater to depth is considered possible. Lateral contaminant migration will be able to occur where groundwater bodies are in hydraulic continuity with local surface water bodies. The risk to groundwater is considered to be Moderate .
SPRL4		Direct contact with contaminants (e.g. sulphates and hydrocarbons) in the soil and groundwater with below ground structures (Underground potable	B1	Moderate Risk (Likely/Medium)	The potential presence of Made Ground deposits can impact on the durability of buried services/utilities due to aggressive ground conditions. An assessment of the aggressive ground conditions is required to determine the level of mitigation required. Some contaminants can taint new water supply.

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
		water pipes and buried concrete)			A water supply pipe selection assessment will be required prior to placing a new drinking water supply. A Moderate level of risk is considered to be appropriately conservative.
SPRL5		Accumulation of hazardous gases within below ground structures in the future development (explosive risk).	B1	Moderate Risk (Low Likelihood/Severe)	Ground gases have the potential to accumulate in confined spaces and may pose a risk of explosion. Limited ground gas assessment has been completed for the Site to date. The risk from ground gas and vapours to future Site users, workers and visitors is considered to be Moderate in the Lake Zone and Moderate/Low in the remaining areas of the Site.
SPRL6		Leaching of contaminants, lateral and vertical migration into groundwater, plants and lake bed sediments	AF1	Moderate Risk (Likely/Medium)	Contaminants with leachable potential may be present within the lake bed sediments. The previous ground investigations have detected leachable concentrations of metals in the Made Ground. A correlation between the leachable contaminants in the Made Ground and groundwater and lake surface water samples has not been found. The potential for contaminants to adversely impact the health of the aquatic flora and fauna within the lakes cannot be precluded. Low leachate concentrations were detected in the remainder of the site and therefore the risk is considered and Moderate/Low for the Core Zone and West Gateway Zone.

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
SPRL7	Electrical substations	Inhalation of dusts and fibres	HH1 HH2	Moderate/Low Risk (Low Likelihood/Medium)	<p>The generation and mobilisation of dusts/fibres is most likely to occur during the Construction Phase. Occupants of neighbouring land are considered to be at a Moderate/Low Risk from fugitive dust and fibres.</p> <p>If the Proposed Development requires the removal of the substations, potential risks posed to receptors will be managed by the Principal Contractor during the Construction Phases by applying appropriate health and safety control measures as per <i>CDM Regulations 2015</i>¹⁴.</p> <p>As such, the risk posed to third party neighbours and future Site users is would be reduced to Low.</p>
SPRL8		Overland flow to on-Site and off-Site surface water features; Leaching of contaminants through the unsaturated zone and subsequent impact to groundwater within the underlying aquifers; and, Lateral migration of contaminants within groundwater and subsequent impact of surface water receptors.	CW1 CW2 CW3 CW4	Moderate/Low Risk (Low Likelihood/Medium)	Unknown PCB contamination associated with the electrical substations in the Lake Zone is likely to be localised to the source. The risk to controlled waters is considered to be Moderate/Low .

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
SPRL9		Direct contact with contaminants (e.g. PCBs and hydrocarbons) in the soil and groundwater with below ground structures (underground potable water pipes and buried concrete)	B1	Moderate/Low Risk (Low Likelihood/Medium)	PCBs and oils could potentially enter buried utilities, particularly where aggressive ground conditions exist and impact on the durability of buried construction materials. If the Proposed Development requires the removal of the existing substations, as assessment of the local ground conditions is required to determine the level of any remediation required. A Moderate/Low level of risk is considered to be appropriately conservative.
SPRL10	Structurally bound asbestos within the fabric of remaining buildings in the Lake and West Gateway Zones.	Inhalation of dusts and fibres	HH1 HH2	Moderate Risk (Low Likelihood/Severe)	The generation and mobilisation of dusts/fibres is most likely to occur during the Construction Phase. Prior to the Construction Phase a pre-demolition survey will be undertaken to help identify and design appropriate risk mitigation measures. During the Construction Phase, potential risks posed to receptors will be managed by the Principal Contractor by applying appropriate health and safety control measures as per <i>CDM Regulations 2015</i> ¹⁴ . As such, the risk posed to future human health receptors is considered to be Moderate .
SPRL11	Agricultural Practices and use of pesticides and herbicides	Inhalation of dusts	HH1 HH2	Moderate Risk (Likely/Medium)	The generation and mobilisation of dusts/fibres is most likely to occur during the Construction Phase. Occupants of neighbouring land are considered to be at a Moderate/Low risk from fugitive dust and fibres. During the Construction Phase, potential risks posed to off-Site receptors will be managed by the

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
					Principal Contractor by applying appropriate health and safety control measures as per <i>CDM Regulations 2015</i> ¹⁴ . Appendix 2.3: OCEMP (Volume 3) will mitigate against the creation of potential pollutant pathways during the project's construction such as mud being transported on to local roads from construction plant/vehicles. As such, the risk posed to third party neighbours and future Site users would be reduced to Low .
SPRL 12		Overland flow to on-Site and off-Site surface water features; Leaching of contaminants through the unsaturated zone and subsequent impact to groundwater within the underlying aquifers; and, Lateral migration of contaminants within groundwater and subsequent impact of surface water receptors.	CW1 CW2 CW3 CW4	Moderate/Low Risk (Low Likelihood/Medium)	Whilst the risk presented to controlled water receptors is considered to be Moderate/Low , further assessment of potential contaminant impacts on surface water and groundwater receptors located within close proximity of the Site is required in order to better understand the hydrogeological regime of the Site and the risks presented.

SPRL	Potential Source	Pathway	Receptor	Preliminary Risk Rating (Probability/Severity)	Comments
Off Site					
SPRL13	Off-Site sources of contamination identified within 250m including: <ul style="list-style-type: none"> ■ Made Ground from off-Site developments and land uses; ■ Railway sidings; ■ Disused pits converted to landfills; and ■ Cement plants. 	Migration of hazardous gases/vapours in the unsaturated zone with subsequent inhalation	HH1	Moderate/Low Risk (Unlikely/Severe)	Contaminant impact and the presence of artificial deposits may pose a gas and vapour risk to any future enclosed spaces or structures developed across the Site via existing and new buried utilities.
SPRL14		Migration of hazardous gases/vapours in the unsaturated zone within subsequent accumulation of hazardous gases within below ground structures in the future development (explosive risk).	B1	Moderate/Low Risk (Unlikely/Severe)	Completion of a ground investigation with follow-up monitoring of the ground gas regime is required for further structures/enclosed spaces. Risks are considered to be Moderate/Low .
SPRL15		Lateral migration of contaminants within groundwater to Site. Lateral migration of contaminants within groundwater and subsequent impact of surface water receptors.	CW1 CW2 CW3	Moderate Risk (Low Likelihood/Medium)	It is considered likely that off-Site sources of groundwater contamination are present and have the potential to present an unacceptable risk to groundwater and surface water at the Site. Further assessment of the groundwater quality is required. Risk is considered to be Moderate .

5 OUTLINE LAND REMEDIATION OBJECTIVES AND CONSTRAINTS

5.1.1 This section defines the outline land remediation objectives and constraints and sets out the basis for selecting the most appropriate overall remediation option for the Site. It should be noted that these objectives and constraints are based on current information and subject to change when further ground investigation/characterisation is undertaken.

5.2 OUTLINE LAND REMEDIATION OBJECTIVES

5.2.1 The objectives of the proposed remediation are as follows:

- Protection of human health and the environment;
- To provide a site suitable for the proposed end-use;
- Contributing to a sustainable development;
- Minimising adverse environmental impact on off-Site locations; and
- Best practical remediation measures.

The protection of human health from soil contamination must address;

- Unacceptable risks to human health; and
- Release of contaminants to groundwater to be reduced to an acceptable level.

5.2.2 The outline land remediation objectives of this strategy are set out below. These are required to address the potential risks to human health, controlled waters, services and buildings for the future development. Only the relevant contaminant linkages have been brought forward within this section. **Table 5-1** provides a summary of the Outline Land Remediation Objectives for each identified Relevant Contaminant Linkage (RCL).

Table 5-1 - Summary of Outline Land Remediation Objectives per Relevant Contaminant Linkage

RCL	Source	Aim/ Requirements	Comments
RCL 1	Asbestos containing Soils and ACMs in Stockpiles	Protection of future Site users, construction/maintenance workers and third-party neighbours	Control measures during cut and fill works associated with providing enabling works platform and associated road infrastructure. Source removal of unsuitable ACMs, predominantly associated with the Lake Zone (to include the existing stockpiles). During groundworks appropriate Personal Protective Equipment/Respiratory Protective Equipment and mitigation methods as outlined within an Asbestos Management Plan shall be produced to mitigate the risk against the release of airborne asbestos fibres (including air monitoring) within

RCL	Source	Aim/ Requirements	Comments
			<p>areas/zones where asbestos has been identified.</p> <p>Provision of a pathway break in soft landscaped areas, where underlying Asbestos containing soils have been identified.</p>
RCL 2	PAH and TPH in soils	Protection underlying Aquifers and surface water quality within the Lake.	<p>Although no free phase product has been observed within the groundwater underlying the Site, frequent faint to strong organic odours noted within Made Ground recovered from trial pits within the Lake Zone. Oily sheens were noted on surface of groundwater encountered within a few trial pits in the Lake Zone. This may be indicative of wider soil/groundwater TPH/PAH contamination.</p> <p>Hydrocarbon impacted groundwater may be encountered during construction activities.</p> <p>Source removal comprising further Ground Investigation and removal of any hydrocarbon hotspots and will be required prior to development.</p> <p>If piling is proposed as part of the development, a piling risk assessment will be undertaken to assess the risks to the deeper underlying aquifers.</p>
RCL 3	Dissolved hydrocarbons, in groundwater	Protection underlying Aquifers and surface water quality within the Lake.	
RCL4	Ground gases	Protection of future Site users, construction/maintenance workers and future building structures.	<p>Control measures shall be employed during excavation works as defined in the Appendix 2.3: OCEMP (Volume 3) along with the prevention of gas migration through the use of suitable gas protection measures as a part of the Proposed Development, where required.</p>
RCL 5	Aggressive compounds (i.e. sulphate and hydrocarbons)	Protection of below ground construction materials including concrete and drainage pipes.	<p>Pyrite is recorded across the Site and assessment of concrete in aggressive ground and potential requirement for barrier pipes (subject to agreement with relevant statutory authority) is likely to be required subject to further testing.</p>
RCL 6	Previously unidentified contamination	To mitigate exposure risks associated with previously unidentified contamination if encountered during the earthworks across the Site and	<p>Watching brief during any major earthworks to be completed on-Site (refer to Section 7.10 for further details).</p>

RCL	Source	Aim/ Requirements	Comments
		preventing the potential for cross contamination.	

5.3 OUTLINE CONSTRAINTS AND CONSIDERATIONS

5.3.1 The following are Site-specific factors that are likely to affect the choice of remediation solution. These are summarised in **Table 5-2** below.

Table 5-2 - Site Constraints

Category	Site Specific Constraint
Site Setting	The Site is located within a semi-rural setting however, it is noted that the majority of the Site comprises tenanted agricultural land.
Utilities	Utilities include but not limited to: <ul style="list-style-type: none"> ▪ Potable Water Supply main in the East Gateway Zone; ▪ 33Kv overhead electrical lines across the West Gateway Zone; ▪ 33Kv overhead electrical lines across the Core Zone; and ▪ BT lines within the Lake Zone.
Structures	It is understood the former brick works was demolished to ground level and below ground structures such as foundations, pits, manholes and underground drainage will likely still be present. A control building is also present on the Lake Zone.
Made ground and Stockpiles.	Made Ground is present across parts of the Site, particularly in the Lake Zone. A number of stockpiles of demolition rubble and soil are located on the Lake Zone.
Landfill	An historical landfill that was licenced to accept inert industrial, commercial and household wastes is associated with the former brickworks is located with the Lake Zone.
Ecology	There are a number of ecological constraints associated with the Site. In particular nesting birds within the stockpiles located in the Lake Zone.
Watercourses and Lake	There are a number of surface water features located across the Site. An unnamed stream, running through the West Gateway Zone from south to north, along the western boundary of the Core Zone and Lake Zone. This stream is known to be the Elstow Brook, which is tributary of the River Great Ouse. Minor field drains are also noted throughout the whole Site. A series of unnamed lakes/ponds are noted on-Site throughout the Lake Zone. A narrow unnamed stream runs through the Core Zone, from an unnamed lake in the Lake Zone. A large unnamed lake is noted adjacent to the east of the Lake Zone. These surface water features will require environmental protection during any large-scale remediation works, particular with the landfill located on the Lake Zone.
UXO	Historically ROF Elstow was located adjacent to the east of the Site. The risk of UXO was assessed as Low, 'defined as 'no positive evidence that UXO is present, but its occurrence cannot be totally discounted'.

Category	Site Specific Constraint
Archaeology	Archaeological trial trenching has been undertaken across parts of the Site and an Archaeological watching brief is likely to be required for large scale ground disturbance during any remedial works.

6 OUTLINE LAND REMEDIATION OPTIONS APPRAISAL

- 6.1.1 An appraisal has been undertaken taking into consideration technical, logistical and financial aspects of the remediation technology/options and incorporates the staged approach as defined in LCRM (2023)¹.

The outline remedial options available to manage unacceptable risks will either:

- Manage (remove, destroy, modify or immobilise) the source;
- Interrupt the pathway; or
- Modify the receptor or the behaviour of the receptor.

- 6.1.2 For the landfill area within the Lake Zone the approach is to leave the landfill undisturbed as far as reasonably practicable. As such the existing hardstanding and the landfill cap (where present) will limit human health exposure via dermal contact and ingestion.

- 6.1.3 The most appropriate approach at this stage (and subject to further ground characterisation) is considered to be a combination of source treatment and removal/modification of the migration pathway.

6.2 UNSATURATED SOIL OPTIONS

- 6.2.1 The assessment of chemical data indicates that there are areas of asbestos and hydrocarbon contamination.

- 6.2.2 The proposed options are designed to manage the source of contamination or interrupt the pathway. Modifying receptor or receptor behaviour has not been considered in this instance. Source management may involve at least one of the following remedies: the removal, destruction, stabilisation, or transformation of the source. Pathway interruption may involve either the blocking of the pathway or the destruction or removal of contaminants moving along a pathway or combination of the aforementioned remedies.

- 6.2.3 Feasible remedial techniques for the Site include in-situ and ex-situ based and process-based solutions.

Excavate and dispose

- 6.2.4 This technique simply involves excavating the source of contaminated material noting this will be predominately focused within the Lake Zone. It has the advantage that it is an observational technique and contaminated material identified by visual and olfactory means may be removed with some confidence. The disposal option is an expensive and environmentally unsustainable solution, requiring disposal of the contaminated material to a suitable disposal facility, a source of chemically suitable material to backfill the excavation and transport of the waste and fill materials. Any excavation and disposal works will be undertaken in line with materials management of the soils in accordance with waste management guidance as outlined within Section 7.7.

Landfill Area – Lake Zone

- 6.2.5 At this stage of development process, any soils excavated within the Landfill Area - Lake Zone will be designated as a waste which will require off-Site disposal to a licensed waste disposal facility. Refer to Section 7.7 for further discussion on disposal/re-use options for the landfill materials.

Excavate and removal to soil treatment facility

- 6.2.6 This technique involves excavating the source of contaminated material. This is an observational technique based on visual/olfactory evidence of contamination which will be confirmed by validation testing (See Section 7.8 below for more details). This unsuitable material (predominately within the Lake Zone and outside the footprint of the Landfill) will then be disposed of off-Site to a registered Soil Treatment Facility (STF) for treatment and re-use off-Site. Based upon the volume of contaminated material, this may prove to be a more cost-effective approach than treatment on Site however, segregation should be undertaken to ensure that this is cost effective.

Excavate and re-use under Materials Management Plan (MMP)

- 6.2.7 For areas outside the licensed landfill area, re-use of on-Site soils will be carried out under the Contaminated Land: Applications in Real Environments (CL:AIRE) *Definition of Waste Code of Practice (DoWCoP)*¹⁵ to facilitate the re-use of on-Site material that might otherwise be classified as waste. This technique involves excavating the source of contaminated material and reusing it in accordance with the defined suitability for use criteria. This is an observational technique based on visual/olfactory evidence of contamination which will be confirmed by validation testing. This material will then be re-used by the management of soils within areas of lower risk such as areas of proposed hardstanding where infiltration of water will be minimal. It should be noted that some material may be unsuitable for re-use in any of the likely land-use scenarios and require further remediation or removal from Site.

Ex-situ Bio-Remediation

- 6.2.8 This technique is suitable for organic contamination and ranges in complexity from simply placing and turning over excavated contaminated source material in windrows, to adding spent compost or seeding with bacteria and allowing biological degradation of the contaminants. It has the advantage that treatment progress can be observed, and visual and olfactory contaminated material may be removed with confidence. Once treated and validated the material can be placed back into the excavation and compacted to an engineering specification. However, it is a time-based solution and requires a temporary impermeable working area to store material during treatment. Surface water runoff and leachate are collected for treatment. The remediation endpoints also must be sufficiently low to meet assessment criteria.

Chemical Techniques

- 6.2.9 This technique ranges in complexity with regards to the application of chemical compounds introduced to the site to initiate a reaction with the contaminants in the soil and convert the contaminants to harmless products that pose little or no risk to end users. Chemical treatment is applicable to organic and inorganic contamination, the final chemical selection being based on both contaminant and the specific ground conditions. The technique includes options such as oxidation, reactive walls, solidification and stabilisation. In the same way as biological degradation of contaminants, it has the advantage that treatment progress can be observed, and visual and olfactory contaminated material may be removed with some confidence. Once treated and validated the material can be placed back into the excavation and compacted to an engineering specification. However, some treatment can

¹⁵ CL:AIRE (2011) *The Definition of Waste: Development Industry Code of Practice*. Available at: <https://claire.co.uk/projects-and-initiatives/dow-cop/28-framework-and-guidance/111-dow-cop-main-document> [Accessed: 09 June 2025].

render materials unsuitable for engineering re-use and the process may not work too well in clayey soils.

Materials Management and Cover Systems/Barriers

- 6.2.10 This technique introduces an appropriate barrier, removing the pathway to the receptor. Import of clean materials or on-site management of appropriate materials is required for construction of the barrier. Systems range from simple cover layers to provide a reduction of the hazard to human health and to provide a suitable medium for plant growth; through to engineered systems designed to provide a complete separation of the receptor from the hazard and to perform a number of functions including limiting upward migration of contaminants due to capillary rise and controlling the downward infiltration of water.

6.3 PREFERRED REMEDIATION OPTIONS

- 6.3.1 Each of the above have been numerically scored against a number of criteria including:
- **Applicability** – how applicable the particular technology is for the treatment of the CoC in the context of the site and the project objectives;
 - **Technical Feasibility** – whether the treatment of the CoC and the achievement of the remediation objectives is feasible using the particular technology;
 - **Effectiveness** – How effective treatment is likely to be;
 - **Cost** – What is the comparative cost against the other technologies being screened;
 - **Compatibility with Earthworks (Soil Improvements)** – How compatible is the treatment with soil improvement requirements for the project;
 - **Carbon Footprint** – Comparative cost in carbon of the remediation technology;
 - **Enabling Works** – How much in the way of plant, equipment, infrastructure or engineering is required to implement the remediation;
 - **Duration** – How long will it take; and
 - **Sustainability** - The relative use of resources, material intensity, carbon dioxide emissions and environmental impacts of each of the proposed technologies.
- 6.3.2 The outcome of the multi-criterion assessment for all of the above categories are finally multiplied by the score for 'Applicability' to provide a final rating. A copy of the appraisal matrix used in the selection process is attached as **Annex 2**.
- 6.3.3 Based upon literature review and from direct experience on sites of similar complexity, it is considered that an appropriate and cost-effective approach that can be adopted is a mixture of hotspot removal and off-site disposal to an STF and re-use of the soils under a MMP and construction of cover systems/barriers to prevent contact with/exposure to the contamination.

7 LAND REMEDIATION STRATEGY

7.1 RELEVANT POLLUTANT LINKAGE (RPL) 1 – ASBESTOS CONTAINING MATERIALS

- 7.1.1 This outline strategy proposes that where asbestos containing soils, is present (predominantly within the Lake Zone) within the upper 600mm of the final finished formation levels following the enabling works site profiling works, residual risks to human health can be mitigated by a pathway interruption method. In areas where buildings and hardstanding are proposed, this will provide suitable mitigation to prevent dermal contact and ingestions human health exposure.
- 7.1.2 The placement of clean cover systems is likely to be the responsibility of the relevant Undertaker¹⁶ who should appoint a suitably qualified environmental engineer to independently verify that imported cover materials meet the required standard, and the cover systems are constructed in accordance with the requirements set out below.
- 7.1.3 In areas of proposed soft landscaping, where Made Ground remains in place, there is the potential for residual contamination to be present which may pose an increased risk to sensitive human receptors if brought to the surface due to maintenance work. As such a minimum cover is designed to mitigate residual risks and a marker layer such as orange terram or similar will be required. In addition, soft landscaping will require suitable growing medium for cultivation.
- 7.1.4 The capping thicknesses are shown in **Table 7-1** below. The clean cover layer will be placed in the sequence as shown below during the Construction Phase. It is considered that areas of soft landscaping will be managed by the building management who can take appropriate mitigation measures to limit exposure to their workforce.
- 7.1.5 Such a cover barrier would need to be agreed with the Contaminated Land Officer at the relevant Planning Authority and will be dependent on the final development layout and levels.

Table 7-1 - Typical Capping Thickness

AREA ON SITE	GEOTEXTILE MARKER LAYER	SUB-SOIL (MM)	TOPSOIL (MM)	TOTAL THICKNESS (MM)
Public Open Space/landscaping areas	Yes	200	400	600

- 7.1.6 The chemical requirements for the landscaping areas are outlined within Section 7.8 and geotechnical requirements of subsoil and topsoil are as outlined within *BS 8601:2013*¹⁷ and *BS 3882:2015*¹⁸, respectively.

¹⁶ The persons (corporate or otherwise) who are permitted to carry out the Proposed Development (including their contractors and other persons appointed by them in connection with the carrying out of the Proposed Development).

¹⁷ British Standards Institution (2013) *BS 8601:2013 - Specification for subsoil and requirements for use*. UK: British Standards Institution.

¹⁸ British Standards Institution (2015) *BS 3882:2015 – TC - Specification for topsoil*. UK: British Standards Institution.

- 7.1.7 Based on the depth of the groundwater table, the requirement for a capillary break layer has been excluded.
- 7.1.8 Cement bound asbestos was noted in the demolition rubble stockpiles located in the Lake Zone. Where present, cement bound asbestos will be subjected to complex sorting and asbestos picking by a licensed asbestos contractor. The asbestos will be removed from Site as hazardous waste. The remaining stockpile materials will be chemically tested in accordance with suitable of use criteria (including asbestos) in **Table 8-4** prior to re-deposit.
- 7.1.9 The re-use criteria for asbestos will be ‘below the analytical limit of detection’ following quantification. If above the limit of detection but below 0.1 %v/v, a risk-based approach will be adopted for the re-use of the material, if not notifiable.
- 7.1.10 If asbestos is identified during the earthworks on the Site, this material will require careful management in accordance with *Control of Asbestos Regulations 2012*¹⁹. Asbestos exposure risk assessment, mitigation such as dust suppression and air monitoring will be required.
- 7.1.11 As general site management good practice, earthworks operatives will be given a toolbox talk on potential contaminated land risks in particular the possibility of encountering ACM prior to excavation.
- 7.1.12 If suspected ACM is identified then the following is required:
- Stop works in the vicinity of the suspected location;
 - Inform Site manager;
 - Inform the environmental Engineer;
 - Operatives to be provided with appropriate PPE;
 - Damp and cover the location to prevent release of asbestos fibres;
 - Fence off the area to prevent tracking of fibres across the Site by vehicle/people movements;
 - Collection of soil sample by the Contractor for asbestos quantification testing; and
 - If material above acceptance criteria remove from Site.

7.2 RPL 2 AND 3– PROTECTION OF GROUNDWATER AND SURFACE WATERS

- 7.2.1 Although no free phase product has been observed within the groundwater underlying the Site, frequent faint to strong organic odours were noted within Made Ground recovered from trial pits within the Lake Zone. Oily sheens were noted on surface of groundwater encountered within a few trial pits in the Lake Zone. This may be indicative of wider soil/groundwater TPH/PAH contamination. Hydrocarbon impacted groundwater may be encountered during construction activities.
- 7.2.2 If a risk is demonstrated through further assessment, contaminated soils will be removed for off-Site treatment at a STF. At this stage any material excavated within the Landfill area designated as a waste will require off-Site disposal to a licensed waste disposal facility. Refer to Section 7.7 for further discussion on disposal/re-use options for the landfill materials.
- 7.2.3 If piling is proposed as part of the Proposed Development, which will be identified during the detailed design process, a piling risk assessment will be undertaken to assess the risks to the deeper underlying aquifers.

¹⁹ HM Government (2012) *The Control of Asbestos Regulations 2012*. Available at: <https://www.legislation.gov.uk/uksi/2012/632/contents> [Accessed: 11 June 2025].

- 7.2.4 Should groundwater be encountered in the excavations, or significant runoff enter open excavations from any source, dewatering will be undertaken by arranging for the rapid removal of water and maintaining the water level sufficiently by appropriate measures to enable the backfill to be laid and compacted. Any abstracted water will need to be managed, treated and disposed of in accordance with agreed discharge consents from the Local Planning Authority or local foul sewer provider.

7.3 RPL 4 – GROUND GAS

- 7.3.1 At this stage the elevated ground borne gas (indicating a CS2 classification – in the Core Zone) will be re-assessed upon completion of additional ground investigation and the associated earthworks to confirm the gas protection measures required to protect buildings from ground borne gas and/or migration (if required).
- 7.3.2 The proposed gas protection measures should be confirmed with the appropriate regulatory authority which should include the specific details of the gas protection measures, installation procedures and the locations in relation to the foundations.
- 7.3.3 Verification of the gas protection measures shall be undertaken and provided to the relevant approving authority prior to the foundation works.

7.4 RPL 5 – PROTECTION OF BELOW GROUND SERVICES

- 7.4.1 Based on UK Water Industry Research (UKWIR) ‘*Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites*’²⁰ and the available data, an indicative assessment has been undertaken on the type of water supply pipes that may be suitable for the Site. The initial assessment suggests that barrier pipes may be required in parts of the Lake Zone. The detailed Land Remediation Plan will require soil testing in order to gather a sufficient level of detail to inform the final selection of the type of water supply pipes suitable for the Site. The appropriate soil testing requirements will be agreed with the relevant water service provider.
- 7.4.2 It should be noted that the water supply company’s bespoke threshold concentrations take precedence over the UKWIR guidance, therefore, this should be confirmed prior to construction.
- 7.4.3 Pyrite has been identified in the soils on Site. Where pyrite is found to be present concrete classification appropriate for the risk will be utilised.

7.5 RPL 6 – MANAGING UNEXPECTED CONTAMINATION AND FURTHER GROUND INVESTIGATION

- 7.5.1 Further ground investigation is proposed to fill in the data gaps identified in Section 3 including further characterisation of the contaminant status of the previously licenced landfill located in the Lake Zone.
- 7.5.2 In areas outside the landfill, excavations should be undertaken with a suitably qualified Environmental Engineer/Scientist overseeing excavation works. The Environmental Engineer/Scientist should be aware of the different types of material ‘expected’ and ‘not expected’ on this Site. If suspected

²⁰ UK Water Industry Research (2010) *Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites*. Available at: <https://ukwir.org/eng/reports/10-WM-03-21/67108/Guidance-for-the-Selection-of-Water-Supply-Pipes-to-be-used-in-Brownfield-Sites> [Accessed: 09 June 2025].


contaminated material is encountered during the construction works, it should be managed by implementing the following steps:

- Stop excavation works in that area of the Site;
- Environmental Engineer to assess the material, initially by visual and olfactory assessment;
- Samples of the material shall be collected by the Contractor under the guidance of the Environmental Engineer and sent to an appropriately UK Accreditation Service (UKAS) and Monitoring Certification Scheme (MCERTS) accredited laboratory for analysis. The suite of analysis shall be suitable for the suspected contaminants of concern, determined by the Environmental Engineer;
- The material will be reported immediately to the relevant Planning Authority;
- The Environmental Engineer will assess the risks presented by the encountered material in the context of the Site, its setting and CSM in accordance with best practice^{1,21};
- Where remediation is necessary, a revised Land Remediation Strategy must be prepared which ensures the Site will not qualify as contaminated land under Part IIA of the *Environmental Protection Act 1990*² in relation to the intended residential use of the land after the works;
- A survey shall be completed of all contaminated material excavated, along with detailed material tracking;
- On completion of the contaminated material excavation, verification sampling should be completed in the excavation faces on the following criteria:
 - Sample from the excavation base, every 10m by 10m area;
 - Sample from excavation sides, every 10 linear m or if the excavation is small, one from each face (minimum four samples); and
 - Excavation base and side samples shall be tested against a suite of analysis suitable for the suspected contaminants of concern, determined by the Environmental Engineer.
- All findings, records and laboratory reports to be presented within a Verification Report which will be subject to approval of the relevant Planning Authority, discussed further in Section 10.
- All of the findings will be reported within the Verification Report.

7.5.3 The procedure for assessing unexpected contamination outside the landfill area will be a risk-based assessment and will be in accordance with the following the procedure outlined in **Table 7-2**. The level of risk assessment will dependant on the identified pollutant linkage and the severity of the unexpected contamination.

²¹ British Standards Institution (2017) *BS 10175:2011+A2:2017 – Investigation of potentially contaminated sites. Code of practice*. UK: British Standards Institution.

Table 7-2 - Flow Chart Showing Procedures for Assessing and Managing Unexpected Contamination



Step	Actions
Identify Pollutant Linkage	Review the CSM to identify any relevant Pollutant Linkages
Conduct Risk Assessment	Undertake a Quantitative Risk Assessment to determine if the level of risk is acceptable
Remediation Options Appraisal	If the level of risk is not acceptable then review the options to select the most cost-effective option to either break or remove the pollutant linkage
Determine Land Remediation Strategy	Finalise and present the Strategy for regulatory approval
Submit to Regulator for approval	In the event that regulatory approval is not obtained then revisit the Land Remediation Options Appraisal and Land Remediation Strategy to meet regulatory requirements
Implement Strategy	Implement Remediation in accordance with the agreed strategy
Verification	Undertake verification works and report in a final Validation Report to be approved by the relevant Planning Authority

7.6 CUT AND FILL

- 7.6.1 To facilitate the enabling work platform level and associated road infrastructure a significant volume of material (c1.5m cu.m of cut and c1.5m cu.m of fill) will be needed to provide an approximate mass balance across the Site.

Materials Management Plan

- 7.6.2 In order to ensure that all movement, reuse and disposal of materials are properly tracked and traceable, following detailed earthworks modelling and prior to the commencement of cut and fill works, a MMP in accordance with the CL:AIRE DoWCoP¹⁵ will be produced by either WSP or the Contractor and submitted to CL:AIRE.
- 7.6.3 The MMP will require declaration by a CL:AIRE Qualified Person and notification to the relevant authority and the Environment Agency prior to commencement of the works.
- 7.6.4 A 'Qualified Person' as defined under the *DoWCoP*¹⁵ will review the development of the Materials Management Plan, Risk Assessments and Land Remediation Strategy together with documentation relating to Planning and Regulatory issues will sign a Declaration which is forwarded to the Environment Agency and which confirms compliance with the *DoWCoP*. Any need for the disposal of material off-Site will require appropriate pre-classification and pre-treatment to minimise the waste volume. It is the strategy of the Site however to maximise re-us of materials where possible.
- 7.6.5 The Contractor is required to provide method statements illustrating how compliance with waste management legislation is to be achieved for those materials classified as waste, to include but not limited to:
- Use of imported material;
 - Criteria for assessing of the suitability of imported materials;

- Management of material that arises during the works and is classified as waste;
- Waste streams are appropriately classified prior to off-Site disposal;
- Audit process for the selection of waste management contractors to include the collection and assessment of licences, permits and registrations; and
- Audit process and record keeping.

7.6.6 Soils and below ground structures in the area marked around the former brickworks in the south of the Lake Zone as a historic landfill cannot be re-deposited using an MMP (Refer to Section 7.7).

Imported fill

7.6.7 Any imported materials will require suitable validation certificates to demonstrate their suitability for use within the development. Any material imported onto the Site will first be screened and visually assessed at the site of origin to provide evidence for validation that all material imported to Site is 'free from solvent, hydrocarbon or contaminant odour, discolouration and propagules of aggressive weeds, fragments of glass, wire, ash or other potentially hazardous foreign matter, asbestos and bulk vegetative growth.' Inspection and photos will be required which will form part of the validation report. Sampling will also be taken from the source of the material prior to import.

7.6.8 In addition to the pre-importation validation, imported materials will be spot-tested on-site to confirm their suitability for a commercial end use, as detailed below:

- One sample per 100m³ frequency for materials arising from a previously developed site regardless of the use and if sourced from within the development site itself; and
- One sample per 500m³ for natural materials arising from a site with no known previous contaminative use.

7.6.9 The samples will be submitted to a UKAS and MCERTS accredited laboratory for analysis provided in **Table 7-4** and **Table 7-6**. Imported fill shall comply with Paragraph 7.6.7 and 7.6.8 and the UDX import standards - whichever are more stringent. The Material Management Plan shall be written with due regard to both the requirements set out in the Outline Land Remediation Strategy and the UDX import standards taking the most conservative approach between the two standards. In addition, any imported topsoil will be tested to demonstrate compliance with the specification detailed in *BS 3882:2007*²² to be confirmed by the landscape architect.

7.6.10 Note that this strategy excludes the requirements for determining that they are geotechnically suitable for use. Geotechnical acceptability testing requirements are set out in the Preliminary Earthworks Specification.

7.7 WASTE MANAGEMENT IN THE LANDFILL AREA

7.7.1 At this stage, it is noted that the soils and below ground structures in the area marked around the former brickworks in the south of the Lake Zone as a historic landfill are precluded from being included in the MMP. Excavated material will need disposal to a registered waste disposal facility. Alternatively, a separate mechanism such as a Deposit for Recovery Environmental Permit with an associated Waste Recovery Plan would be required for this material to be reused on Site.

²² British Standards Institution (2007) *BS 3882:2007 - Specification for topsoil and requirements for use*. UK: British Standards Institution.

- 7.7.2 However, based on historical mapping and the records the landfill occupies a much smaller area than the licenced landfill boundary. Furthermore, it is understood that the landfilled waste was associated with on-site materials originating from the former brickworks.
- 7.7.3 As such it may be possible to compile lines of evidence associated with the provenance of the material, historical mapping and recent soil chemical testing results. The result of the assessment can be shared with the Environment Agency with the aim of reducing the licenced landfill boundary to the area associated with the historic backfilled pit and thus reduce the volume of landfill waste soil to be removed from Site.
- 7.7.4 If a Deposit for Recovery Environmental Permit is sought a Waste Recovery Plan supporting documentation will need to be submitted to the Environment Agency for approval.
- 7.7.5 The volume of waste intended for recovery and deposit will determine if a Standard Rules use of waste in a deposit for recovery operation (maximum 60,000m³) or bespoke version of the permit is required. Application for a bespoke Deposit for Recovery permit incurs additional assessments and engagement with the Regulators.

7.8 SAMPLING AND TESTING FOR SUITABILITY OF USE

Human Health and Phytotoxicity

- 7.8.1 Sampling shall comply with Section 7.8 and the UDX import standards - whichever are more stringent. The testing shall be written with due regard to both the requirements set out in the Outline Land Remediation Strategy and the UDX import standards taking the most conservative approach between the two standards.
- 7.8.2 Sampling and testing of any backfill materials will be required in order to demonstrate suitability of use. Sampling frequency and strategy is detailed in **Table 7-3** below:

Table 7-3 - Proposed Sampling Strategy

Activity	Testing Frequency	Testing Suite
Stockpiled materials for disposal	Testing frequency as required by the receiver of the waste	Waste acceptable criteria analysis if being taken to a landfill or a full testing suite for metals, inorganics and organics if being taken to another site or a STF (subject to the requirements of the receiver site).
Site won crushed concrete used to backfill excavations/piling mat construction	Frequency to be determined against risk at a later date	Asbestos and TPH – Criteria Working Group (CWG)
Site won soils for cut and fill associated with the enabling works platforms and associated structures and materials used to infill excavations and voids	Frequency to be determined during enabling works design	Suite of testing as outlined within Tables 8-4 to Table 8-6 .

Activity	Testing Frequency	Testing Suite
Imported materials	Frequency to be determined against risk at a later date*	Suite of testing as outlined within Table 8-4 to Table 8-6 . Asbestos and TPH – CWG if crushed concrete.
Validation of clean cover materials for soft landscaped areas	Subsoil – Class 4 Frequency to be determined against risk at a later date Topsoil – Class 5 Frequency to be determined against risk at a later date	Suite including TPH – CWG, asbestos, metals and PAHs.
	Import only: Frequency to be determined against risk at a later date	BS 3882:2015 ¹⁸ testing suite

* - Where imported material is a certified product or from a virgin source or the material has been demonstrated to have been produced in accordance with the Waste and Resources Action Programme Quality protocol and is used below the clean cover layer, the sampling and testing of the material would not be required. A visual/olfactory assessment of the material once imported onto Site would however be required.

- 7.8.3 All soils being excavated and re-deposited to include enabling works platforms; infrastructure; clean cover layer; general backfill and imported soils would be assessed for suitability by comparison to the Generic Assessment Criteria for Commercial end use **Table 7-4** below.

Table 7-4 - Preliminary Re-use Criteria – Soil re-use and Imported Soils

Parameters	Units	Site Won General/Structural Fill	Imported General/Structural Fill
Metals and Inorganics			
Asbestos	% w/w	<0.001	0 (No asbestos detected)
Arsenic	mg/kg	635	635
Cadmium	mg/kg	223	223
Chromium (III)	mg/kg	9550	9550
Chromium (VI)	mg/kg	24	24
Copper	mg/kg	69,800	500*
Lead	mg/kg	1,390	1,390

Parameters	Units	Site Won General/Structural Fill	Imported General/Structural Fill
Mercury (inorganic)	mg/kg	1,110	1,110
Nickel	mg/kg	1,710	600*
Selenium	mg/kg	12,300	12,300
Zinc	mg/kg	N/A	1,800*
Cyanide (total)	mg/kg	78	78
Total Phenols	mg/kg	760	760
PAHs			
Benzo[a]pyrene	mg/kg	38	38
Naphthalene	mg/kg	193	193
TPHs (CWG Approach)			
Aliphatic EC >5-6	mg/kg	3,190	999*
Aliphatic EC >6-8	mg/kg	7,780	
Aliphatic EC >8-10	mg/kg	2,000	
Aliphatic EC >10-12	mg/kg	9,690	
Aliphatic EC >12-16	mg/kg	58,800	
Aliphatic EC >16-21	mg/kg	N/A	
Aliphatic EC >21-35	mg/kg	N/A	
Aliphatic EC >35-44	mg/kg	N/A	
Aromatic EC >5-7	mg/kg	26,200	
Aromatic EC >7-8	mg/kg	56,100	
Aromatic EC >8-10	mg/kg	3,460	
Aromatic EC >10-12	mg/kg	16,200	
Aromatic EC >12-16	mg/kg	36,200	

		Site Won General/Structural Fill	Imported General/Structural Fill
Parameters	Units		
Aromatic EC >16-21	mg/kg	28,200	
Aromatic EC >21-35	mg/kg	28,400	
Aromatic EC >21-35	mg/kg	28,400	
BTEX			
Benzene	mg/kg	27	500*
Toluene	mg/kg	56,300	
Ethylbenzene	mg/kg	5,710	
p & m-Xylene	mg/kg	5,920	
o-Xylene	mg/kg	5,920	
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	7,480	

* Limits are capped to prevent import of hazardous waste

- 7.8.4 All soils being excavated and re-deposited for clean cover layer; landscaping and imported topsoil would be assessed for suitability by comparison to values provided **Table 7-5** and **Table 7-6** below.

Table 7-5 - Zinc, Copper & Nickel Limiting Values for Landscape Fill and Topsoil

Parameters	Units	Soil pH <6.0	Soil pH 6.0 - 7.0	Soil pH >7.0
Zinc (nitric acid extractable)	mg/kg	<200	<200	<300
Copper (nitric acid extractable)	mg/kg	<100	<135	<200
Nickel (nitric acid extractable)	mg/kg	<60	<75	<110

Table 7-6 - Limiting Values for Landscape Fill and Topsoil

Parameters	Units	Site Won & Imported and Landscape Fill
Metals and Inorganics		
Asbestos	% w/w	0 (No asbestos detected)
Arsenic	mg/kg	635

Parameters	Units	Site Won & Imported and Landscape Fill
Cadmium	mg/kg	223
Chromium (III)	mg/kg	9550
Chromium (VI)	mg/kg	24
Copper	mg/kg	See Table 7-5
Lead	mg/kg	1,390
Mercury (inorganic)	mg/kg	1,110
Nickel	mg/kg	See Table 7-5
Selenium	mg/kg	12,300
Zinc	mg/kg	See Table 7-5
Cyanide (total)	mg/kg	78
Total Phenols	mg/kg	760
PAHs		
Benzo[a]pyrene	mg/kg	38
Naphthalene	mg/kg	193
TPHs (CWG Approach)		
Aliphatic EC >5-6	mg/kg	999*
Aliphatic EC >6-8	mg/kg	
Aliphatic EC >8-10	mg/kg	
Aliphatic EC >10-12	mg/kg	
Aliphatic EC >12-16	mg/kg	
Aliphatic EC >16-21	mg/kg	
Aliphatic EC >21-35	mg/kg	
Aliphatic EC >35-44	mg/kg	
Aromatic EC >5-7	mg/kg	
Aromatic EC >7-8	mg/kg	
Aromatic EC >8-10	mg/kg	

Parameters	Units	Site Won & Imported and Landscape Fill
Aromatic EC >10-12	mg/kg	
Aromatic EC >12-16	mg/kg	
Aromatic EC >16-21	mg/kg	
Aromatic EC >21-35	mg/kg	
Aromatic EC >21-35	mg/kg	
BTEX		
Benzene	mg/kg	500*
Toluene	mg/kg	
Ethylbenzene	mg/kg	
p & m-Xylene	mg/kg	
o-Xylene	mg/kg	
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	

* Capped to prevent import of hazardous waste

- 7.8.5 The re-use criteria for asbestos is 'below the analytical limit of detection' following quantification. If above the limit of detection but below 0.1%vv, a risk-based approach should be adopted for the re-use of the material, if not notifiable.

Controlled Waters

- 7.8.6 Groundwater was encountered during the intrusive ground investigations at a range of depths and within strata including the Made Ground, superficial Alluvium and Head Deposits and the Peterborough Member Mudstone and Kellaways Sand Member bedrock. Perched groundwater within the Made Ground and the on-Site aquifers are interpreted to be in variable hydraulic continuity with one another across the Site.
- 7.8.7 The superficial Alluvium and the Kellaways Sand Member bedrock are classified by the Environment Agency as Secondary A Aquifers. The Head Deposits are classified by the Environment Agency as a Secondary Undifferentiated Aquifer. The Peterborough Member Mudstone is classified by the Environment Agency as an Unproductive Stratum. The Principal Aquifer is formed within the Cornbrash that underlies the Kellaways Clay Member of the Oxford Clay Formation.
- 7.8.8 There are no active potable water abstractions within one kilometre of the Site and the Site does not lie within a groundwater SPZ. The Site lies within an area where the vulnerability of groundwater to a pollutant discharged at ground level is medium to high.
- 7.8.9 The Elstow Brook, that is a tributary of the River Great Ouse, runs broadly west to east through and adjacent to the Site. The Elstow Brook has been identified as a sensitive receptor to contamination

from the lateral migration of contaminants. The Elstow Brook is likely in continuity with underlying groundwater bearing strata.

- 7.8.10 A number of unnamed lakes are present within the Lake Zone. It is interpreted that the lakes were formed through groundwater flow and surface water runoff following the extraction of clay mineral used in the brick making at the Kempston Hardwick brickworks formerly located in the west of the Lake Zone.
- 7.8.11 Based on the above findings, soil leachate testing is required for any site won Made Ground, naturally occurring soils and bedrock and imported material that is used in the earthworks to ensure the sensitive water receptors present on Site and adjacent to the Site are protected.
- 7.8.12 The acceptance criteria for controlled waters is given in **Table 7-7** and the results of the testing will be screened against them.
- 7.8.13 The limits have been derived from the *Environmental Quality Standards (EQS)*²³ for surface waters. Where a quality standard for a particular determine and is not set within the EQS or a more conservative/suitable limit is available, the *UK Drinking Water Quality Standards (DWS)*²⁴ and *World Health Organisation (WHO) guidelines*²⁵ have been utilised.
- 7.8.14 If the material produces leachate concentrations below that provided within **Table 7-7**, then the use of the material should not cause adverse impacts to the environment.
- 7.8.15 Should the tested material not conform to the leachate criteria provided in **Table 7-7**, the relevant Undertaker reserves the right to undertake the following:
 - a) Produce a CSM to provide further conceptualism of the site (in accordance with *LCRM 2023*¹) to establish whether a pathway exists between the material backfilled and the identified controlled waters receptors. The CSM must be reviewed based on any additional information related to potential contaminative sources. Should additional CoC be identified, UDX will require additional tests to confirm the quality and suitability of the material, the results of the testing shall be compared against equivalent industry standards to those outlined in **Table 7-7**. If a pathway does not exist the Contractor may be able to increase the criteria in **Table 7-7** subject to agreement/acceptance by the Responsible Person in discussion with the Environment Agency and the Local Planning Authority's Contaminated Land Officer.
 - b) If a pathway exists, UDX reserves the right to undertake a Detailed Quantitative Risk Assessment for controlled waters (in accordance with *LCRM 2023*¹) to determine if dilution, dispersion, degradation and/or attenuation could naturally reduce a harmful concentration to a compliant value through a groundwater modelling exercise and assess appropriate site specific soil and/or soil leachate reuse or imported criteria for **Table 7-7**. This is carried out subject to

²³ Publications Office of the European Union (2022) *Environmental quality standards applicable to surface water*. Available at: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=legissum:i28180> [Accessed: 11 June 2025].

²⁴ Drinking Water Inspectorate (n.d.) *Drinking Water Standards and Regulations*. Available at: <https://www.dwi.gov.uk/drinking-water-standards-and-regulations/> [Accessed: 11 June 2025].

²⁵ World Health Organisation (2008) *Petroleum Products in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality*. Available at: https://cdn.who.int/media/docs/default-source/wash-documents/wash-chemicals/petroleumproducts-2add-june2008.pdf?sfvrsn=9f397b0c_4 [Accessed: 11 June 2025].

agreement/acceptance by the Responsible Person in discussion with the Environment Agency and the Local Planning Authority's Contaminated Land Officer.

- 7.8.16 All soil leachate testing shall be in accordance with UKAS/MCERTS accreditation and be in accordance with *BS EN 12547 (BSI 2002) Part 2²⁶* – one stage test using a liquid to solid ratio of 10:1 per kilogram.
- 7.8.17 In addition to leachability testing of earthwork materials, the Contractor shall collect groundwater samples from excavations and undertake analysis if encountered and there becomes a requirement for pumping, treatment and/or disposal. The results of the groundwater testing should be screened against **Table 7-7** for the protection of controlled water receptors.
- 7.8.18 No soils exhibiting visual or olfactory evidence of contamination shall be used on-Site. In addition to the above criteria stated, soils must also be visually inspected and rejected if there is evidence of visual or olfactory contamination.
- 7.8.19 The Contractor shall advise the Responsible Person in the Contractor's sampling and testing method statement, sampling, containment, storage, transit, scheduling and reporting for review.
- 7.8.20 Additional sampling and analysis shall be carried out by the Contractor where other contamination is suspected for any reason as instructed by the Responsible Person's Engineer.

Table 7-7 - Acceptance Criteria for Protection to Controlled Waters

Parameter	Units	Standard	Limiting Values for Site Excavated & Imported Materials
pH	pH	EQS	>= 6.5 - <= 9
Metals and Inorganics			
Arsenic	µg/l	EQS	10
Boron	µg/l	EQS	1,000
Cadmium	µg/l	EQS	0.08*
Total Chromium	µg/l	EQS	4.7
Chromium VI	µg/l	EQS	3.4
Copper	µg/l	EQS	1**
Lead	µg/l	EQS	1.2**
Mercury (inorganic)	µg/l	EQS	0.07**
Nickel	µg/l	EQS	4**

²⁶ British Standards Institution (2002) BS EN 12457-2:2002 - *Characterisation of waste. Leaching. Compliance test for leaching of granular waste materials and sludges - One stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 4 mm (without or with size reduction)*. UK: British Standards Institution.

Parameter	Units	Standard	Limiting Values for Site Excavated & Imported Materials
Selenium	µg/l	DWS	10
Cyanide (free)	µg/l	EQS	1
Zinc	µg/l	EQS	11.9**
Ammoniacal Nitrogen as N	µg/l	EQS	200
Ammoniacal Nitrogen as NH ₄ (converted from Ammoniacal Nitrogen as N)	µg/l	DWS	500
PAHs			
Benzo[a]pyrene	µg/l	DWS	0.01
Anthracene	µg/l	EQS	0.1
Naphthalene	µg/l	EQS	2
Fluoranthene	µg/l	EQS	0.12***
PAH 4 ⁺ summed	µg/l	DWS	0.1
Phenols			
Phenols (Total)	µg/l	EQS	7.7
TPHs			
Aliphatic EC >5-6	µg/l	WHO	1,000****
Aliphatic EC >6-8	µg/l	WHO	1,000****
Aliphatic EC >8-10	µg/l	WHO	300
Aliphatic EC >10-12	µg/l	WHO	300
Aliphatic EC >12-16	µg/l	WHO	300
Aliphatic EC >16-21	µg/l	No criteria available	
Aliphatic EC >21-35	µg/l	No criteria available	
Aliphatic EC >35-44	µg/l	No criteria available	
Aromatic EC >5-6	µg/l	WHO	10

Parameter	Units	Standard	Limiting Values for Site Excavated & Imported Materials
Aromatic EC >6-8	µg/l	WHO	700
Aromatic EC >8-10	µg/l	WHO	300
Aromatic EC >10-12	µg/l	WHO	90
Aromatic EC >12-16	µg/l	WHO	90
Aromatic EC >16-21	µg/l	WHO	90
Aromatic EC >21-35	µg/l	WHO	90
BTEX			
Benzene	µg/l	WHO	10
Toluene	µg/l	WHO	70
Ethylbenzene	µg/l	WHO	300
m-Xylene	µg/l	WHO	500
o-Xylene	µg/l		
p-Xylene	µg/l		

Notes:

EQS = EQS for inland waters

DWS = Drinking Water Standards

WHO = WHO Petroleum Products in Drinking Water Guidelines for Drinking Water Quality

* Assumes hardness of 0-50 mg CaCO₃/l

** Assumes 100% bioavailable

*** Pelagic freshwater EQS adopted in accordance with PAH-5-6-rings EQS dossier, 2011 and Fluoranthene EQS dossier, 2011

+ Sum of four PAH – benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene and indeno(1,2,3-cd)pyrene

**** Values reduced to 1000 ug/l for the protection of Controlled Waters

7.9 HARDSTANDING, SUB-BASE AND FOUNDATIONS

Hardstanding and Sub-base

7.9.1 Concrete hardstanding is present within the southern section of the Lake Zone.

7.9.2 When breaking out the hard standing, these materials should be segregated, and records will be kept of the volumes of recycled material, including volumes of concrete generated.

- 7.9.3 Locations of material stockpiles will also be recorded on a live Site plan, which will be revised during the course of the works in line with Material Management requirements. Reinforcing bar and other recovered metals will also be logged prior to being conveyed to a licensed metal recycling facility.
- 7.9.4 As part of the hardstanding removal works, sub-base materials, where present, will be stockpiled separately for verification testing and potential re-use.

Removal of in-ground obstructions

- 7.9.5 Based on the historical development of the Site and the findings of the ground investigation works, in-ground foundation structures may be present in the Lake Zone. Where required, the foundations should be carefully excavated to avoid excess soil generation, particularly within the Lake Zone.
- 7.9.6 If visual/olfactory evidence of contamination is noted during the works, this should be addressed in line with Section 7.5.

Concrete Crushing

- 7.9.7 Excavated structures that are determined to be potentially suitable for re-use (free of visual or olfactory signs of contamination) will be transferred to designated crushing areas on-Site. Steel reinforcement bar liberated during crushing will be stockpiled separately prior to off-Site disposal to a suitable recycling facility.
- 7.9.8 All crushed material will be sampled at the specified frequency outlined in Section 7.8 and given a unique sample reference linking them to a specific stockpile.
- 7.9.9 Areas designated for crushing will be segregated and subject to Environmental Compliance monitoring in accordance with the Mobile Plant Environmental Permit. Methods including damping materials prior to crushing should be employed.

Stockpiling

- 7.9.10 Where material movement is required, stockpiles of excavated and imported materials should be stockpiled at pre-designated locations identified by the Contractor prior to the commencement of Site works and agreed with the Environmental Engineer and regulators. Stockpiles should be located to avoid double-handling of materials, as far as reasonably practicable, potential for cross contamination of stockpiled material.
- 7.9.11 Stockpiles should be separated according to material types. Individual stockpiles, as far as is reasonably practicable, should be composed of materials displaying a high degree of homogeneity, both in terms of geotechnical and chemical characteristics.
- 7.9.12 Should any potentially contaminated materials be excavated, they shall be stockpiled on a membrane or intact concrete slab to avoid potential contamination of the soils underneath prior to characterisation and/or disposal to landfill, as appropriate.
- 7.9.13 Stockpiles of materials arising from excavations and earthworks activities will be managed to prevent nuisance impacts and any spreading of contamination, including all necessary environmental controls, such as run off control and dust control. This should include consideration of the following:
- Preparation and maintenance of basal areas and perimeter bunds. Where required, basal areas are to be formed of low permeability material or a suitably protected geomembrane liner;
 - Construction of collection sumps to contain and control leachate and perched water run-off;

- Limiting the height of stockpiles to not greater than 4 m and volume to 500m³, unless agreed otherwise with relevant Planning Authority;
- Shaping the stockpile and smoothing the upper surface of the stockpile to help limit rainwater ingress and dust generation;
- Pumping collected water to on-Site holding tanks or intermediate bulk containers prior to treatment and/or disposal; and
- Use of dust suppression on stockpiles and excavations to minimise potential for windblown dusts and/or use of a tarpaulin to prevent rainwater ingress and release of odours/vapours and dust/fibres.

7.10 WATCHING BRIEF

- 7.10.1 Excavations will be undertaken with a suitably qualified Environmental Engineer overseeing excavation works. The Environmental Engineer shall be aware of the different types of material 'expected' and 'not expected' on this Site. In the event that unexpected contamination is encountered then refer to the procedure detailed in **Table 7-2**.
- 7.10.2 In addition to the above, a watching brief by a suitably qualified person will be carried out during all earthworks including slab removal. All Site personnel will be briefed on the potential areas of concern, contamination risks and observations to be made during the works. The engineer shall ensure:
- Observations of all excavations during the works and any potential contamination is noted and addressed in accordance with **Table 7-2**;
 - A photographic record is kept during the key stages of the development and key occurrences of the works;
 - All contamination observations are addressed in accordance with this Outline Land Remediation Strategy; and
 - All of the findings will be reported within the Verification Report.

8 ENVIRONMENTAL MONITORING AND CONTROL MEASURES

8.1 INTRODUCTION

8.1.1 As part of construction works at the Site there will be a requirement for environmental controls and monitoring.

8.1.2 Typical considerations will focus on perched groundwater, air, noise and vibration and odour. The requirement for detailed information on the methodologies and controls will be detailed in the **Appendix 2.3: OCEMP (Volume 3)** or Construction Code of Practice document as listed below:

- General good construction working practices such as dust suppression (damping down), windbreak netting around excavations and/or perimeter fencing, covering stockpiles with tarpaulins and road sweeping to prevent construction workers and local residents/employees in the vicinity of the earthworks from being exposed to windblown dusts, vapours and asbestos fibres;
- Appropriate stockpile segregation, locations and containment measures to minimise the exposure of surface water and groundwater from contaminated run-off and construction workers and local neighbours from windblown dusts, vapours and asbestos fibres;
- All workers on-Site will be made aware of potential contamination issues on the Site and will use best practice techniques during the Construction Phase;
- Use of appropriate PPE at all times during the construction works;
- Appropriate Site hygiene facilities will be put in place and the presence of contaminants, and the associated risks will be explained to construction staff undertaking groundworks before they begin work;
- Wheel washing of Site vehicles will be carried out in order to minimise the potential for dust generation and tracking of mud/silt onto local roads;
- UXO awareness briefing for all construction staff involved with below ground excavations to be undertaken where necessary;
- Construction vehicles and plant will be regularly maintained and supplied with spill kits and drip trays to reduce the risk of hydrocarbon contamination;
- Refuelling must be undertaken in specified areas where there is non-permeable hardstanding and Site drainage passes through an oil interceptor prior to discharge. Drip trays will be installed to collect leaks from diesel pumps;
- Adequate bunded and secure areas with impervious walls and floors, with a capacity of 110% of substance volume, are to be provided for the temporary storage of fuel, oil and chemicals on Site during construction;
- Oil interceptor(s) will be installed on discharge points from any temporary oil storage/refuelling areas;
- Development of Site pollution control procedures in line with Environment Agency's Pollution Prevention Guidance²⁷, and appropriate training for all construction staff. Provision of spill containment equipment such as absorbent material on Site;
- Hazardous materials already present on-Site or proposed to be used during the construction works will be identified and an appropriate Control of Substances Hazardous to Health Assessment carried out;

- The Principal Contractor must comply with relevant legislation, technical guidance and regulations in the identification, handling, storage, recovery and disposals of waste. Provision will be made for a suitably qualified consultant to identify “*hazardous waste*” so that materials can be appropriately managed and disposed of during works;
- Disposal sites and routes will be identified by the Principal Contractor and Project Manager in engagement with the Bedford Borough Council and the Environment Agency. Consideration should be given to transportation modes and alternatives to reduce the adverse environmental effects, times, landfill capacity and license conditions;
- The Principal Contractor must comply with all relevant legislation and regulations when dealing with contaminated materials. The Principal Contractor will prepare a full management plan, also referring to the Preliminary Risk Assessment under the Proposed Development, where contaminated land is identified to comply with all relevant handling and disposal legislation; and
- It is anticipated that some of the excavations will encounter groundwater (perched or otherwise). Water ingress has the potential to be contaminated and will require management through either dewatering and/or disposal under Duty of Care to dispose appropriately of excavated water or discharge to a surface water lake within the Site under an appropriate surface water discharge consent. Measures should be taken to ensure that when emptying and/or excavating such structures, contaminated liquids do not contaminate the surrounding soil or other materials or enter groundwater or any surface water feature.

9 HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

- 9.1.1 The health and safety management scheme operated during remediation, earthworks and validation operations shall take into account all relevant health and safety documentation, policy and methodology applicable to such works. The works shall also comply with the *CDM Regulations 2015*¹⁴.

9.2 CONTAMINATION

- 9.2.1 Construction workers involved in excavations at the Site may potentially be exposed to concentrations of contaminants that could present a **low** to **moderate** risk to human health. Construction workers must be adequately protected and a suitable health and safety management scheme must be operated during construction and remediation activities.
- 9.2.2 As a minimum the health and safety plan must address the following potential health and safety issues:
- Potential for vapours in excavations;
 - Dermal contact;
 - Ingestion; and
 - Dust and (asbestos) fibre inhalation.
- 9.2.3 Visual inspection revealed isolated fragments of cement board debris to the surface of all three stockpiles located in the Lake Zone. Earthworks and construction contractors must be aware of the potential for ACMs in soils and be vigilant to its presence. If potential ACMs are identified during redevelopment professional advice must be sought.

9.3 ENVIRONMENTAL CONTROLS

- 9.3.1 The Contractor shall be responsible for the provision of all necessary environmental controls during the remediation works. As applicable, these measures will include:
- Protection of surface water drains and catchments of surface run-off to reduce the risk of contaminated run-off and high-suspended solids moving off-Site;
 - Management of stockpiles of recycled (crushed) construction aggregates and contaminated soils awaiting off-Site disposal and/or on-Site treatment to minimise the potential for generation of contaminated run-off and dust;
 - Use of dust and odour suppression techniques during development to minimise off-Site impacts; and
 - Storage of all fuels, oils and chemicals will be stored in appropriate containers within bunded compounds.
- 9.3.2 Guidelines presented within the Environment Agency document, '*Pollution Prevention Guidance 6 – Working at Construction and Demolition Sites*²⁷ should be adhered to and all relevant licences obtained.

²⁷ Environment Agency (2014) *Construction and demolition sites, PPG6: prevent pollution*. Available at: <https://assets.publishing.service.gov.uk/media/5a7f0ca340f0b6230268d1f1/pmho0412bwfe-e-e.pdf> [Accessed: 11 June 2025].

9.4 DECOMMISSIONING OF BOREHOLES

- 9.4.1 Once the boreholes associated with the Ground Investigation are no longer required, they will be decommissioned in line with the Environment Agency Guidance (Guidance on the design and installation of groundwater quality monitoring points²⁸, SC020093, dated January 2006) in order to ensure that no pollutant pathways are created as a part of the Proposed Development of the Site.

²⁸ Environment Agency (2006) *Guidance on the design and installation of groundwater quality monitoring points*. Available at:
<https://assets.publishing.service.gov.uk/media/5a7ce4a1e5274a2c9a484c2e/scho0106bkct-e-e.pdf>
[Accessed: 11 June 2025].

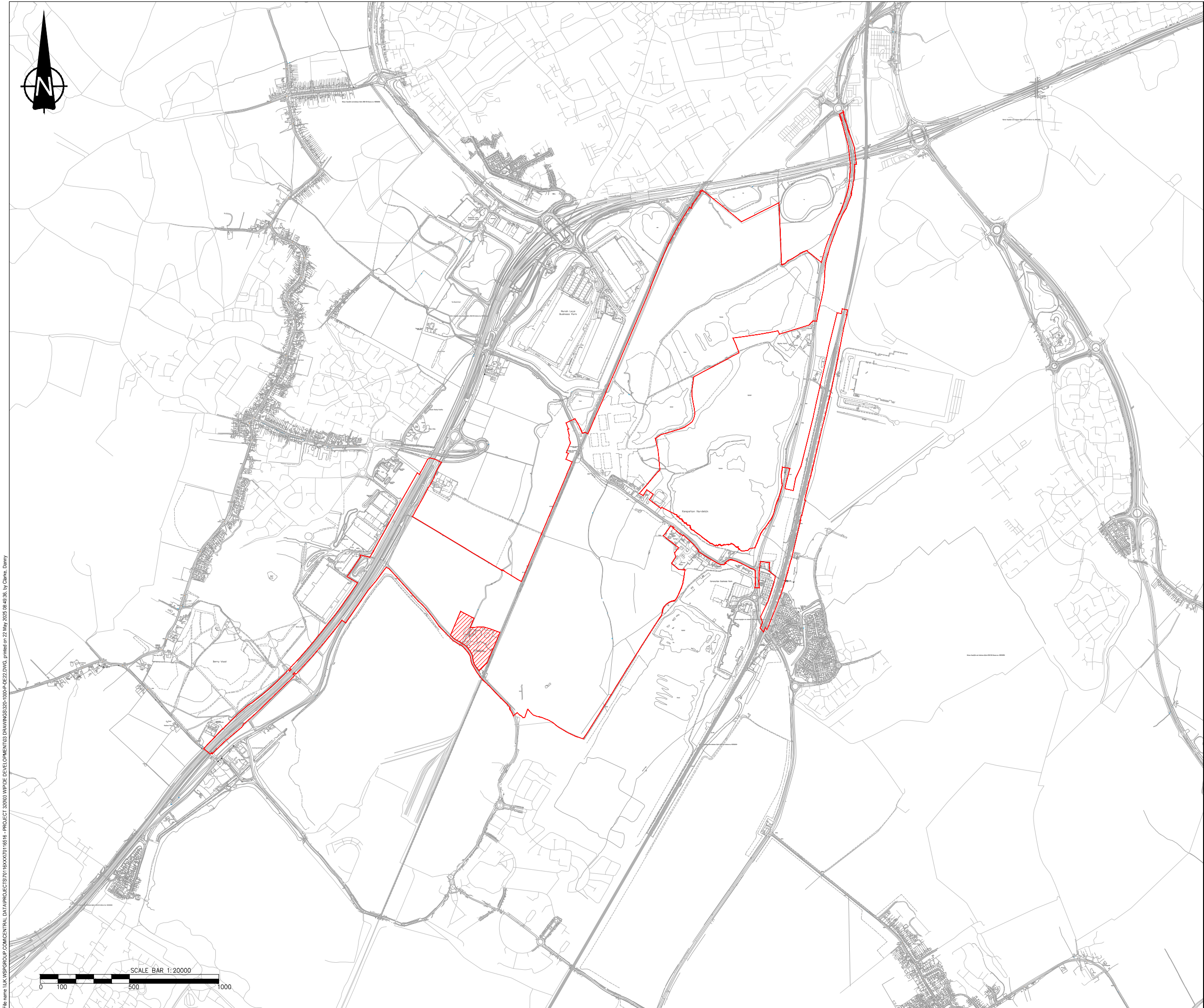
10 VERIFICATION REPORTING

- 10.1.1 The phasing of works has yet to be determined, however all relevant information shall be collected during each phase of remediation works and a series verification reports compiled on completion. The report shall take account of the recommendations in LCRM 2023¹ and comprise as a minimum:
- A summary of the information contained in the risk assessment reports along with the agreed redevelopment strategy and objectives;
 - Details of all parties involved in the works;
 - Laboratory validation test certificates if unexpected contamination encountered;
 - Details and quantities of excavated soils and soils re-used on-Site or disposed of off-Site;
 - Records of all earthworks, excavations and sorting including as built drawings, photographs, quantities of materials exported and imported;
 - An annotated photographic record showing sides and base of the excavation during the drainage infrastructure works. Photographs should include details of the location and date and as built survey showing the base of excavation;
 - Inclusion of information from an asbestos specialist providing a summary of the asbestos removal works completed which as minimum should include Consignment Notes, Air Monitoring Records and an account of the works completed;
 - Verification of backfill materials on completion of the enabling works in order to confirm suitability of re-use;
 - As built drawings; and
 - Waste classification and management documentation (including consignment notes, waste carrier licenses and waste management licence).
- 10.1.2 It is envisaged that the Site Health and Safety File will include all information pertaining to the areas affected by ground contamination.

Annex 1

FIGURES





ARCHITECT/ENGINEER STAMP:

Approved by: **sb**

Drawn by: **pc**

Latest Revision Date: 21/05/2025

Issuance and Revision History

Rev.	Date	Issuance and Revision Description
00	21/05/2025	First Issue

Legend

— Site Boundary

▨ Excluded from Site Boundary

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Project Name: Universal Destinations & Experiences UK Project

Site Address: Former Kempston Hardwick Brickworks and adjoining land, Bedford

Scale: 1:20,000 © A3

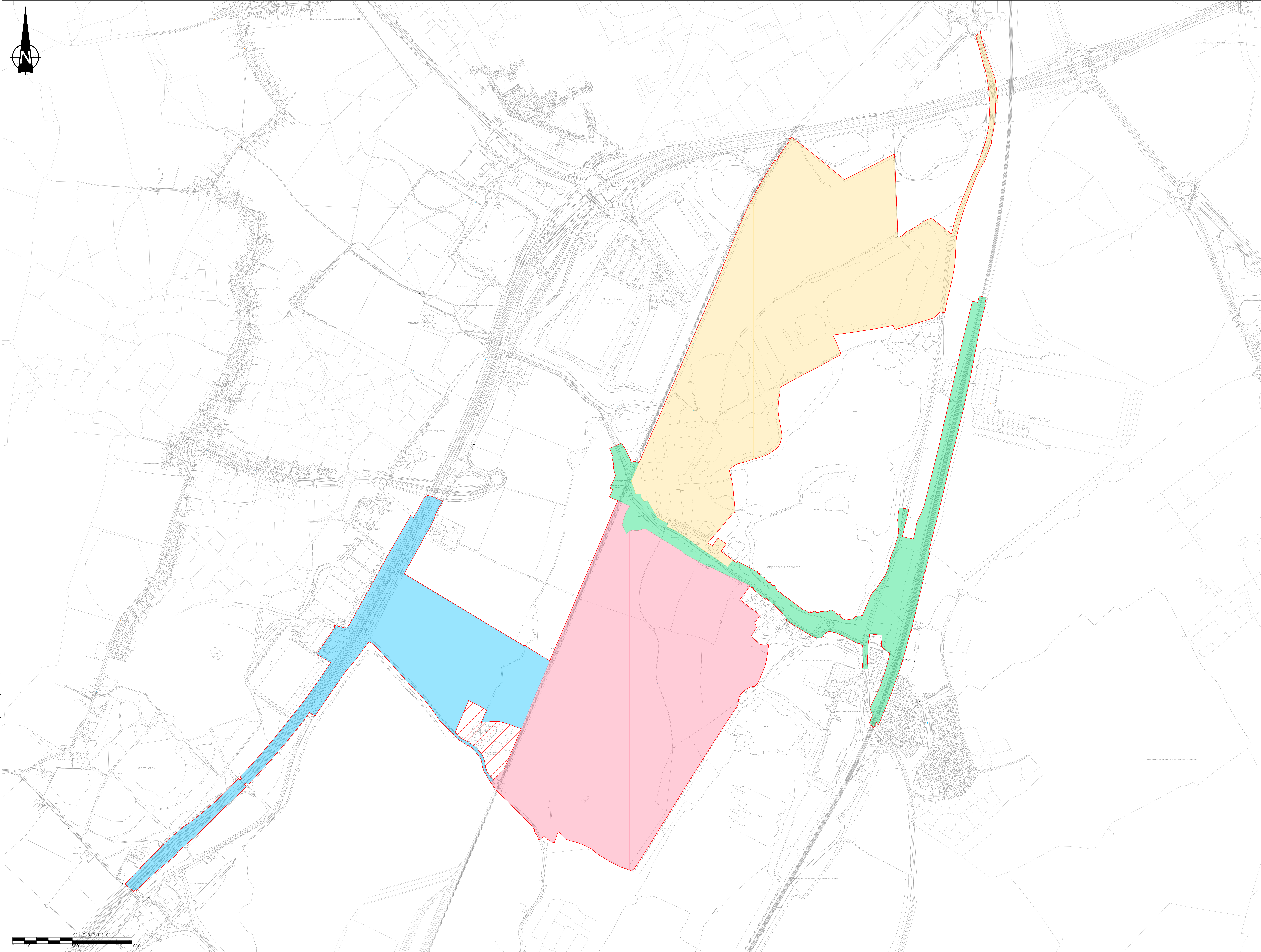
Project Locator:
320 — 100 — SDO

Sheet Name:
Figure 1 - Site Location Plan

Sheet No.: 1.6.0

Rev #:

File name: LUK_WSPGROUP_COM\CENTRAL_DATA\PROJECTS\7011600\70116516 - PROJECT 32003_WP\DEVELOPMENT\03_DRAWINGS\320-100-P-QEZZ.DWG, printed on 22 May 2025 08:49:36, by Clarke, Danny



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pc

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Issuance and Revision History

Rev	Date	Description	Issuance and Revision
00	21/05/2025	First Issue	

Legend

Site Boundary

Excluded from Site Boundary

Core Zone

Lake Zone

East Gateway Zone

West Gateway Zone

Project Name: Universal Destinations & Experiences UK Project

Site Address: Former Kempston Hardwick Brickworks and adjoining land, Bedford

Scale: 1:5,000 @ A0

Project Locator: 320 - 100 - SDO

Sheet Name: Figure 2 - Zonal Plan

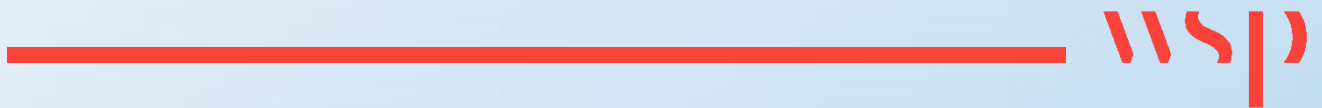
Sheet No.: 1.8.0

Rev #:

File name: UKAS\SDO\004\CONCENTRA\CA\PROJECTS\01\10000001\1816 - PROJECT 32000 MPDE DEVELOPMENT\CONCENTRA\0004\SDO\004\SDO\1816.dwg, printed on 21 May 2025 09:03:11 by Gwladys Perry

Annex 2

REMEDIATION OPTIONS APPRAISAL MATRIX



Remediation Options Screening Matrix (Soils)

Remediation Method	Method Description
No Action	Only an applicable course of action where quantitative risk assessment and qualitative support arguments indicate that a 'Do Nothing' approach is acceptable, this may be relevant to the ashy made ground scenario.
Excavation and off site disposal	Materials are excavated and disposed to a suitable licensed treatment facility. Soils can either be disposed directly treated (at an off-site treatment facility) prior to disposal. Main advantage is that the contamination is completely removed from site the main disadvantages are that off-site treatment and/or disposal are relatively expensive.
Excavation and removal to a soil treatment facility	This technique involves excavating the source of contaminated material. This is an observational technique based on visual / olfactory evidence of contamination which will be confirmed by validation testing. This material will then be disposed of off-site to a registered Soil Treatment Facility (STF) for treatment and re-use off-site. Based upon the volume of contaminated material, this may prove to be a more cost-effective approach than treatment on site, however, segregation should be undertaken to ensure that this is cost effective.
Excavation and Ex-Situ Bioremediation	Biological Treatment - Comprises the Excavation and biological treatment of soils in engineered treatment beds. Treated material can either be re-used or disposed off site as lower classification hazardous materials. Longer chain hydrocarbons are more resistant to biodegradation. and can sometimes require extended treatment times and/or the addition of an additive to stimulate biodegradation. Contaminants destroyed (through degradation) or absorbed onto an absorptive media (volatilisation). Due to the predominant TPH fractions present ex-situ volatilisation is not considered to be appropriate for all soils.
Enhanced Excavation and Ex-Situ Bioremediation	Similar in principle to bioremediation. Whereby contaminated soils are excavated and treated in engineered treatment beds. With enhanced bioremediation the process of degradation is stimulated as a mean of treating more recalcitrant contaminants or to accelerate treatment. Soils are typically excavated and placed in engineered biopiles where the addition of warm/hot air, oxygen (in the form of compressed air) and specialist bacterial and/or fungal populations can be applied to enhance treatment. Treated material can either be re-used on site or disposed of site as non-hazardous materials. Biological Treatment
In-Situ Solidification/Stabilisation	Comprises the in-situ mixing of a solidifying or stabilising agent (such as pozzolans and/or Portland Cement) to reduce the mobility of contaminants of concern. Stabilising agent is either applied through continuous trenching tool or continuous flight auger (CFA). Contaminants may remain on-site (depending on disposal route), but are immobilised and rendered unavailable. Potential for increased leaching of contaminants over time. More suited to lead/metals but also have benefit for TPH and low concentrations of PAH. Unsuitable for soils with high concentrations of hydrocarbons/free product. May be applicable where soils are not readily accessible or where excavation is not possible. Some soils will require stabilisation as part of earthworks - opportunities for combining objectives (i.e. stabilisation and remediation) into one treatment.
Ex-Situ Solidification Stabilisation	Comprises the excavation, processing and ex-situ mixing of a solidifying or stabilising agent (such as pozzolans and/or Portland Cement) to reduce the mobility of contaminants of concern. Treated material can either be used on site or disposed off site as lower classification of hazardous material. Contaminants may remain on-site (depending on disposal route) but are immobilised and rendered environmentally unavailable. Potential for increased leaching of contaminants over time. More suited to inorganics but may have limited benefit for TPH and PAH depending on concentrations. Selective emplacement of soils into areas with less onerous remedial targets will be required
Soil washing / flushing	Soil Washing - Comprises the removal of contaminants from the soil by chemical or physical treatment methods using a liquid solution. Soil excavation is required prior to washing and effluents comprising extracted contaminants requires treatment or disposal. Soil flushing - Similar process to soil washing but undertaken in-situ, effluent is typically recovered with pump and treat systems.
Ex-situ Thermal Treatment	Soils are excavated, processed and heated to remove organic contaminants. Two types of thermal treatment generally available. Low temperature and high temperature thermal desorption. Low temperature thermal desorption is generally suited to more volatile contaminants that are easily volatilised. volatilised contaminants are removed from off gasses prior to discharge to atmosphere. High temperature thermal desorption is generally suited to less volatile, longer chain hydrocarbons. Higher temperatures volatilise and thermally degrade proportion of the desorbed contaminants whilst the remainder are removed from off-gasses
In-situ Thermal Treatment	The soils are heated with either steam or electricity to c.100°C via a series of steam injection wells or heating points. Contaminants are then thermally degraded and/or volatilised. Volatilised contaminants are recovered via a network of vapour wells. Particularly suited to more volatile organic contaminants.
Capping	Capping - the contaminants are left in situ and an impermeable engineered cap put in place to remove potential Human Health exposure pathways and reduce leaching through the reduction of water infiltration/percolation through the soil column. Contaminants remain on-site but their exposure pathway to the receptor is eliminated.
Containment	Typically comprises the installation of an impermeable barrier (i.e. sheet piling, Bentonite slurry Wall) to remove migration pathway by physically containing contaminants. Contaminants remain on-site but are rendered relatively environmentally immobile. Containment is not expected to be required given the localised areas of TPH and predominant contaminant composition (TPH C12 to C35) which is relatively environmentally immobile.
Soil Vapour Extraction/Bioventing	Soil vapour extraction (SVE) is used to remediate unsaturated (vadose) zone soil. A vacuum is applied to the soil, usually via Soil Vapour Extraction Wells to induce a controlled flow of air and remove volatile and some semi volatile organic contaminants from the soil. Bioventing uses forced air to induce a flow of air within the subsurface to encourage aerobic degradation of certain contaminants. Volatilisation is best suited to VOCs, whilst Bioventing is best suited for the in-situ aerobic degradation of organics such as TPH. Off gasses require treatment. Soil Structure is single most limiting factor. TPH makeup will likely prevent beneficial reduction of contaminant mass (TPH C12 to C35).

Remediation Options Screening Matrix (Soils)

Remediation Method	Remediation Impacts (Environmental, Health & Safety, Material Intensity, Emissions etc.)	Assessment	Applicability	Technical Feasibility	Effectiveness	Cost	Enabling Works	Carbon Footprint	Compatibility with site use	Duration	Overall Sustainability	Final Score*
No Action	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Excavation and off site treatment and/or disposal.	High	Highly effective in the contaminated materials are physically removed from site . Main disadvantages are that the relatively high cost of treatment and disposal and environmental impacts (Landfill, transport, re-importation etc)	5	4	5	2	3	1	4	4	1	120
Excavation and removal to a soil treatment facility	High	Effective method as contaminated soils are removed from site and taken to a soil treatment facility for treatment / re-use which is more sustainable. Main disadvantages are that the cost of treatment can be high however this would not be as expensive as disposal to landfill.	5	4	5	2	3	2	4	4	2	130
Excavation and Ex-Situ Bioremediation	Low	The soils are considered likely to respond to bioremediation treatment however the heavier end organic compounds may have longer treatment times. The establishment of Ex-situ treatment beds will require will require a relatively large area quarantine, treat and stockpile materials.	2	4	4	3	3	4	3	2	5	56
Enhanced Excavation and Ex-Situ Bioremediation	Low	With enhanced bioremediation degradation is stimulated by the addition of warm/hot air, oxygen (in the form of compressed air) and specialist bacterial and/or fungal populations can be applied to enhance treatment. Although bioremediation using thermally enhanced biopiles and bioamendments may improve treatment performance, the method faces the same constraints as those posed by non-enhanced bioremediation i.e. the relative lack of space and the predominance go granular materials.	2	3	4	3	3	3	2	3	4	50
Ex-Situ Solidification/Stabilisation	Medium	Materials are excavated processed and replaced. Although ex-situ solidification/stabilisation is generally compatible with the contaminants requiring treatment, the process may produce a monolith. This may not be compatible with the re-use of the material.	2	3	2	4	3	3	3	5	3	52
In-Situ Solidification Stabilisation	Medium	Similar to the above in principle with the main difference being that stabilising agents are mixed in-situ-using a variety of means (such s continuous flight auger. Better suited to applications where soils requiring treatment are relatively thick.	2	2	2	4	3	3	1	4	3	44
Soil washing / flushing	Medium	Due to the relatively clayey nature of the soils, soil washing will unlikely be effective means for ex-situ treatment of contaminated soils.	1	1	2	3	3	4	4	3	4	24
Ex-situ Thermal Treatment	High	Requires the establishment of soil processing area and thermal treatment plant. Will alter soils structure potentially rendering it geotechnically unsuitable without significant further processing - therefore careful consideration of the destination of treated soils is required. The type of contaminants present on site respond well to thermal treatment but energy inputs, carbon footprint, relatively treatment volumes and cost can be prohibitively expensive for large volumes of soils with relatively low levels of contamination.	3	2	2	1	2	1	2	4	3	51
In-situ Thermal Treatment	High	Requires the establishment of a well field and process pipework rendering the area inaccessible for the duration of the remediation although this may be viable.	3	1	2	1	2	1	1	2	1	33
Containment	Medium	Containment will require both an impermeable barrier surrounding the contaminants contained within unsaturated soils and an impermeable cap to prevent/reduce the potential for vertical percolation of precipitation through contaminated materials. Incompatible with the objectives of the project.	2	2	3	2	2	5	1	3	3	42

* Applicability is a weighted score. The Final Score = Applicability x the total score of the eight parameters

Annex 3

SUMMARY OF PREVIOUS REPORTS AND RISK ASSESSMENTS



Universal Destinations & Experiences

UNIVERSAL DESTINATIONS & EXPERIENCES UK PROJECT





Universal Destinations & Experiences

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1 SUMMARY OF PREVIOUS REPORTS AND RISK ASSESSMENT

SLR Global Environmental Solutions, Former Kempston Brick Works, Bedfordshire – Factual Geotechnical Investigation Report (ref: 403.00027.00436), October 2016

- 1.1.1. It should be noted that this phase of investigation was restricted to just the very southern extents of the present-day Lake Zone of the Site as defined above. At the time this area of land (formerly occupied by Kempston Brickworks) was proposed for residential redevelopment. An intrusive investigation was undertaken at the former brickworks Site and provided general coverage and targeted former tanks (CP2, WS6 – WS8, WS10, WS11) landfill areas (CP4, WS1, WS2, WS5 & TP1) and comprised the following:
- Five cable percussion boreholes (CP1 – CP5) drilled to depths between 17.25m and 19.55m below ground level (bgl), terminating on limestone bedrock of the Cornbrash Formation.
 - 19 No. trial pits (TP1 to TP19) excavated to depths of between 1.80m and 4.0m bgl;
 - 11 No. window sample boreholes (WS1 – WS11) drilled between 4.80m and 6.0m bgl;
 - Collection of soil samples for a suite of environmental laboratory testing;
 - Installation of monitoring wells within all cable percussion boreholes (CP1 – CP5) and within select window sample borehole locations (WS1, WS5, WS8, WS9 & WS10);
 - CP2 was installed with a response zone that targeted 2.00 – 6.00m bgl;
 - All other monitoring wells were installed to full depth with surface seals ranging in thickness between 0.50m and 2.0m in thickness (i.e., crossing several strata boundaries);
 - Completion of two return visits to complete groundwater level monitoring on one occasion and gas monitoring on two occasions (August 2016); and,
 - Collection of a total of 11 No. groundwater samples for laboratory analysis.

Encountered Ground Conditions

- 1.1.2. Made Ground was found to vary in thickness between 0.60m and 10.80m across the Site. A greater proven thickness of Made Ground was identified towards the east of the Site. Made Ground was generally found to comprise of brick rubble overlying reworked sandy/silty clay containing various artificial inclusions such as asphalt, clinker, wood, metal, plastic, concrete and potential asbestos tiles. The following evidence of contamination was noted during the ground investigation:
- Elevated Photo Ionisation Detector (PID) headspace test results up to 31 ppm recorded within CP1 (1.50m bgl);
 - Frequent faint to strong organic odours noted within Made Ground recovered from trial pits (typically 1.00 to 2.50m bgl) and a faint chemical/organic odour noted within TP3 (1.70 to 2.40m bgl);
 - Oily sheen noted on surface of groundwater encountered within:
 - TP3 (1.50m bgl);
 - TP12 (2.60m bgl);
 - Rare inclusions of potential asbestos containing materials (ACMs) in the form of tiles within TP14 (0.10 to 0.80m bgl);
 - Identification of potential asbestos within CP4 (7.80m bgl) resulting in abandonment of this location; and,

- CP4 was dampened down and re-instated with bentonite. CP4A was instead progressed approximately 10m further north.

1.1.3. The Made Ground was underlain by deposits of the Oxford Clay Formation (Peterborough Member) to a proven depth of 14.4m bgl. These deposits were recorded as firm to stiff dark grey, thinly laminated silty clays with frequent shells/fragments.

1.1.4. An approximately 5.0 to 5.5m thick layer of clay and sand members of the Kellaway's Formation, was encountered beneath the Oxford Clay Formation, prior to encountering an interface of strong grey limestone of the Cornbrash Formation, between 17.25m and 19.55m bgl.

Groundwater Conditions

1.1.5. Groundwater strikes encountered within the window sample holes were not recorded during the ground investigation (i.e., levels on logs equate to post investigation monitored levels). Water strikes recorded within the trial pits indicated the presence of a shallow water table between 1.30m bgl (TP5) to 3.20m bgl (TP10) (approximately 30 to 32.5m AOD). Groundwater was observed to be in hydraulic connection with Made Ground and underlying natural deposits. A deeper groundwater strike was also observed between 12m and 13m bgl (20.5 to 21.5m AOD), thus within the Oxford Clay Formation, during the drilling of all cable percussion boreholes, with the exception of CP04A.

Soil Laboratory Analysis

1.1.6. A total of 63 No. soil samples were submitted for chemical analysis for pH, asbestos, Total Organic Carbon (TOC), metals, hydrocarbons (including Polycyclic Aromatic Hydrocarbons (PAHs) & Total Petroleum Hydrocarbons (PAHs), Benzene, Toluene, Ethylbenzene and Xylenes (BTEX compounds)).

1.1.7. No asbestos was detected within the sample of suspected ACMs collected at 0.30m within TP14.

Monitoring and Assessment of Controlled Waters

1.1.8. A total of ten groundwater samples were collected from installed monitoring wells on the 3rd August 2016 and an eleventh was also obtained from TP05 during the ground investigation. Samples were collected by use of disposable bailers. Groundwater samples were scheduled for analysis of heavy metals, PAHs, TPHs, BTEX compounds and MTBE (Methyl Tert-Butyl Ether), Volatile Organic Compounds (VOCs) and pH.

Gas Monitoring and Assessment

1.1.9. Both rounds of gas monitoring completed at the Site were undertaken during periods of high atmospheric pressure (1004 mbar, round 1 - 03/08/16 and 1019mbar, round 2 - 31/08/16). Elevated concentrations of carbon dioxide (CO₂), relative to atmospheric conditions, were noted predominantly within deeper monitoring wells advanced by cable percussive drilling (CP1, CP3, CP4A & CP5) and WS10. Readings ranged between:

- 3.1%v/v (CP5) and 8.3%v/v (WS10), round 1; and
- 3.6%v/v (CP5) and 10.9%v/v (WS10), round 2.

1.1.10. Depleted oxygen levels (minimum of 0.3%v/v, WS10, round 2) were also observed alongside the elevated CO₂ readings. Consistent readings of 2 ppm of carbon monoxide (CO) were observed at all locations with the exception of WS5 (16 ppm observed for round 1). Marginal and inconsistent detections of hydrogen sulphide (H₂S) were also recorded at a few locations (1 ppm was consistently noted at CP2, CP5, WS1, WS8 & WS10). Methane (CH₄) was not detected within any of

the monitoring wells across both rounds. PID readings were only recorded during round 1 with a maximum of 7.3 ppm observed within WS109. All gas flows recorded were negative (-0.1 to 0.3 l/hr). There were no comments attached to the monitoring records.

- 1.1.11. It should be noted that based on the groundwater levels recorded (only during round 1), all wells were partially flooded with the exception of WS09 which was entirely flooded by groundwater on this occasion. When flooded, ground gas can become trapped in the monitoring well's air space, resulting in anomalous concentrations that are not necessarily representative of the site's ground gas levels

Arcadis, Project 320 Kempston Hardwick, Phase 2 Preliminary Geo-Environmental Ground Investigation Interpretive Report (Ref: 30174974-ARC-P01-XX-TR-GE-00001), May 2023.

- 1.1.12. This report covers the Lake Zone and Core Zone (referred to as Areas A1 to A3 and B within the Arcadis reports, respectively). At this time, the Site was being promoted for commercial/residential redevelopment through the Local Plan process.
- 1.1.13. The intrusive investigation was undertaken between 20th March to 21st April 2023 and consisted of the following:
- Machine excavation of 36 No. trial pits (TP01 to TP38) to depths between 1.7m and 4.0m bgl.;
 - Progression of 16 No. cable percussion boreholes (CP01 to CP16) to depths between 13.1m and 21.0m bgl;
 - Four of which were advanced to greater depths (30 to 30.85 m bgl) with rotary drilling techniques (CP04, CP07, CP10 and CP14) with the aim of characterising the upper boundary of the Rutland Formation;
 - Collection of soil samples for laboratory analysis;
 - Installation of gas and groundwater monitoring wells within all boreholes;
 - Dual installations targeting both shallow Made Ground for gas monitoring purposes and deeper installs within natural strata to assess groundwater conditions;
 - Completion of six return visits between 27th April 2023 and 29th May 2023 to complete groundwater level and gas monitoring;
 - Completion of groundwater quality monitoring (by determination of in-situ water quality parameters) on five occasions following an initial round of well development;
 - Proposed collection of groundwater samples from each installed monitoring well on two occasions (i.e., 16 No. groundwater samples in total)*; and
 - Proposed collection of surface water samples from eight locations (SW1 – SW8) on two occasions (i.e., total of 16 No. surface water samples)*.

*Based on the version of the report WSP has been provided to review (ref: 30174974-ARC-P01-XX-TR-GE-00001) the dataset available was incomplete (i.e., only one round of groundwater and surface water sampling and the first five rounds of gas monitoring available).

- 1.1.14. The exploratory holes were positioned to both provide good spatial coverage in addition to specifically targeting:
- The footprint of a former Elstow Brook river channel (TP02, TP04 & TP06);
 - The edges of former clay pits (current-day lakes) (TP09 -TP11, TP13 & TP15);
 - The contents of a terraced spoil heap identified north of the former brickworks (CP04, TP12A and TP16);

- A former structure (TP37); and
- The spatial distribution of Alluvium at the Site (in relation to BGS map records).

1.1.15. It is worth noting that a number of trial pit locations (TP07, TP08 and TP12) proposed along the edges of the existing lakes (i.e., within Arcadis' Area A3) were abandoned due to access and ecological constraints. Furthermore, a number of stockpiles of demolition rubble were noted within the footprint of the former brickworks (Arcadis Parcel A2) which were not sampled due to ecological constraints. These stockpiles are considered by WSP to be separate to the terraced spoil heap referred to in the above list.

Encountered Ground Conditions

Made Ground

- 1.1.16. Made Ground up to 3.00m in thickness was only encountered locally within exploratory holes positioned within the undeveloped fields within the Lake Zone (TP02, TP05 & TP06). Organic rich soils (black) and accompanying organic odours were noted within positions targeting the former river channel. Topsoil (0.20m to 0.40m) overlying natural deposits was more typically encountered in this area of the Site.
- 1.1.17. Although exploratory holes positioned within Arcadis' Parcel A3 mostly sit outside the current boundary of interest (i.e., to the east of the Lake Zone), it is worth noting that similar recovered thicknesses of Made Ground were noted in this area (2.80m – 3.00m).
- 1.1.18. A thicker and more spatially continuous layer of Made Ground (1.70m to 5.00m) was encountered within exploratory holes positioned about the location off the former brickworks (Arcadis Area A2). Frequent inclusions of brick/concrete cobbles and gravel were generally noted within Made Ground recovered in this part of the Site. An infilled basement structure was also encountered at TP23 (1.00 m – 2.50m bgl).
- 1.1.19. Very limited recovery of Made Ground was recorded across the Core Zone (Arcadis Area B), varying in thickness between 0.20m (TP37) and 0.60m (CP08) across only two exploratory hole locations.

Evidence of Contamination

- 1.1.20. Visual evidence of contamination was limited to the observation of ash within Made Ground arisings recovered from trial pits TP18 to TP20; all of which were located towards the south of the Lake Zone (i.e., footprint of the former brickworks). Organic odours were also noted within areas of thick Made Ground associated with either the infilled Elstow Brook river channel (TP02) or at a number of exploratory holes located in close proximity to/within the footprint of the former brickworks. In-situ head space testing of environmental soil samples was undertaken. A maximum reading of 0.7 ppm was recorded within CP06 (4.00m bgl) and the majority of all other readings did not exceed the instrument's limit of detection (i.e., <0.1 ppm).

Natural Ground

- 1.1.21. In general, the ground investigation encountered a similar sequence of strata to those characterised within the Lake Zone exclusively by the 2016 SLR Ground Investigation detailed above.
- 1.1.22. Made Ground or topsoil was encountered at the surface overlying either superficial deposits of Alluvium or Head Deposits (where present). Alluvium was encountered in general accordance with the footprint of BGS mapped exposures. The subsequent Peterborough Member (Oxford Clay Formation) was noted to initially comprise an upper weathered zone, overlying a non-weathered

deposit. The Kellaway's Formation, present beneath the Oxford Clay Formation, comprised both sand and clay members, the latter of which was noted to be absent locally.

- 1.1.23. The strata underlying the Kellaways Formations was only encountered within the rotary follow-on boreholes (CP04, CP07, CP10 and CP14) and comprised the Cornbrash Formation, the Forest Marble Formation, the Blisworth Formation (divided into the Blisworth Clay Member and the underlying Blisworth Limestone Member) and the Rutland Formation. The Forest Marble Formation was generally described to comprise a very stiff dark grey fissured clay with frequent to absent fossilised shells. The Blisworth Clay Formation was described as a very stiff yellow to black fissured clay with fossilised shells and as an extremely weak dark grey mudstone (CP14 only). The underlying Blisworth Limestone Formation was described as a strong light grey limestone. The Rutland Formation was encountered in all rotary follow-on boreholes (except CP04) underlying the Blisworth Limestone Formation and was generally described as a very stiff dark grey fissured clay with pockets of organic matter and peat.

Groundwater Conditions

Groundwater strikes encountered during the ground investigation indicated the presence of:

- A shallow groundwater table between 1.0 to 2.0m bgl within the superficial Alluvium and Head Deposits or in continuity with the Made Ground;
- A deeper aquifer within the Peterborough Member (Oxford Clay Formation) was encountered in seven boreholes between 3.9m bgl (TP30) and 12.9m bgl (CP11); and
- A confined groundwater body within the Kellaways Sand Member (i.e., significant rises noted after 20 minutes of up to 5.5m within CP07).

- 1.1.24. It was noted that similar conditions were anticipated within the deeper limestone strata, but it was not possible to confirm this during the ground investigation due to the masking of groundwater strikes with the addition of rotary flush water.

Soil Laboratory Analysis

- 1.1.25. A total of 73 No. soil samples were collected during the ground investigation, of which 51 No. were scheduled for chemical laboratory testing. The general suite of testing included metals, PAHs, TPHs, inorganics and TOC. Select samples of Made Ground and topsoil were also subject to asbestos screening. A total of three soil samples collected from the undeveloped field to the north of the Lake Zone were also subjected to a suite of acid herbicide and pesticide testing.
- 1.1.26. The laboratory results were screened against Generic Assessment Criteria (GAC) protective of a number of different end use scenarios including public open space, commercial/industrial use and residential land use (with consumption of homegrown produce). No exceedances of GAC protective of commercial and public open space end use scenarios were identified across the Arcadis study site (i.e., across both the Lake Zone and Core Zone). Limited exceedances of metals (arsenic and lead) and PAH compounds (dibenzo(a,h)anthracene, benzo(b)fluoranthene and benzo(a)pyrene) relative to the applied residential GAC were noted. All residential human health soil GAC exceedances were recorded within Made Ground with the exception of elevated arsenic detected within superficial deposits within CP02 (0.50m bgl). All exceedances noted fell within the Lake Zone. Contaminant concentrations were recorded within the same order of magnitude as that of the GAC.

- 1.1.27. Asbestos was not detected in any of the 45 No. samples subjected to laboratory analysis. Similarly, no detections of pesticide and herbicide compounds were identified within the three samples subjected to analysis (i.e., concentrations fell below the laboratory limit of detection).

Monitoring and Assessment of Controlled Waters

- 1.1.28. A total of 8 No. groundwater and 8 No. surface water samples were collected and scheduled for laboratory testing. The report states that no visual or olfactory evidence of hydrocarbon contamination was identified. No measurable Light Non-Aqueous Phase Liquid (LNAPL) was recorded and there was no sheen mentioned on any of the groundwater encountered.
- 1.1.29. Groundwater and surface water laboratory results were principally screened against Environmental Quality Standards (EQS) on the basis that groundwater beneath the Site is of limited sensitivity / is of limited future resource potential (unproductive aquifer).
- 1.1.30. Marginal exceedances of metals (nickel, copper and zinc) were identified within both groundwater and surface water samples recovered from both the Lake Zone and the Core Zone. Concentrations recorded within groundwater and surface water samples were comparable, indicating hydraulic connection.
- 1.1.31. An exceedance of mercury EQS (0.07µg/l) was also identified within SW01 (0.24µg/l), located in the very north-western corner of the Site (within the Lake Zone). Elevated concentrations of long chain aromatic hydrocarbon compounds were also noted at this location (TPH>C21-C35, 300 µg/l). This may indicate the presence of an off-Site source.
- 1.1.32. Various inorganic compounds have been recorded at concentrations exceeding EQS GAC (ammonia, chloride, sulphate, boron), which were recorded predominantly within groundwater samples. Ammonia concentrations exceeding EQS GAC were only recorded within SW09, located in the south-eastern corner of the Core Zone (i.e., within an undeveloped field in agricultural use).
- 1.1.33. Arcadis concluded that no unacceptable risk to human health or controlled waters receptors had been identified in light of the proposed development being considered.

Gas Monitoring and Assessment

- 1.1.34. Gas monitoring was undertaken within all installed boreholes across five monitoring rounds between 26th April and 24th May 2023. It should be noted that all five rounds of gas monitoring were undertaken during periods of relatively high atmospheric pressure (1006 - 1027mbar). A summary of the gas monitoring results is presented below:
- CH₄ detections across the Site varied between <0.1% and 0.2%;
 - CO₂ detections were noted to vary between 0.1% v/v and 2.9% v/v (CP05S);
 - H₂S generally remained undetected across the majority of the Site; and
 - CO levels were consistently noted to fluctuate typically between 2% v/v and 36% v/v.
- 1.1.35. The majority of monitoring wells were identified as flooded for the duration of the monitoring period and many were recorded to be missing bungs and/or gas taps by rounds 4 and 5. As such, it is unlikely that the data recorded at these locations and during those periods was representative of the actual ground gas regime.

- 1.1.36. Positive peak and steady flow readings were recorded within a number of monitoring wells distributed across both the Lake and Core Zones on more than one occasion (CP02, CP03S, CP08S & CP08D). The report does highlight the potential for some of these readings to have been erroneous/anomalous.
- 1.1.37. Based on a review of the desk-based information and reliance on the data collected from solely unflooded monitoring well locations (rounds 1 – 4), the risks posed from ground gas were low to very low across both the Lake and Core Zones. Arcadis classified the Lake Zone (Arcadis Areas A1 to A3) as representative of Characteristic Situation 1 conditions (CS1 – very low risk). The Core Zone (Arcadis Area B) was classified as representative of Characteristic Situation 2 (CS2 - low risk).

Project 320 West Gateway Zone D Generic Quantitative Risk Assessment and Geotechnical Ground Investigation Report (Ref: 70116516-GQRA), June 2024

- 1.1.38. WSP UK Ltd was commissioned by UDX to undertake a Generic Quantitative Risk Assessment for the Project 320 Parcel D West Gateway Zone site. The purpose of the assessment was to evaluate subsurface conditions and to quantify any potential risks associated with current soil and groundwater conditions at the Site, to human health and controlled waters. These works were designed in support of a future Site redevelopment plan at the Site and any potential developments which may take place in adjacent land also under investigation.
- 1.1.39. To inform the risk assessment, three boreholes were drilled with dual ground gas/groundwater monitoring wells installed in them, six machine excavated trial pits, seven cone penetration tests commencing with hand dug trial pits, the onsite works were undertaken in June 2024. Ground conditions on the Site in the areas drilled comprised a surface layer of topsoil, superficial Alluvium or Head Deposits, then the Peterborough Member was encountered, followed by the Kellaways Formation.
- 1.1.40. During subsequent groundwater monitoring period, groundwater was encountered between depths of 0.51m and 2.47m bgl. Groundwater monitoring was carried out on the three shallow and deep monitoring wells.
- 1.1.41. No visual or olfactory observations of contamination was encountered in the exploratory holes. No visual or olfactory evidence of contamination was identified within the groundwater samples obtained from the site.
- 1.1.42. Chemical concentrations of soil samples retrieved from Site and laboratory analysed were below the screening criteria for a commercial end use.
- 1.1.43. From the laboratory analysis and in situ head space testing, the risk from potential soil bound sources of vapours is considered to be acceptably low.
- 1.1.44. All of the groundwater results are below the GAC's for vapours derived from dissolved contaminants in groundwater. Overall, the risk to third party neighbours is considered to be Low.
- 1.1.45. Soil leachate and exceedances of the water environmental quality standards were encountered with respect to metals (chromium, copper, lead, nickel and zinc). Groundwater exceedances of the GSVs were detected for boron, copper, nickel, zinc, ammoniacal nitrogen and sulphate. The risk to groundwater from contamination contained within the soils is considered to be Low to Moderate.

- 1.1.46. Should a piled foundation solution be utilised as part of the proposed development, a piling risk assessment was recommended to assess the risk to the aquifers underlying the Site from piling activities.
- 1.1.47. The evidence provided by the water level gauging undertaken indicated that the water bodies contained within the superficial deposits and the Kellaways Member Sands are hydraulically connected.
- 1.1.48. The risk to surface waters from the lateral migration of contaminants within the soils and groundwater is considered to be Low to Moderate.
- 1.1.49. Ground gas monitoring data classified the Site to be Characteristic Situation 1 and the risk to the proposed development is considered to be Very Low. The Site is adjacent to a large landfill to the South and further ground gas monitoring is required to fully characterise the ground gas regime from this off site source.
- 1.1.50. Based on the available data and the preliminary assessment, polyethylene PE pipes may be appropriate if drinking water supply pipes are to be installed across the Site. However, this is based upon a preliminary assessment and any pipe design should be subjected to the appropriate testing along the proposed water supply route and pipe materials should be agreed with the relevant statutory authority prior to construction.

Project 320 Parcel A Lake Zone Generic Quantitative Risk Assessment and Geotechnical Ground Investigation Report (Ref: 70116516_LZLS_GQRA), July 2024

- 1.1.51. WSP UK Ltd was commissioned by UDX to undertake a Generic Quantitative Risk Assessment for the Project 320 Lake Zone site. The purpose of the assessment was to evaluate subsurface conditions and to quantify any potential risks associated with current soil and groundwater conditions at the Site, to human health and controlled waters. These works were designed in support of a future Site redevelopment plan at the Site and any potential developments which may take place in adjacent land also under investigation.
- 1.1.52. To inform the risk assessment, three boreholes were drilled, with all being installed as groundwater monitoring wells in May 2024. Ground conditions on the Site in the areas drilled comprised a surface layer of topsoil, underlain by Made Ground. Anthropogenic inclusions were identified in the Made Ground comprising brick/concrete gravels and some cobbles. Beneath the Made Ground, the Peterborough Member was encountered, followed by the Kellaways Formation.
- 1.1.53. Further to the risk assessment, waste stockpile sampling was undertaken on ten of the stockpiles present on the Site. Although the stockpiles showed some variations between location, the composition of each stockpile was generally consistent through, being made up of a layer of cobbles of brick and concrete, with more clay material underneath containing cobbles and gravel of brick and concrete. Visual inspection revealed isolated fragments of cement board debris to the surface of three stockpiles.
- 1.1.54. Hand pits were excavated adjacent to the former electricity substation that is outside the southwest of the subject Site boundary. Samples were collected for determining if any contamination associated with the substation have migrated onto the Site. No contamination was detected including analysis of the soils for PCBs.

- 1.1.55. During subsequent surface water and groundwater monitoring, groundwater was encountered between depths of 0.74m and 3.27m bgl. Groundwater monitoring was carried out on the three new wells in addition to pre-existing wells from the Arcadis ground investigation.
- 1.1.56. No visual or olfactory evidence of contamination was encountered on the Site. No visual or olfactory evidence of contamination was identified within the groundwater.
- 1.1.57. Potential risks to human health were appraised through the screening of soil and groundwater concentrations against criteria for commercial end use, based on the future planned redevelopment of the Site. Risks to human health were assessed as low.
- 1.1.58. Chemical concentrations of soil were below the screening criteria for a commercial end use. Asbestos material was identified in one sample and the overall the risk to third party neighbours was considered to be Low.
- 1.1.59. Soil leachate and exceedances of the water quality standards were encountered with respect to metals (chromium, copper and nickel). Groundwater exceedances were detected for ammoniacal nitrogen, sulphate, boron and selenium. A groundwater sample collected from the Blisworth Limestone Formation, that is expected to be the most likely source of any new potable drinking water abstraction on the Site, detected no exceedances of the DWS. The risk to groundwater from contamination contained within the soils was considered Low.
- 1.1.60. EQS exceedances for the surface water samples collected from the lakes included sulphate, TPH and PAH. The TPH and PAH exceedances are considered to be minor and isolated. The sulphate concentrations may be indicative of natural background levels and the geology of the region.
- 1.1.61. Groundwater level monitoring data and differences in the detected contaminant exceedances indicated the surface waters and the groundwater are not hydraulically connected. The risk to surface waters from the lateral migration of contaminants within the soils and groundwater was considered to be Low.
- 1.1.62. Ground gas monitoring and subsequent risk assessment classified the Site to be Characteristic Situation 1 and the risk to the proposed development was considered to be Very Low.
- 1.1.63. Based on the available data and the preliminary assessment, the presence of concentrations of aliphatic and aromatic TPH chains EC16 – EC40 greater than the 500 mg/kg threshold values published by the UK Water Industry Research (UKWIR) indicate that barrier pipes may be required if water supply pipes are to be installed. However, this is based upon a preliminary assessment and any pipe design should be subjected to the appropriate testing in service trenches and pipe materials should be agreed with the relevant statutory authority.

Project 320 Contaminated Land Preliminary Risk Assessment, (Ref: 70116516), November 2024

- 1.1.64. Based on the data obtained as part of the Preliminary Risk Assessment, the following potentially contaminative sources have been identified at the Site:
 - Structurally bound asbestos within existing on-Site buildings;
 - Made Ground around infilled Elstow Brook river channel, former brickworks, clay pits, infilled land, historical landfill Site and surrounding on-Site roads and railway;
 - Agricultural practices and use of pesticides and herbicides.
- 1.1.65. The following potentially contaminative sources have been identified off-Site:

- Made Ground;
- Railway sidings;
- Disused pits converted to landfill; and,
- Cement plants.

1.1.66. Overall the risks posed to human health, controlled waters receptors and future infrastructure from the potential sources of contamination identified were considered to be **Moderate and Moderate / Low**.

Project 320 Quarterly Groundwater Level Monitoring Results, January 2025

- 1.1.67. The resting groundwater level data indicates the flow direction is generally towards the north and the River Great Ouse, with localised flow towards the 'landfill lakes' in the Lake Zone.
- 1.1.68. The Made Ground and Head Deposits, where present, are considered perched groundwater bodies.
- 1.1.69. Data collected during the WSP ground investigation within the former Kempston Hardwick brickworks portion of the Lake Zone suggests that the surface water present in the 'Landfill Lake' may be in hydraulic continuity with the groundwater body contained within the Peterborough Member.
- 1.1.70. The groundwater bodies contained within the Blisworth and Rutland Formation and the Kellaways Sand Member appear to be confined aquifers that demonstrate sub-artesian conditions where the resting groundwater elevations rise greatly above the level of the aquifer.



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