
Land Contamination Assessment

at: Phase 3, Horsham
Enterprise Park
(previously Novartis),
Parsonage Road,
Horsham, West Sussex
RH12 4AN

for: Muse Places Ltd

Report Reference:
3750851/Phase3/1

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EXECUTIVE SUMMARY

The site comprises a former pharmaceutical works it is understood the onsite structures have been demolished, with a single 1930s Art Deco building retained in the centre. The site is approximately 7.5 Ha in size and has been the subject of a number of historic investigations, as well as remediation and validation activities carried out by the previous owners. Residential redevelopment was planned on the western portion of the site. The eastern area of the site (Phase 3) was proposed to be redeveloped for commercial use, including conversion of the retained building. It is understood the developers propose to redevelop Phase 3 for a residential end use. This report reviews the original Phase III investigation by LEAP (LP2441) and the subsequent additional investigation (LP2575) and represents the data for the Phase 3 area, reassessed for a residential end use from a human health perspective. The change of land use to low rise residential properties will not affect the geotechnical sections of the original LP2441 Phase III report and those aspects are not considered further in this report.

The site is bound by Parsonage Road to the north, Wimbleshurst Road to the west, and railway lines to the south (extending to the southwest) and to the east. The railway line on the eastern boundary is on an embankment raised by 2-3 m relative to the land to the west. The railway line to the south is broadly level with the site (although in a slight cutting in the far northeast of the site).

Site-wide historical features (now demolished) associated with the former pharmaceutical works included: fuel / solvent storage; boiler houses; above ground heating oil tanks; below ground fuel storage; below ground water storage; LPG storage; interceptors; tunnels; extensive below ground utility services including condensate and compressed air pipes; coal hopper; chillers; electrical sub-station; pharmaceutical research, development and manufacture; engineering works; water treatment; and offices.

The site is mapped as being underlain by the Upper Tunbridge Wells Sand Formation - Sandstone and Mudstone in the northwest, which is classed as a Secondary A Aquifer and Upper Tunbridge Wells Sand Formation - Mudstone for the remainder of the site, which is classed as an unproductive strata. The site is not located in a potable water supply source protection zone. No surface water features are present on site or within 250 m of the site boundaries, but a small pond located in a local park (~800 m to the southwest) is reported to be connected to the site via surface water drains. The site is not mapped as being within a radon affected area and no special protective measures are required in respect of radon gas.

A non-targeted ground investigation was undertaken across the site comprising 54 machine excavated trial pits to depths up to 3 m, 6 rotary cored boreholes to depths up to 20.50 m and 17 windowless sampler boreholes to depths of between 0.80 m and 3 m. Fifty-one of these locations are within the Phase 3 area.

An additional 13 trial trenches and two trial pits targeted the KDC remediated areas to confirm the absence of gross contamination, to confirm the thickness of fill material, where possible and collect additional soil samples for laboratory analysis. The samples were screened for the presence of volatile organic compounds using a handheld photo-ionisation detector. The additional investigations targeted areas reported as previously remediated by KDC, further investigation of the surface water drains; and additional land gas monitoring.

In areas of demolished buildings, ground conditions comprised made ground of around 2 m up to a maximum depth of 4 m, over firm to very stiff clays and silts to over extremely weak weathered interbedded mudstones, siltstones and sandstones, which were encountered from 0.80-4.05 m bgl. Weak interbedded rock was encountered from 2.60 m to 7.30 m to the full excavation depth of 20.50 m. Shallow groundwater was encountered during the intrusive investigation, (at surface in some areas of the site) as well as during subsequent monitoring of the installed monitoring wells. A deep groundwater aquifer was encountered within the rotary cored boreholes.

A geo-environmental risk assessment has been carried out and laboratory test results have been screened against generic assessment criteria (GAC) for residential with home grown produce (resi HGP) land use. The assessment identified elevated concentrations of arsenic, lead and benzo(a)pyrene above residential GAC within the made ground fill material in the eastern half (Phase 3) of the site. Asbestos was identified to be present in one location in the entirety of the soil testing carried out by LEAP. Locations of contaminant exceedances of residential GAC are shown in Drawing ref: 3750851-LW-241-XX-D-G-24101-C01, **Appendix B**.

Six rounds of ground gas monitoring were initially undertaken. The site is characterised as CS1 very low risk or green following NHBC, with the exception of one deep monitoring well c.100 m northwest of Phase 3 (BH106), that recorded initial very high flow rates over several days (maximum reported flow of 104 l/hr) and carbon monoxide at 13.6%.

Following additional monitoring, reported under LP2575 to which the reader is referred, the data evaluation concluded that the initial peak flows of carbon dioxide released from BH106 were likely due to a trapped pocket of carbon dioxide within a sandstone layer beneath a layer of clay with low permeability. Continuous gas monitoring results suggest that the gas source generated in BH106 was indicative of microbial respiration. Provided that in residential areas the foundation design does not create permeable pathways, the proposed residential properties were considered unlikely to require gas protection measures.

Within Phase 3 (eastern area), where a piled foundation solution may be adopted (deep made ground) the method used must adequately seal into the surrounding bedrock, so as not to create new pathways i.e. use of CFA piles.

This report recommends that the land gas risk assessment is reviewed by a competent geo-environmental consultant once the detailed foundation design details are finalised. Limited further assessment may be required at that time by way of validation.

Groundwater sampling targeted the deep groundwater aquifer in six locations, 4 of which are located within Phase 3. In one location (BH101D) xylene was recorded at concentrations above minimum reporting values (MRV) for groundwater. A single shallow groundwater sample was tested at this location to confirm if shallow groundwater was impacted with xylene. Xylene was present but at lower concentrations than in the deep groundwater body. Xylene was not considered to pose a significant risk to offsite groundwater receptors on the basis that the CSM did not identify plausible contaminant migration pathways from onsite groundwater to offsite groundwater receptors. Groundwater remediation is not proposed at this stage.

During 2016 KDC Contractors Ltd remediated fifteen areas that they determined posed a risk to a future residential development due to vapour inhalation pathways or where gross contamination was present. The remedial works comprised excavation and removal offsite, sidewall and base verification, and backfill with site won verified material or quarries type 1 aggregate. Dewatering

also occurred in places. An additional nine trial trenches and three trial pits targeted the KDC remediated areas within Phase 3 to confirm the absence of gross contamination, to confirm the thickness of fill material where possible, and collect additional soil samples for laboratory analysis. The samples were screened for the presence of volatile organic compounds using a handheld photo-ionisation detector. The laboratory testing was predominantly for CWGTPH with BTEX, based on the KDC remediation works. In the samples tested, the potential contaminants of concern were reported at concentrations below residential with home grown produce generic assessment criteria (resi HGP GAC).

Two trial pits were excavated approximately northwest and southwest of BH101, where groundwater testing had identified xylene and phenol above detection limits in the deep aquifer. Soil testing did not record elevated concentrations of xylenes or speciated phenols.

Where accessible, water samples were collected from five onsite locations within the surface water drains. In addition, one offsite upgradient and four offsite down gradient surface water samples were collected, as was one sample from the location of the outfall at Horsham Pond. The samples were tested for heavy metals, speciated PAHs, CWG-TPH and BTEX. PAHs and TPHs were detected at concentrations above analytical detection limits in the onsite samples. The highest contamination was localised to an area northeast of the retained building. CCTV surveys indicated that in this area that the drains were blocked. CCTV surveys also identified damage and unmarked connections to the surface water drains throughout the eastern half of the site, which could allow shallow groundwater to enter the drains. The surface water drains in the east of the site should be repaired to remove blockages, fix cracked or damaged pipes and seal redundant connections, which could act as preferential pathways for shallow groundwater to enter the network.

The downgradient surface water samples recorded PAHs and TPHs at less than detection limits or at low concentrations that were generally marginally above analytical detection limits. The Horsham Pond reported high concentrations of PAH and TPH. Based on the sampling and laboratory analysis undertaken to date the contaminants identified onsite do not appear to be migrating offsite, although a plausible pathway does exist.

The asbestos, arsenic, lead and benzo(a)pyrene contamination identified poses a risk to human health, where present in critical areas such as gardens or areas of soft landscaping.

Recommendations are made for remedial works with respect to the contamination identified on site and where made ground extends into soft landscaped areas.

As with any redevelopment site, there is always the risk of hitherto undetected contamination, and further investigations should be carried out prior to complete redevelopment.

1 INTRODUCTION

1.1 Authority

RSK Environment Ltd trading as Leap Environmental (hereafter referred to as **LEAP**) were engaged by Muse Places Ltd herein referred to as the “Client” to carry out a review of previous reports and provide a land contamination assessment to support the amendment of the proposed end use from ‘commercial’ to ‘residential’ for the Phase 3 area at the former Novartis site located at Horsham Enterprise Park, Parsonage Road, Horsham, West Sussex RH12 4AN.

The works were undertaken by means of **LEAP’s** fee proposal letter LPQ11297 dated 2nd January 2025 including RSK Standard Terms and Conditions which forms the appointment between **LEAP** and the Client.

References in this report to ‘we’, ‘us’ or ‘our’ shall mean Leap Environmental as a trading name of RSK Environment Limited (company no.SC115530) at registered address 65 Sussex Street Glasgow G41 1DX.

The report should be read and used in accordance with the limitations and constraints identified in the report text, and at **Appendix A – Service Constraints**.

The wider site is approximately 7.5 hectares (Ha) in size, with Phase 3 occupying 5 Ha on the eastern side of the wider site and is located at NGR TQ178317, with the nearest postcode being RH12 4AN (Drawing Ref: 3750851-LW-111-XX-D-G-11101-C01, **Appendix B**).

1.2 Objective

The site has been the subject of numerous previous investigations and remediation works. It is understood that proposed end use of the eastern portion of the site, referred to as Phase 3 of the Horsham Enterprise Park Development, previously comprised commercial buildings and open space, with planning approval for this development. However, it is understood that a planning application is to be submitted for a proposed residential scheme within the Phase area, with the proposed residential development shown on Drawing 17100-HGP-XX-XX-D-A-0102 RevP03, **Appendix B**. Due to the change in the proposed nature of the site, the previous assessments of the contamination risk were required to be reviewed and updated to ensure the conclusions are supportive of the more conservative proposed end use.

The objectives of this report are to:

- review the previous reports to provide information on the environmental quality of the ground present on the site with respect to the modified change of end use from commercial to residential, for Phase 3 of the development
- assess the potential health and other environmental risks posed by the site to the proposed development and to other specifically identified receptors with respect to the modified change of end use.

A review of the geotechnical information pertaining to Phase 3 is outside the scope of this report.

1.3 Previous studies

The site has been the subject of previous investigations by LEAP and others. The following site investigation reports have been found under the existing planning application and the reader is referred to these earlier reports, which should be read in conjunction with this report.

- Addendum Site Investigation Report by LEAP ref. LP2575 dated 7 July 2021
- Phase III Site Investigation Report by LEAP re: 2441 dated 6 May 2021
- Phase 1 Desk Study & Site Reconnaissance Report by LEAP ref. LP2441 dated 5 March 2021
- Asbestos Investigation Letter Report, Parsonage Road, Horsham, RH12 4AN by LEAP ref. OA/20/LP2309 dated 18 September 2020
- Phase I Geo-Environmental Site Assessment by REC Ltd dated June 2018
- Land Quality Interim Report by KDC Contractors Ltd dated November 2016
- Phase 2 Environmental Investigation by KDC Contractors Ltd dated June 2016
- Historical Land Quality Investigations Data Review and Preliminary Risk Assessment by KDC Contractors Ltd March 2016
- Asbestos Demolition Survey Reports by Riverside Environmental Services Ltd dated January 2015
- Further Land Quality Investigation by Jacobs dated 17 October 2014
- Phase 2 Land Quality Assessment by SKM Enviros dated 12 July 2013.

It is understood that the client has reliance on these reports, which were previously produced for other clients.

1.4 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described below and throughout this document.

This report was prepared in accordance with good practice guidance at the time of issue. Consideration should be considered in the light of changes in legislation, statutory requirements, or industry practices subsequent to the date of issue.

The comments given in this report and the opinions expressed are primarily based on third party data and investigations, while RSK have undertaken a review of the information provided RSK cannot be held liable for the quality of the data provided. There may be conditions pertaining to the site that have not been disclosed by the investigations and therefore could not be taken into account.

In particular, it should be noted that there may be areas of made ground and potential contamination not detected due to the limited nature of the investigations or the thickness

and quality of made ground, and concentrations of contamination across the site may be variable. In addition, groundwater levels and groundwater concentrations may vary from those reported due to seasonal, or other, effects.

2 PHASE I DESK STUDY SUMMARY

2.1 Site description, history and environmental setting

The site has been subject to previous investigations by LEAP and others. The relevant information from these reports to support development of the preliminary risk assessment (PRA) is summarised in Table 1 below. The previous reports considered the wider development, however, only the eastern area of the site known as Phase 3, is considered within this report.

The site location is in Drawing ref: 3750851-LW-111-XX-D-G-11101-C01 and site boundary in Drawing 3750851-LW-112-XX-D-G-11201-C01 in **Appendix B**.

Table 1: Summary of site description, history and environmental setting

Information ¹	Details
Name and site address	Horsham Enterprise Park, land off Parsonage Road, Horsham, West Sussex, RH12 4AN
National Grid Reference	TQ 178 317
Site area	Phase 3 comprises the eastern portion of the site and occupies 5 ha of the wider 7.5 ha development.
Topography and elevation	Central areas are broadly flat and level, with a gentle downward slope from west to east (~57.50 m to 56.50 m AOD). North eastern and eastern boundaries slope downwards into the site from ~60 m AOD at the crest of the slope to ~58-57 m AOD at the toe of the slope. Slope angles are estimated to be between 20-22° on the north-eastern and eastern boundaries. Regionally, the topography of the surrounding area slopes downwards to the southwest.
Site description and current use	At the time of the investigation in 2021, the wider site was unoccupied and cleared of most of the former structures, with the exception of the retained central structure referred to as Building 3/36 to the west of the Phase 3 area. This report noted a soft strip including asbestos removal was being undertaken by others on the central building, and the installation of secure fencing around the site perimeter. The wider site is bound by Parsonage Road to the north, Wimblehurst Road to the west, and railway lines to the south (extending to the southwest) and to the east. The railway line on the eastern boundary is on an embankment raised by 2-3 m relative to the land to the west. The railway line to the south is broadly level with the site (although in a slight cutting in the far northeast of the site).

¹ Source: LP2441 Phase I Desk Study and Site Reconnaissance by LEAP dated March 2021. The report includes publicly available data in the form of an Envirocheck Report.

Information ¹	Details
	The raised ground present along the north-eastern and eastern boundaries appears in part to be related to earthworks during the construction of the pharmaceutical works, where land was presumed to have been 'cut' into to create a level construction platform for buildings. A concrete crib wall is present along the eastern boundary embankment ~95 m south of Parsonage Road. It is ~15 m long and ~2 m high and formed of interlocking precast concrete.
Surrounding area	The wider site is located to the north of Horsham town centre in a predominantly residential setting, with residential housing to the north, southwest and west of the site. A commercial/light industrial development is located beyond the railway line to the east. To the south beyond the railway line are college playing fields and a mix of residential and light industrial land uses. Approximately 230 m to the northeast of the site is Parsonage Farm Industrial Estate.
Site history	From the earliest provided mapping (1875) the wider site is shown as open land with an 'old clay pit' in the far south-eastern corner. Three historical drainage ditches are mapped on the wider site, two in the eastern half of the site and one in the western half. Railway lines are shown to be present forming the southern and eastern boundaries. Mapping from the late 1930's show Building 3 present and labelled as 'laboratories'. Further expansion of the site with new structures, is shown on historical maps dating from the 1960's, 1980's and 1990's. Minor additions to the site layout are noted from the 2000's. The Phase 3 area of the site following construction of the laboratory comprised a production and storage building/area in the centre, a former boiler house in the west-centre, a waste store/incinerator and solvent storage in the south and a pumping station in the east, among other office, warehouse and ancillary buildings. A boiler house and pumping station were present directly west of the Phase 3 area. It is understood from previous reports that the former pharmaceutical buildings were demolished between April 2015 and June 2016, with demolition of most structures and removal of foundations and slabs to 1.0 m below existing ground level. It is then understood that some remedial and investigation works were undertaken (see KDC Contractors Ltd Land Quality interim report ref: 10), including excavations around a partly decommissioned fuel storage tank and removal of petroleum hydrocarbon impacted soils. However no details of the remedial works were provided for review. Land immediately surrounding the wider site broadly follows a similar trajectory in that it was largely open fields, but with minor areas of residential development to the southwest and industrial usage (Horsham Iron Works) to the southeast from the late 19th century. From the 1930's and 1960's further residential expansion of Horsham town is noted to the west, south and east. By the 1980's extensive industrial / commercial land use is mapped on land to the east and southeast of the site, but with residential use shown beyond that. Playing fields are mapped to the north of the site in the 1980's but are mapped as residential land use from the 2010's.
Geology	The wider site is mapped as being underlain by the sandstone and mudstone of the Upper Tunbridge Wells Sand, with the majority of the wider

Information ¹	Details
	site including Phase 3 mapped as underlain by mudstone of the Upper Tunbridge Wells Sand. Sandstone is mapped in the northwestern corner. Superficial deposits are not mapped for the site.
Regional hydrogeology	The Upper Tunbridge Wells Sand - Mudstone beneath Phase 3 is mapped as an Unproductive Strata. The Upper Tunbridge Wells Sand - Sandstone in the northwest of the site is classified as a Secondary A Aquifer. The site is not located within a groundwater source protection zone (SPZ). It is noted that there are two historical groundwater abstraction licences for the site which are mapped to a single point southwest of Building 3 (to the west of Phase 3).
Surface water	There are no recorded surface water features on the wider site or immediately bounding the site (within 250 m). An unnamed surface water feature is mapped 326 m to the northeast of the site. It is understood that two surface water drains are present in Phase 3 and connect to the Horsham Pond ~800 m to the southwest of the site. One of the drains extends from the northeast corner along the northern boundary towards Building 3/36, where it turns to the south and extends southwards towards the southern boundary. It then turns to the southeast following the southern boundary past Building 11, before exiting the site beneath the railway line. A second surface water drain is present in the southern half of the site aligned east to west from the Foundry Lane industrial estate apparently connecting to the same outfall along the southern boundary. It has been reported to LEAP anecdotally that the site drainage did not connect into these features. A historical decommissioned drain is mapped from the north east crossing the centre of the eastern half of the site and connecting to the outfall along the southern boundary. We understand that this was decommissioned with the construction of Building 42. The approximate routes of the drains are shown on Drawing ref: 3750851-LW-126-XX-D-G-12601-C01, Appendix B. It is not known if historical drains / ditches (that were mapped pre-development of the site) are still active.
Flood risk	According to the Envirocheck data, the wider site is not located within a flood zone at risk from Rivers or Sea. The north-western part of the site, where the Upper Tunbridge Wells Sand - Sandstone is present is mapped in the Envirocheck Report as an area with 'limited potential for groundwater flooding to occur'. Phase 3 is not identified as being at risk of groundwater flooding. Phase 3 is also mapped as at risk of surface water flooding.

2.2 Previous investigations

The wider site has been the subject to numerous reports undertaken by LEAP and others as listed in Section 1.3. A summary of the previous investigations by other consultants is provided in the LEAP Phase I Desk Study report (report ref: ref. LP2441) and pertinent information has been included within the preliminary conceptual site model (CSM). The desk study concluded the following residual concerns persisted at the site, and a Phase III investigation was conducted to address these concerns:

- residual near surface risk to human health to future land users for a residential land use and construction workers, following remedial works
- possible residual contamination in the areas that were remediated by KDC
- possible point source pathway from historical drainage network connecting to the Horsham pond
- possible previously unknown areas of contamination
- groundwater quality in the bedrock aquifer has not been adequately characterised
- elevated concentrations of ground gases have been recorded and further gas monitoring is recommended. Whilst significant amounts of onsite organic matter have not yet been identified, the gas may be sourced from either on or off site filled areas.

After the desk study was issued and prior to the issue of the Phase III report, further anecdotal supporting evidence was obtained from West Sussex County Council (WSCC) and included with the Phase III report.

A further ground investigation (report ref: LP2575) was undertaken to target areas WSCC believed to be previously remediated, for quality assurance, and to obtain further gas monitoring data and surface drains water sampling. Additionally, WSCC were concerned that security breaches at the site may have resulted in asbestos impacting shallow soils, which was also investigated. The results of this further investigation have been presented within this report.

3 SUMMARY OF PRELIMINARY RISK ASSESSMENT

3.1 Preliminary geoenvironmental conceptual site model

A risk-based approach is used in the UK to assess contaminated or potentially contaminated land. For a potential risk to exist, there must be a contaminant linkage in place, i.e. there must be a source of contamination, a potential receptor, and a pathway linking the two.

The sections below provide a summary of the preliminary conceptual site model (CSM) during the Phase 1 desk study, specific to the Phase 3 area, which was used to systematically identify all of the potential contaminant linkages using the background information summarised in Section 2 of this report.

3.1.1 Potential sources of contamination

Table 2 below summarises the potential onsite and offsite sources of contamination identified in the previous desk study report for the Phase 3 area. In this instance offsite sources are considered to be sources outside the Phase 3 boundary, including sources on the wider site.

Table 2: Summary of potential sources of contamination on Phase 3

Potential Source	Potential Contaminants of Concern	Anticipated Distribution
On-Site		
Residual contamination in near-surface made ground	Wide range of contaminants but likely limited to heavy metals, asbestos, polycyclic aromatic hydrocarbons (PAH) and petroleum hydrocarbons	Site-wide – both KDC and LEAP encountered concentrations of contaminants at levels above residential land use criteria in isolated locations
Backfilled clay pit	Ground gases (carbon dioxide, methane)	Located in the south of Phase 3 – up to 2 m of fill previously encountered
Unidentified contamination in previously covered areas	Potential asbestos, metals, PAHs, petroleum hydrocarbons, BTEX, VOCs and SVOCs	Potentially site wide
Off-Site		
Residual contamination in near-surface made ground to the west of Phase 3	As above; heavy metals, asbestos, polycyclic aromatic hydrocarbons (PAH) and petroleum hydrocarbons	

Potential Source	Potential Contaminants of Concern	Anticipated Distribution
Historical filling in the surrounding area	Ground gases (carbon dioxide, methane)	Historical brickfield ~50 m to the southeast Filled pond ~80 m to the north

Previous reports did not find evidence of offsite migration of potential contaminants migrating to the wider site (railway line / fuel storage depot), and specifically onto Phase 3. The only main offsite source remains any residual contamination present across the remainder of the wider site, which could impact Phase 3. However, there was considered the potential for ground gas from offsite sources to migrate to site, and as such it is considered as a potential risk to the site.

3.1.2 Potential receptors

In the context of the proposed future land use, the following potential receptors of ground contamination were identified:

3.1.2.1 Human health

- future residents
- construction workers.

3.1.2.2 Controlled waters

- Secondary A Aquifer within the Upper Tunbridge Wells Sands outcropping on the wider site in the northeast (sandstone)
- Horsham Pond c.800 m to the southwest, understood to be connected to the site via surface water drainage system.

3.1.2.3 Other

- material construction of buildings and infrastructure.

3.1.3 Potential contaminant linkages

The preliminary risk levels were determined following a review of the available desk-based information with the significance of particular contaminant linkages being dependant both upon the likelihood of exposure occurring and the severity of that exposure. The potential risk to the future site users has been updated to reflect the amended proposed end use of Phase 3 from commercial to residential.

3.1.3.1 Human health

The proposed development in Stage 3 now comprises residential housing with private gardens and areas of public open space. Therefore, all the generic Contaminated Land

Exposure Assessment (CLEA)² exposure linkages between humans and potential contaminants in the ground are plausible i.e. direct ingestion of soil, ingestion of homegrown produce, and inhalation of indoor and outdoor vapours and dusts. Groundworkers could be potentially exposed via all these pathways, except for those involving edible plants.

Given the known presence of residual contamination remaining following the remedial works, there is currently a high likelihood for concentrations of contaminants to be present on-site which could significantly impact future residential. As such the potential for unacceptable risks to human health via these pathways is considered to be moderate. Due to the severity of exposure to asbestos, the risk to future residents and groundworkers is considered to be moderate-high.

The assessment of future on-site users is considered to be protective of the surrounding off-site residents and off-site commercial workers.

3.1.3.2 *Ground gases (excluding mine gas)*

The following potential ground gas generating sources have been identified for the site:

- deep, site wide made ground
- infilled former clay pit.

Based on the investigations undertaken prior to and immediately post demolition/remedial works, it is considered unlikely that the made ground will contain appreciable putrescible material and is considered unlikely to be a significant source of ground gas. Low to moderate concentrations of carbon dioxide (reported up to 12.1%) and methane (reported up to 4.3%) and low flow rates were recorded in monitoring rounds before and after demolition works, however it is noted that these monitoring regimes were generally short (~2 visits per regime) and the recorded concentrations are highly variable.

Some off-site sources of ground gases were identified however given that Phase 3 is underlain by more impermeable mudstone it is considered unlikely that significant lateral and vertical migration could occur from either onsite or offsite sources.

Overall the potential risk from ground gases is considered to be low to moderate. It is also noted that the previous reports indicated further monitoring would be required to fully characterise the ground gas regime.

3.1.3.3 *Controlled waters*

Phase 3 is mapped as underlain by mudstone of the Upper Tunbridge Wells Sands (an unproductive aquifer), with sandstone (a Secondary A aquifer) outcropping to the northwest. Based on local BGS boreholes and onsite intrusive works water table is anticipated to be some distance below ground surface, with perched waters common in the more granular beds. It is considered unlikely that shallow perched waters within the made ground are in hydraulic continuity with the deeper aquifer.

² Environment Agency 'Updated technical background to the CLEA model' Science Report: SC050021/SR3. January 2009.

There is a potential pathway for leachate from residual soil contaminants and for mobile liquid contaminants to enter the deep aquifer onsite, if perched and deep aquifers are connected. But there is unlikely to be an active pathway between onsite groundwater (shallow or deep) to offsite groundwater on the basis of the low permeability of the unproductive strata. This is evidenced by a controlled waters detailed quantitative risk assessment (CWDQRA) undertaken post remedial works, which identified isolated failures for hexavalent chromium, nickel, PAHs and low carbon-fraction (C5-6) petroleum hydrocarbons. The CWDQRA concluded there was no ongoing or significant soil or groundwater source of contamination that could impact the groundwater.

This applies to offsite surface water receptors i.e. there is unlikely to be an active pathway between the groundwater onsite to offsite surface water features, with the exception of a potential direct preferential pathway via the drains that are present on site. Surface water drains that run through the site connect to the Horsham Pond 800 m to the southwest.

A CCTV survey undertaken in 2018 suggested that sections of the drains were damaged and may receive water from the site, a copy is included within **Appendix J**. This could allow a preferential pathway to the Horsham Pond from shallow groundwater via the surface water drainage network. Three historical drains / ditches were also mapped for the site, it is not known if these are still active or whether there is connectivity from offsite contaminant sources to offsite receptors.

Overall, given the ground conditions, depth to groundwater recorded and only minor exceedances recorded within the groundwater, the overall risk to controlled waters (both groundwater and surface water) is considered to be low to moderate.

3.1.3.4 Below ground infrastructure

The site has been subject to industrial development, storage of chemicals, or deposition of waste, which may contain aggressive chemicals in residual surface materials or in ground penetrated by leachates. As such the site is determined as “brownfield” with respect to the BRE Special Digest 1, and the potential for unacceptable impacts to below ground infrastructure, including concrete and plastic pipework is considered to be moderate/high.

4 INTRUSIVE INVESTIGATION

4.1 Rationale

Two phases of intrusive investigation were undertaken by LEAP following the completion of the Phase I desk study in 2021. The rationale of these investigations is summarised below.

4.1.1 LP2441 Phase III investigation rationale (May 2021)

The main purpose of this investigation was to collect supplementary geo-environmental to support the redevelopment of the site. Critically the investigation was designed to provide information identified as a data gap or uncertainty within the Phase I Desk Study.

To achieve the investigation rationale, the scope of works comprised a total of 77 investigation locations across the site. Of these locations, 35 No trial pits, 4 rotary boreholes and 10 windowless boreholes were undertaken within the Phase 3 area. An additional 4 hand dug pits were conducted to sample the bund along the eastern boundary.

The scope of the investigation was non-targeted to give general coverage with the spacing between investigation locations consistent with the recommended density of 25 to 50m for an exploratory investigation outlined in BS10175 Section 7.7.

Due to the potential for groundwater contamination and historic reporting confirming presence of ground gases, monitoring wells were installed in a selection of boreholes.

The site investigation locations are provided in Drawings Refs: 3750851-LW-222-XX-D-G-22201-C01 to 22208-C01, **Appendix B** and Table 3 provides a summary of the rationale, proposed scope and what was achieved in the field:

Table 3: Rationale for Phase III investigation by LEAP

Trial Hole/Test Location	Rationale	Achieved Depth (mbGL)	Notes
BH101-BH104	Provide Information on ground conditions and location of groundwater and gas monitoring wells.	20 – 20.5	Deep groundwater monitoring wells installed within each borehole to depths between 14 m to 20.20 m. Gas wells to a depth of 2m were also installed within BH101 and BH103.
WS108 - WS117	Provide information on the ground conditions, location of gas monitoring well and provide samples for contamination testing.	0.8 – 3.0	Positions terminated early due to refusals on bedrock or below ground obstructions. Gas monitoring wells were installed within WS108, WS109, WS111, WS113, WS115 and WS116.

Trial Hole/Test Location	Rationale	Achieved Depth (mbGL)	Notes
			WS114 was aborted due to a surficial obstruction.
TP117 - TP152	Provide information on the ground conditions and provide samples for contamination.	0.6-3.10	Locations that terminated early due to confirmed and potential below ground services were TP129 and TP137.
B1-B4	Shallow pits to provide information on ground composition of the raised ground/bund on the north-eastern perimeter.	0.5-1.0	B3 terminated at 1 m due to encountered electrical cable caution tape.

4.1.2 LP2575 Addendum investigation rationale (July 2021)

Further site works were carried out to investigate areas of remaining uncertainty onsite following completion of the Phase III investigation.

Across the site a total of 18 additional trial holes were excavated, of which 12 were located within the Phase 3 area of the development, comprising 9 machine excavated trial trenches (trial pits extended from 2 m length to 10 m) and 3 trial pits to depths up to 3 m. The trial trenches were positioned to target KDC remediation areas and land around BH101 in the southeast of the site.

The investigation rationale for the trial holes is summarised below:

Table 4: Rationale for Addendum Investigation by LEAP

Trial Hole/Test Location	Rationale	Achieved Depth (mbGL)
TT205 - TT214	Targeting known KDC remediation areas, to confirm presence of remnant hydrocarbon contamination (TPH fractions) in KDC remediation areas. To identify if visual (i.e. discoloured soils, non-aqueous phase liquids (NAPL), oil sheens) or olfactory (strong hydrocarbon odours or elevated PID readings) evidence of contaminated soils.	3.0
TP203 - TP204	Target land around BH101, where phenol and xylene had been detected in groundwater, and collect soil samples for laboratory testing.	3.0

4.2 Site work

4.2.1 Date and weather conditions

The Phase III intrusive investigation was undertaken between 11 January and 1 February 2021. At the time of the investigation, the weather was overcast with periods of heavy rain and sub-zero temperatures. The additional intrusive investigation was undertaken between 25 and 26 May 2021. At the time of the investigation, the weather was warm, with occasional light drizzle.

Based on long term averages³ the weather preceding the investigation in November 2020 reported temperatures slightly above the average, but with below average rainfall for the month. In December 2020 temperatures were reported at slightly above the long term average and with above average rainfall. In January 2021 temperatures for the UK were ~1.5°C below the historical average, but with above average rainfall. The weather preceding the investigation in May 2021 reported mean average temperatures close to the long term average, with a generally dry and sunny month. In April 2021 temperatures were reported at slightly above the long term average and with below average rainfall.

Photographs from the fieldwork have been included in **Appendix C**.

4.2.2 Site work methods

4.2.2.1 Borehole drilling

The deep boreholes were drilled using a rotary coring rig (Fraste MultidrillPL). The rotary boreholes were drilled using 146mm diameter casing. All locations were hand dug to 1.20 m below ground level (bgl) with following drilling using percussive methods to bedrock. The bedrock was drilled using a Geobore-S type system. Drilling flush was added as the boreholes progressed. Drill cores were recovered for logging and monitoring wells were installed in each location. Borehole logs are available in **Appendix D**.

4.2.2.2 Windowless sampler

The shallow boreholes were drilled during a windowless sampler rig. The Windowless sampling rig consists of a tracked barrow with a sampling unit mounted on the top. When in the required position, the mast was raised to a height allowing a mechanised drop weight to fall repeatedly onto an anvil, and drive attached sample tubes or probe rods into the ground to produce reasonably intact continuous samples, which were then extracted using the integrated hydraulic ram.

To reduce any tendency of the tubes to stick in the ground, a succession of smaller diameters may be used to obtain full depth. Excavated soils were placed aside for inspection and sampling. Hand dug starter pits to 1.20 m bgl were excavated in all locations.

³<https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index>

On completion the trial hole was backfilled with excavated material, placed in reverse order, and the surface reinstated unless a monitoring well was installed. The windowless sampler logs are available in **Appendix D**.

4.2.2.3 Trial pitting

Trial pits were dug by a backhoe excavator. The trial pits had a target depth of 3 mbgl and were typically 2 m long by 0.50 m wide. The trial trenches were typically 10 m long by 0.50 m wide, with a target depth of 3 m bgl. Spoil was replaced in reverse order to prevent cross-contamination. Trial pits were left mounded to allow for future settlement. The trial pit logs are available in **Appendix D**.

4.2.2.4 Soil logging and sampling

Soil samples were recovered from the boreholes and trial pits for field screening, logging and sampling.

Boreholes were logged in general accordance with the requirements of BS 5930:⁴ and BS EN ISO 14688⁵.

Visual and olfactory evidence of contamination was noted if encountered. These observations were used to aid scheduling of samples for chemical laboratory analyses, and are included on the exploratory hole logs in **Appendix D** and summarised in Section 4.3.1.2.

Samples were collected with a clean sampling trowel or by hand (using dedicated nitrile gloves for each sampling location). Samples were placed into laboratory supplied sampling containers, specific to the type of analyses required.

All sample containers were sealed and labelled with a unique location identity, depth and date of sampling.

4.2.2.5 Monitoring well installation

19 monitoring wells were installed across the wider site during this investigation, 13 of which were in the Phase 3 area. 8 were installed within the rotary coring boreholes (two locations had nested shallow and deep monitoring wells) and 11 were installed within the windowless sample boreholes. The monitoring wells were constructed of 50 mm diameter HDPE pipe. Installations within the rotary boreholes included a deep response zone to intercept groundwater within the bedrock and was surrounded by washed filter gravel. The window sampler locations and two rotary boreholes had shallow installations to target potential land gas sources and the response zones were also surrounded by washed filter gravel. The plain zone was surrounded with bentonite pellets (saturated with water) to provide a seal. The monitoring wells were finished with bungs with gas taps and flush

⁴ BS5930:2015+A1:2020 Code of Practice for Ground Investigation

⁵ BS EN ISO 14688 Parts 1-2 (2018) Geotechnical Investigation and Testing. Identification and classification of soil

mounted or raised steel covers. Monitoring well installations are shown on the borehole logs and summarised in the following table, wells outside of Phase 3 are shaded grey:

Table 5: Borehole installation details

Borehole	Type G-gas W-water	Plain Screen (mbgl)	Well	Slotted Screen (mbgl)	Well	Bentonite (mbgl)	Seal
BH101D	W	GL-8		8-14		0.3-1	
BH101S	G	GL-1		1-2		2-4.5 7-9 14-20.1	
BH102	W	GL-17.5		17.5-20.2		0.3-2 15-17 20.2-20.5	
BH103D	W	GL-17		17-20		0.3-1	
BH103S	G	GL-1		1-2		2-4 7-17 20-20.3	
BH104	W	GL-10		10-15		0.3-2 8-10 15-20	
BH105	W	GL-10		10-16		0.3-2 7.5-9.5 16-20.2	
BH106	W	GL-11.3		11.3-20		0.3-2 8.8-10.8 20-20.3	
WS102	G	GL-1		1-2		0.2-1	
WS103	G	GL-1		1-2		0.2-1	
WS105	G	GL-0.9		0.9-1.9		0.2-0.9	
WS106	G	GL-1		1-2		0.2-1	
WS108	G	GL-1		1-3		0.2-1	
WS109	G	GL-1		1-3		0.2-1	
WS111	G	GL-0.5		0.5-1		0.2-0.5	
WS113	G	GL-0.9		0.9-1.9		0.2-0.9	
WS115	G	GL-1		1-2		0.2-1	
WS116	G	GL-0.5		0.5-1.5		0.2-0.5	
WS118	G	GL-0.5		0.5-1.5		0.2-0.5	

4.2.2.6 Monitoring well development

The deep monitoring wells were developed on 5 February 2021 using a submersible electric pump. A minimum of three well volumes were removed from BH101 and BH103. A full three well volume purge was not completed on BH102, BH104, BH105 and BH106 despite several attempts to do so using the available equipment. Low flow sampling methods as described in Section 4.2.4.1 were employed to collect representative groundwater samples from the deep standpipes for analysis.

4.2.2.7 Continuous gas monitoring

Ambisense GasfluX units were installed in BH106 and WS106 (outside of Phase 3) to provide continuous gas monitoring records. The units log various parameters including atmospheric pressure (mbar), flow (l/hr), and concentrations of CH₄ (%), CO₂ (%), O₂ (%), CO(ppm), and H₂S(ppm). Readings were recorded at approximately one hour intervals. The high frequency monitoring took place between 12 May to 25 June 2021. Volatile organic compounds and water levels in both locations were also continuously logged.

4.2.3 Sampling and field tests

4.2.3.1 Soil sampling

Geoenvironmental soil samples were selected to ensure that near-surface exposure of human health via direct contact was targeted, as well as to spatially and vertically delineate possible sources of contamination.

4.2.3.2 Field tests

Field tests for geotechnical parameters were reported in the original Phase III LP2441 report, but omitted here as outside the objectives of this report.

4.2.3.3 Photo-ionisation Detection (PID)

Environmental samples collected from trial trenches / pits were screened for the presence of volatile organic compounds (VOC) using a PhoCheck+ portable PID. A soil sample was placed in a sealed container or plastic bag and soil / headspace allowed to equilibrate for approximately 20 minutes, the PID was inserted into the container and the results recorded. Where visual evidence of hydrocarbon contamination was noted on a sidewall or base of a trial pit/trench and it was considered safe to do so, a PID reading at the surface of the contamination face was also recorded.

4.2.4 Ground gas and groundwater monitoring

4.2.4.1 Groundwater sampling

Three rounds of groundwater sampling were undertaken during this investigation. The visits were completed on 8-9, 22-23 February, and 8-9 March 2021. Groundwater monitoring wells were inspected for the presence of water using an electronic dipmeter.

Following well development groundwater samples were recovered using low flow sampling equipment i.e. a bladder pump attached to a multiparameter probe with a through flow cell.

Water samples were collected when physio-chemical parameters (pH, dissolved oxygen, REDOX, and electroconductivity) were deemed stable on site.

Samples were collected in laboratory supplied containers and placed in cooled insulated boxes for transport to The Environmental Laboratory Ltd for analysis. The laboratory certificates are provided in **Appendix E**, which have been screened against GACs in the **Appendix F** and the results of the groundwater monitoring visits are provided in **Appendix G** and summarised in Section 3.3.1.1 and Section 5.3.2.

4.2.4.2 Ground gas monitoring

Six rounds of land gas monitoring have been undertaken on 8 February, 22 February, 8 March, 15 March, 22 March and 6 April 2021. A seventh gas monitoring visit was undertaken on 16 April 2021, as one monitoring round was missed at BH106, for completeness shallow monitoring wells in the vicinity of BH106 were also measured (WS103 and WS106). The wells were monitored for methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide using a GA2000 portable gas analyser. The results of the land gas monitoring visits are presented in **Appendix G** and summarised in Section 5.4.2.

The wells were monitored for volatile organic compounds using a PhoCheck+ portable Photo-Ionisation Detector (PID) and included within the results in Section 5.4.2.

Ambisense GasfluX units were installed in BH106 and WS106 to provide continuous gas monitoring records. The high frequency monitoring took place between 12 May to 25 June 2021. Volatile organic compounds and water levels in both locations were also continuously logged. The reader is referred to LP2575, where these results are presented.

In addition, periodic readings of the other deep groundwater monitoring wells (BH101-105) were also undertaken on four occasions (12 and 25 May, 18 and 24 June 2021).

4.2.5 Surface water drains

A number of on site and off site manhole chambers were lifted and attempts to sample water within the drains was made over three visits (26 May, 24 June and 30 June 2021). The Horsham Pond, the discharge point for the drains, offsite to the south, was also sampled. Samples were collected using laboratory supplied containers. Samples were not collected from chambers that required manual entry or where insufficient water was present within a chamber. The laboratory certificates are included within **Appendix E**, which have been screened against GACs in the **Appendix F**.

4.2.6 Laboratory analysis

4.2.6.1 Geotechnical testing

Geotechnical testing of the soils was conducted within the original LP2441 Phase III report, however, is outside the scope of this report.

4.2.6.2 Chemical soil analysis

Selected samples of soil have been subjected to laboratory testing. Sampling techniques and storage have been undertaken as per BS 10175:2011+A2:2017 Code of Practice for

Investigation of Potentially Contaminated Sites. The laboratory testing has been carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex. Where available, the tests procedures are UKAS and MCERTS accredited.

The following analyses were completed on selected samples:-

- LEAP standard soil suite (metals, speciated PAHs, asbestos)
- speciated petroleum hydrocarbons (CWG-TPH)
- volatile organic compounds (VOCs)
- semi volatile organic compounds (SVOCs)
- asbestos identification
- waste acceptance criteria tests.

The additional investigation targeted areas previously remediated by KDC. The remediation rationale was predominantly based on the visual and olfactory signs of land contamination, and/or where laboratory testing exceeded generic assessment criteria for petroleum hydrocarbon compounds. Thus the testing was focussed on CWG-TPH with BTEX. In two locations, TT205 and TP202 where visual signs of contamination (black stained soils and oily sheen) were noted LEAP standard Soil suites were also scheduled.

The full laboratory test results are presented in **Appendix E**.

4.2.6.3 Chemical groundwater analysis

Selected Groundwater from deep monitoring wells have been subjected to laboratory testing. Sampling techniques and storage have been undertaken as per BS 10175:2011+A2:2017 Code of Practice for Investigation of Potentially Contaminated Sites. The laboratory testing has been carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex. Where available, the tests procedures are UKAS and MCERTS accredited.

The following analyses were completed on selected samples:-

- LEAP standard water suite (metals, pH, sulphate, sulphide, phenol, boron, total cyanide and basic petroleum hydrocarbon analysis)
- petroleum hydrocarbons including speciated banding via TPH CWG method including BTEX compounds;
- speciated PAHs.

The full laboratory test results are presented in **Appendix E**.

4.2.6.4 Chemical surface water analysis

The laboratory testing on the surface water samples has been carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex.

Analyses included:

- heavy metals, dissolved organic carbon and pH
- dissolved calcium on selected samples

- speciated CWGTPH +BTEX
- speciated PAH
- speciated phenols on selected samples.

The full laboratory test results are presented in **Appendix E**.

4.2.6.5 Gas and Vapour Analysis

A single round of land gas sampling has been undertaken at BH106 and WS106 using laboratory supplied Silonite canisters. The samples were collected and analysed for:

- bulk gases
- C4-C12 TPH
- volatile organic compounds.

The full laboratory test results are presented in **Appendix E**.

4.2.7 Constraints to the scope

Access to areas to the north and south of the retained building were limited due to below ground services (outside of Phase 3). The desk study highlighted the potential for a groundwater interceptor to be present to the immediate south of Building 3/36 and fuel tanks to the southwest (anecdotally reported to have been decommissioned).

4.3 Ground conditions

Made ground conditions encountered were noted to vary between the land west and east of Building 3/36. The original LP2441 Phase III described the west and east areas separately, the scope of this report is focused on the eastern portion of the site (Phase 3) and therefore, the western data has been omitted from Section 4.3. The ground conditions encountered throughout the additional phase of works were in general agreement with the Phase III investigation undertaken by LEAP. Within some KDC remediation areas the made ground contained a coarse, subangular to sub rounded crystalline gravel (possible natural aggregate type material) namely in TP201, TP202, TT202B, TT203, TT204, TT205, TT206, TT209, TT210, TT211 and T212.

Drawings Refs: 3750851-LW-222-XX-D-G-22201-C01 to 22204-C01, **Appendix B** shows exploratory hole location within Phase 3. The stratigraphy encountered is described on the trial hole logs in **Appendix D**.

Table 6: Summary of soils encountered in the eastern portion of the site (Phase 3)

Depth From (m AOD)	Depth To ¹⁷ (m)	Soil Type	Description
GL (56.58 / 57.52)	0.15 / 0.4 (56.18 / 57.12)	TOPSOIL	Dark brown silty clay TOPSOIL.
GL / 0.5 (55.78 / 56.97)	1.0 / 2.0 (54.78 / 55.54)	MADE GROUND	Grey MADE GROUND comprising sandy gravel of coarse subangular to subrounded dark grey crystalline rock. Occasionally present with brick and concrete inclusions.
GL / 1.2 (57.28 / 56.01)	0.2 / 4.05 (56.14 / 52.88)	MADE GROUND	Variable MADE GROUND generally comprising grey demolition fill of fine to coarse and cobbles of brick and concrete and occasional blacktop with localised pockets of black gravel of crystalline rock and areas of red sandy gravelly fill with gravel of fine to coarse brick and concrete
GL / 1.2 (56.42 / 56.08)	0.5 / 2.0* (55.92 / 54.36*)	REWORKED SOIL ¹⁰	Reworked soils comprising grey to brown clayey silt or silty clay occasionally with fragments of fine to coarse brick or concrete pockets containing frequent reworked sandy siltstone or silty sandstone fine to coarse gravel was noted in locations TP118, TP132 and TP136.
0.15 / 2.0 (57.68 / 54.70)	0.6* / 3.1* (57.23* / 54.52*)	Interbedded CLAY & SILT	Interbedded firm becoming very stiff mottled grey to brown and silty CLAY and clayey SILT.
0.8 / 4.05 (56.51 / 52.88)	6.0 / 13.55 (51.37 / 43.38)	Interbedded MUDSTONE, SILTSTONE & SANDSTONE	Extremely weak to very weak reddish brown to dark grey interbedded occasionally laminated ferruginous MUDSTONE, SILTSTONE and SANDSTONE. Occasionally thin coal layers (lignite) and minor deposits encountered within the sandstone strata.
2.6 / 7.3 (54.77 / 49.12)	20.5* (36.63*)	Interbedded MUDSTONE, SILTSTONE & SANDSTONE	Weak reddish brown to dark grey interbedded laminated ferruginous MUDSTONE, SILTSTONE and SANDSTONE. Occasionally thin coal layers (lignite) and minor deposits encountered within the sandstone strata.

* - full depth of excavation

Geological cross-sections of the eastern part of the site are included within **Appendix D**. In general, the ground conditions encountered in the eastern portion of the site were similar to those in the west i.e. made ground over interbedded silts and clays of the mudstone, siltstone and sandstone of the Tunbridge Wells Sands at depth. The made ground encountered on the eastern portion of the site (and to the south of Building 3/36) was generally thicker than in the west extending to depths of <2 m over most of Phase 3.

Areas of deeper made ground were observed in the footprints of the larger demolished Buildings 15 and 42 in the central eastern area of the site, reaching 2.10 m and 2.20 m bgl

at WS111 and TP128 respectively. Deep made ground was also encountered within TP136 and TP132 to the full depth of the excavation at 2.30 m and 2.10 m respectively. Deeper made ground may be present in these areas where the base depth of made ground was not proven.

Concrete obstructions at depth were identified at locations outside of Phase 3, relating to foundations and slabs for an underground reservoir. Obstructions encountered within Phase 3 comprised a concrete footing in TP118 at 1.40-1.60 m bgl.

Made ground shallower than 1 m bgl was generally found outside of the former building footprints. Concrete hardstanding was encountered at or near surface within TP116, TP132, TP149 and TP151.

Additionally, one location, WS108 located ~40 m to the southeast of Building 3/36 encountered soft to firm slightly organic smelling clay. This clay extended to 1.8 m bgl in WS108. Organic odours were also noted in firm clays in TP116 from 1.20 to 2 m and WS106 from 0.47 to 0.52 m. Stiff blue clay was noted in TP123. These may be related to historical drainage features from the early 20th Century and/or the fact that the site was historically low lying.

Made ground was absent on the crest of the slope on the eastern boundary in locations B1, B2, B4 and TP139 and along the only machine accessible area on the northern boundary at TP130.

The desk study highlighted possible below ground tunnels and large service ducts, although these were not encountered during this phase of investigation.

Within Phase 3 the depth to rock head was shallowest in the northeast corner at ~55.70 m AOD (BH103) falling to ~54.60 m AOD in the central areas (BH102, BH104). Where encountered, the mudstone, siltstones and sandstones of the Upper Tunbridge Wells Sands were generally extremely weak to very weak at shallow depths, but generally strengthened to weak from depths below ~6 m bgl, although localised bands of extremely weak mudstones were also noted at depth.

4.3.1.1 Groundwater

Groundwater strikes were recorded in the following trial holes:

Table 7: Groundwater strikes in the eastern area, those outside Phase 3 are shaded grey

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TP116	1.2 (55.2)	Base of made ground	Moderate water seepage
TP117	1.4 (54.85)	Reworked sandy silty CLAY	Significant water seepage
TP118	1.2 (56.08)	Interface between made ground and reworked gravelly CLAY	Moderate water seepage
TP122	1.2 (55.65)	Made ground	Significant water seepage

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TP125	1.2 (54.77)	Made ground	Moderate water seepage
TP126A	2.1 (54.45)	Upper Tunbridge Wells Sand Formation	Slight water seepage encountered at the bottom of the pit
TP126B	1.3 (55.77)	Upper Tunbridge Wells Sand Formation Interface between CLAY and SILTSTONE	Moderate seepage encountered
TP127	0.6 (55.92)	Base of made ground	Slight water seepage encountered
TP128	1.2 (55.8)	Made ground	Moderate seepage encountered
TP128	1.85 (55.15)	Made ground	Significant water ingress encountered
TP131	2.9	Upper Tunbridge Wells Sand Formation. In SANDSTONE	Slight water seepage encountered at the bottom of the pit
TP132	1.0 (56.21)	Reworked SILTSTONE	Water ingress and standing water encountered. Water level rose from base of pit at 2.10 m to 1.60 m after 15 minutes
TP135	0.4 (56.19)	Made ground	Major water ingress encountered
TP136	1.6 (55.45)	Made ground	Moderate water seepage encountered. Water level rose from base of pit at 2.30 m to 1.80 m after 20 minutes
TP137	1.1 (55.26)	Made ground	Moderate water seepage encountered at 1.10 m. Water level rose from base of pit at 1.60 m to 1.40 m after 20 minutes
TP138	0.3 (56.04)	-	Slight surface water seepage encountered from northern face of pit
TP140	0.7 (56.00)	Made ground	Moderate water seepage encountered
TP142	1.0 (55.36)	Made ground	Moderate water seepage encountered
TP146	0.6 (56.68)	Made ground	Moderate water seepage encountered

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TP148	1.1 (56.21)	Upper Tunbridge Wells Sand Formation. In SILTSTONE	Moderate water seepage encountered
TP150	1.0 (56.63)	Upper Tunbridge Wells Sand Formation. In SANDSTONE	Moderate water seepage encountered
TP152	1.0 (55.52)	Made ground	Significant water ingress
WS107	1.4 (54.78)	Made ground	Groundwater encountered
WS110	0.2 (56.63)	Made ground	Water seepage
WS111	0.9 (56.25)	Made ground	Water seepage
WS116	0.3 (56.33)	Made ground	Water seepage
WS117	0.8	Made ground	Water seepage
BH101	5.5 (51.43)	Upper Tunbridge Wells Sand Formation. In SILTSTONE	Steady groundwater level upon completion.
BH103	1.3 (56.07)	Made ground	Groundwater seepage at base of hand-dug pit prior to drilling.
	3.2 (54.17)	Upper Tunbridge Wells Sand Formation.	Groundwater recorded at 3.20 m upon completion and at 2.20 m after 30 minutes.
BH104	16 (40.42)	Upper Tunbridge Wells Sand Formation.	Groundwater recorded at 16 m upon completion and at 13.70 m after 45 minutes.

Table 5: Groundwater strikes in eastern area during addendum works

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TP202	0.2 (56.34)	Made ground	Groundwater seepage
TP203	1.2 (55.78)	Made ground	Groundwater seepage
TP204	1.4 (57.07)	Made ground	Groundwater seepage
TT205	1.0 (54.78)	At base of made ground	Groundwater seepage
TT206	1.0 (54.87)	Made ground	Groundwater seepage
TT207	1.6 (54.79)	Made ground	Groundwater seepage
TT208	1.4 (54.77)	Made ground	Groundwater seepage
TT209	1.3 (55.64)	At base of made ground	Groundwater seepage
TT210	0.9 (55.95)	Made ground	Groundwater seepage

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TT211	1.5 (55.47)	Made ground	Groundwater seepage
TT212	0.65 (55.82)	Made ground	Groundwater seepage

The Eastern Area (Phase 3) recorded perched water within made ground soils and within granular beds (sandstones and siltstones) of the Upper Tunbridge Wells Sand Formation seepages were recorded. The deeper boreholes also encountered groundwater within the Upper Tunbridge Wells Sand Formation, which appear to be at shallower depths than that in the Western Area.

The groundwater monitoring results are as summarised as follows:

Table 9a: Groundwater monitoring results from LP2441, locations outside of Phase 3 are shaded grey

Location	Response Zone	Depth to groundwater m bgl (m AOD)						
		8-9 Feb-21	22-23 Feb-21	8-9 Mar-21	15 Mar-21	22 Mar-21	6 Apr-21	16 Apr-21
BH101D (56.93)	UTW	7.0 (49.93)	7.85 (49.08)	8.0 (48.93)	-	-	-	-
BH101S (56.93)	MG	0.95 (55.98)	1.20 (55.73)	1.35 (55.58)	1.3 (55.63)	1.2 (55.73)	1.2 (55.73)	-
BH102 (57.13)	UTW	14.6 (42.53)	14.1 (43.03)	14.3 (42.83)	-	-	-	-
BH103D (57.37)	UTW	14.4 (42.97)	14.4 (42.97)	14.5 (42.87)	-	-	-	-
BH103S (57.37)	MG/UTW	1.05 (56.32)	1.25 (56.12)	DRY	1.55 (55.82)	1.55 (55.82)	1.5 (55.87)	-
BH104 (56.42)	UTW	10.3 (46.12)	10.35 (46.07)	10.55 (45.87)	-	-	-	-
BH105 (56.31)	UTW	Not taken – equipment failure	12.15 (44.16)	12.15 (44.16)	-	-	-	-
BH106 (57.56)	UTW	16.5 (41.06)	16.4 (41.16)	16.65 (40.91)	16.6 (40.96)	16.53 (41.03)	16.65 (40.91)	16.8 (40.76)
WS102 (57.93)	UTW	1.05 (56.88)	1.00 (56.98)	1.7 (57.68)	1.3 (56.63)	1.6 (56.33)	1.8 (56.13)	-
WS103 (57.58)	MG/UTW	0.20 (57.28)	0.10 (57.38)	0.75 (56.83)	0.5 (57.08)	0.75 (56.83)	1.6 (55.98)	1.8 (55.78)

Location	Response Zone	Depth to groundwater m bgl (m AOD)						
		8-9 Feb-21	22-23 Feb-21	8-9 Mar-21	15 Mar-21	22 Mar-21	6 Apr-21	16 Apr-21
WS105 (57.16)	UTW	-	0.90 (56.26)	1.07 (56.15)	0.93 (56.23)	0.99 (56.17)	1.3 (55.86)	-
WS106 (57.23)	UTW	1.40 (55.82)	1.40 (55.82)	1.50 (55.72)	1.45 (55.58)	1.5 (55.53)	1.6 (55.43)	1.6 (55.43)
WS108 (55.91)	UTW	0.85 (55.05)	0.90 (55.00)	1.05 (54.95)	0.9 (55.01)	1.07 (54.84)	1.15 (54.76)	-
WS109 (56.79)	UTW	-	1.10 (55.68)	1.30 (55.48)	1.05 (55.74)	1.4 (55.39)	1.5 (55.29)	-
WS111 (57.15)	MG	0.70 (56.55)	1.10 (56.15)	1.20 (56.05)	Detected base ~ 1.25 (55.9)	DRY	DRY	-
WS113 (56.69)	UTW	0.95 (55.79)	1.25 (55.46)	1.65 (54.81)	1.32 (55.37)	1.6 (55.09)	1.8 (54.89)	-
WS115 (56.31)	UTW	0.30 (56.01)	0.70 (55.61)	1.50 (54.81)	0.67 (55.64)	0.86 (55.45)	1.2 (55.11)	-
WS116 (56.62)	MG/UTW	0.30 (56.32)	0.45 (56.17)	0.70 (55.72)	0.4 (56.22)	0.4 (56.22)	0.7 (55.92)	-
WS118 (56.51)	UTW	0.50 (56.01)	0.70 (56.50)	0.85 (56.35)	0.7 (55.81)	0.82 (55.69)	0.96 (55.55)	-

Table 9b : Groundwater monitoring results from LP2575, locations outside of Phase 3 are shaded grey

Location	Response Zone	Depth to groundwater m bgl (m AOD)			
		12 May 2021	25 May 2021	18 June 2021	24 June 2021
BH101D (56.93)	UTW	9 (47.93)	-	8.8 (48.13)	9 (47.93)
BH101S (56.93)	MG	-	-	1.2 (55.73)	1.25 (55.68)
BH102 (57.13)	UTW	14 (43.13)	-	13.38 (43.75)	14.1 (43.03)
BH103D (57.37)	UTW	15.4 (41.97)	-	14.35 (43.02)	14.4 (42.97)
BH103S (57.37)	MG/UTW	-	-	-	-
BH104 (56.42)	UTW	11.1 (45.32)	-	11.35 (45.07)	11.1 (45.32)
BH105 (56.31)	UTW	12.35	-	12.35	12.45

Location	Response Zone	Depth to groundwater m bgl (m AOD)			
		12 May 2021	25 May 2021	18 June 2021	24 June 2021
		(43.96)		(43.96)	(43.86)
BH106 (57.56)	UTW	16.6 (40.96)	-	-	-
WS102 (57.93)	UTW	-	1.8 (56.13)	-	-
WS103 (57.58)	MG/UTW	-	1.6 (55.98)	0.35 (57.48)	0.4 (57.43)

The full monitoring results are provided in **Appendix G**.

It should be noted that groundwater monitoring was undertaken during a period of wet weather and the winter months when groundwater levels can be expected to be at their highest.

The differences in groundwater levels between the deep and shallow monitoring well locations suggest that shallow and deep aquifers are not connected.

Based on groundwater elevations within the deep monitoring wells, groundwater within the Tunbridge Wells Sand Formations is indicated to flow towards the north-east. The hydrogeological characteristics of the Upper Tunbridge Wells Sand Formation are complicated by geological fault lines present within 800 m to the east and west of the site, and regionally the geology dips to the southwest and northwest, which may influence local groundwater flow.

4.3.1.2 Visual and olfactory evidence of contamination

Visual and olfactory evidence of contamination noted during the investigation works is summarised in the following table.

Table 10: Visual and olfactory evidence of contamination, locations outside of Phase 3 are shaded grey

Hole ID	Depth (m)	Olfactory Evidence	Visual Evidence
TP111	0.3-0.5		Black staining of natural clayey silt arisings
TP112	0.2-0.4		Black stained sand and gravel made ground fill
TP115	0.9-1.9	Moderate to strong organic 'manure' odour	
TP115	1.9		Partially black stained natural silt at surface of strata

Hole ID	Depth (m)	Olfactory Evidence	Visual Evidence
TP116	1.2-1.5	Faint organic odour	Black staining within natural clay
TP124	0.8-1.4		Black staining of reworked clay soils
TP126A	0.9	Moderate to strong organic 'manure' odour within natural silt soils	
TP126B	0.8		Black staining encountered within the made ground
TP146	0.45-0.6		Black staining encountered within the made ground
WS106	0.47-0.52	Slight organic odour within reworked clay soils	
WS108	0.3-1.6	Slight organic odour within natural clay soils	
WS115	0.3	Slight organic odour encountered within made ground soils	
TP202	0.3	-	Pinkish oily sheen noted at on groundwater surface within trial hole
TT205	1.0-1.2	-	Black stained clay

Non-aqueous phase product (NAPL) / strong hydrocarbon odours were not encountered in any of the trial holes. No elevated PID reading was recorded in any of the samples screened.

4.3.1.3 Other observations

On the 19 January 2021 ground gas was observed to be 'bubbling' from around the headworks of BH106 (the internal section of the cover was flooded during a period of heavy rain), and an audible flow could be heard when the valve was opened. A 'spot' reading was undertaken to initially characterise the gas concentrations emanating from the borehole. A flow rate of 104L/hr with 13.6% carbon dioxide, 0% methane and 1.0% oxygen concentrations were recorded. The gas flow rate was high for at least 24 hours, but was found to gradually decrease over 7 days, as the borehole was visually and acoustically monitored.

The high flow rates were only observed after a period of very heavy rain. The borehole was located away from known services and no voids were recorded when the borehole was drilled. The response zone for the monitoring well extended from 11.30 m to 20.30 m within the Upper Tunbridge Wells Sand Formation. A relatively thin layer of made ground ~0.50 m thick was encountered in BH106. An additional ground gas monitoring well (WS106) was installed within 2 m of BH106 to characterise the shallow ground gas conditions at this position.

During the Phase III site investigation the two lodge houses at the site entrance were demolished. The demolition included grubbing out of below ground foundations and a brick wall using heavy plant and machinery. This caused disturbance to otherwise natural ground.

Boggy soft wet ground was encountered at the surface within the footprint of former Building 12.

Table 11 below summarises obstructions encountered during this phase of investigation, locations outside of Phase 3 are shaded grey.

Table 11: Summary of obstructions encountered during investigation

Hole ID	Depth (m)	Comment
TP116	2.0	No further progress due to concrete slab obstruction encountered. Possible remnant foundation.
TP118	1.4-1.6	Concrete foundation footing encountered within the northern wall of the trial pit.
TP125	1.4	No further progress due to encountered obstruction within the made ground.
TP132	2.1	No further progress due to hard ground. Base of trial pit obscured by groundwater, not possible to confirm if due to concrete or refusal on natural ground.
TP136	2.3	No further progress due to hard ground. Base of trial pit obscured by groundwater, not possible to confirm if due to concrete or refusal on natural ground.
WS104	0.8	Borehole refused on an assumed concrete obstruction. Bottom of the pit not visible due to water ingress.
WS107	2.4	Borehole refused on an obstruction.
TT207	1.0-1.5	Concrete wall along full northern face of excavation with rebar extruding from the top surface. Aligned east to west.

Tunnels or voids were not encountered during this phase of investigation, however the presence of tunnels or voids across the site cannot be discounted.

The record of obstructions encountered during previous investigations by others is outlined below, and a summary of historical exploratory hole locations is provided in Drawing Ref: 3750851-LW-222-XX-D-G-22206-C01, **Appendix B**.

Table 12: Summary of obstructions encountered during previous investigations, locations outside of Phase 3 are shaded grey

Hole ID	Investigation	Depth (m)	Comment
WS19A	SKM July 2013	0.55	Terminated due to concrete at base of inspection pit.
WS20	SKM July 2013	1.0	Terminated due to obstructions in sides and base of inspection pit.
WS22	SKM July 2013	0.65	Terminated due to dense gravel and obstruction at the base.
WS24	SKM July 2013	0.4	Terminated due to concrete obstruction.
WS25	SKM July 2013	0.55	Terminated due to concrete obstruction.
WS29	SKM July 2013	0.6	Terminated due to concrete obstruction.
WS39	SKM July 2013	0.6	Terminated due to brick and concrete obstructions.
WS39A	SKM July 2013	0.9	Terminated due to brick and concrete obstructions. Second attempt at WS39.
WS45	SKM July 2013	0.7	Concrete obstruction recorded across base of the inspection pit. Pit extended but the obstruction continued.
WS60	Jacobs October 2014	0.3	Concrete with rebar noted across the base of the inspection pit.
WS60A	Jacobs October 2014	0.5	Concrete with rebar noted across the base of the inspection pit.
WS61	Jacobs October 2014	0.75	A metal obstruction encountered.
WS70	Jacobs October 2014	1.0	Concrete noted across the base of the pit.
TP35	KDC June 2016	3.7	Trial pit terminated due to two concrete sidewalls encountered causing restricted excavator bucket movement.
TP47	KDC June 2016	0.8	Trial pit terminated upon reaching an obstruction visually described as a concrete slab. Potential cover of a rainwater drain.
TP-CP1	KDC June 2016	1.2-1.5	Encountered an obstruction noted as rows of bricks, possible former oil storage tank foundation.

5 GEO-ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT

5.1 Revised conceptual site model

5.1.1 Introduction

The site has historically been used for the research and development of pharmaceuticals and has been the subject of numerous investigations, which were undertaken both pre and post demolition of the buildings. The reports were summarised in depth in the LEAP Phase I Desk Study. The resulting site conceptual model is summarised below:

Identified as potential risks to human health:

- petroleum hydrocarbons were found by others in former areas of storage/use and these were compared to conservative assessment criteria and in some cases, excavated and removed from site. Resulting excavations were backfilled with either site won or imported clean materials. Residual petroleum hydrocarbons may still be present in these areas or in areas not yet investigated
- heavy metals. Elevated concentrations of arsenic and lead were recorded in made grounds soils across the site pre demolition. Post demolition across the whole site KDC 2015/2016 reported arsenic, lead, beryllium and copper have been recorded at concentrations above residential land use screening criteria
- asbestos was identified in soils pre and post demolition – although generally limited in extent
- ground gas generation. There is the potential for backfilled material on site (former clay pit backfilled areas) to generate gas, although the evidence to date suggests the site backfill is not significantly organic nor subject to degradation. However off-site sources of backfill have been identified and whilst the risk is considered to be low, there is still the potential for off-site gas to migrate to site
- potential asbestos, metals, PAHs, petroleum hydrocarbons, BTEX, VOCs and SVOCs from site use for pharmaceutical production in areas not previously identified.

Identified as potential risks to controlled waters:

- contaminants that have the potential to compact controlled waters include metals, PAHs, petroleum hydrocarbons, BTEX, VOCs and SVOCs. Previous investigations have included groundwater risk assessment and concluded that the risk to controlled water is very low. However, this assessment may need revising to consider continuity between perched and deeper aquifer if further contamination is identified.

Section 3 presents the Preliminary CSM and states that the risk to offsite controlled water receptors (groundwater and surface water) from onsite groundwater is low. The only plausible source pathway linkage to offsite controlled water receptors is via a preferential pathway from site drains that extend through the site and connect to the Horsham Pond 800 m to the southwest.

5.2 Human health risk assessment

5.2.1 Rationale and approach

The generic quantitative risk assessment (GQRA) for human health was conducted in line with the CLEA methodology by comparing the soil analytical results from the ground investigation with Generic Assessment Criteria (GAC). The GACs were selected using the rationale and assumptions provided in **Appendix L**.

Sets of soil GACs are available for SOMs of 1%, 2.5% and 6%. Using the conversion of $SOM = TOC \times 1.72$.

Table 13: Total organic carbon and soil organic matter ranges for soil populations

Population	No. of Samples	TOC Range (%)	SOM Range (%)
Topsoil	2	0.48 – 1.70	0.83 - 2.92
Made Ground	43	0.13 – 2.80	0.22 – 4.82
Reworked	3	0.69 – 1.0	1.19 – 1.72
Natural	3	0.06 – 0.83	0.10 – 1.43

Sets of GACs have been generated for SOMs of 1%, 2.5% and 6%. In this case the TOC in the Made Ground samples that were analysed averaged 1.6%. Using the conversion of $SOM = TOC \times 1.72$, this equates to a SOM of around 2.7% therefore 2.5% SOM was considered to be appropriate to maintain conservatism.

Table 13 above summarises the sampling from the Phase III investigations, samples from the additional investigation to target areas previously remediated did not test the TOC and SOM within the samples.

5.2.2 Soil sampling results

The soils that were analysed within the Phase 3 area comprised 43 made ground, 3 reworked, 3 natural soils and 2 topsoil samples. A further 11 samples were tested for targeted contaminants of concern in the follow up works. The laboratory analytical results were assessed to determine the potential risks to future site users under a generic residential land use scenario assuming that homegrown produce are consumed (resi HGP) and a generic public open space land use adjacent to residential properties (POS resi), if required. The laboratory certificates are provided in **Appendix E**, which have been screened against GACs in the **Appendix F**. A summary table is provided in Table 14 below.

Table 14: Summary of soil contamination test results (Phase 3 only)

Determinand	Number of samples	Number >LOD	Maximum Conc. (mg/kg unless otherwise stated)	Generic Assessment Criteria resi HGP 2.5% SOM (mg/kg)	Number of Exceedances	Locations of Exceedances (m bgl)
METALS						
Arsenic	50	50	44.3	37	1	TP146 – 0.20 m
Cadmium	50	6	3.5	22	0	
Chromium	50	50	87.5	910	0	
Hexavalent Chromium	50	0	0.8	21	0	
Copper	50	50	139	2,400	0	
Lead	50	45	613	200	5	TP127 – 0.20 m TP128 – 0.10 m TP140 – 0.10 m TP141 – 0.10 m WS113 – 0.70 m
Mercury ¹	50	0	0.8	40	0	
Nickel	50	50	60.3	130	0	
Selenium	50	0	-	250	0	
Zinc	50	50	446	3,700	0	
ASBESTOS						
Asbestos	52	1	n/t	n/a	1	TP113 – 0.10 m
HYDROCARBONS						
Benzo(a)pyrene	50	14	14	5.0	2	BH104 – 0.50 m TP141 – 0.10 m
Naphthalene	50	1	0.2	5.3	0	
Total PAHs	50	21	121	n.v.	n/a	n/a
Total petroleum hydrocarbons	21	14	833	n.v.	0	n/a
OTHERS						
Poly Chlorinated	8	1	0.3	n.v.	0	(detected at LOD TP108 – 2 m)

Determinand	Number of samples	Number >LOD	Maximum Conc. (mg/kg unless otherwise stated)	Generic Assessment Criteria resi HGP 2.5% SOM (mg/kg)	Number of Exceedances	Locations of Exceedances (m bgl)
Biphenols (PCBs)						
VOC & SVOCs	2	no significant detections			0	TP115 TP126A
Phenols	2	No >LOD			0	

Notes to table

1. Assessment criterion based on methyl mercury
2. As n.v. – no appropriate value

5.2.2.1 Heavy metals

Of the 50 samples tested for heavy metals, 1 sample recorded arsenic and 5 samples recorded lead at concentrations above residential land use GACs. All exceedances were associated with made ground at the site.

The arsenic was reported above limit of detection for all 50 samples, with one minor exceedance at 44.3 mg/kg of the resi HGP. This exceedance is comfortably below the Public Open Space (resi) C4SL GAC of 79 and just below the C4SL GAC for allotments of 49 mg/kg.

The lead was reported above limit of detection for 45 of 50 samples at the site, with 5 samples exceeding the GAC for resi HGP. These exceedances are below the Public Open Space (resi) C4SL GAC of 630 mg/kg.

Samples collected from 'natural' soils did not record metal contaminants at concentrations above the soil screening criteria.

5.2.2.2 Asbestos

52 samples from the current investigations were screened for the presence of asbestos containing materials and/or loose asbestos fibres.

Asbestos was detected in one sample, namely chrysotile bitumen in TP133 at 0.10 m. In a previous investigation by LEAP (August 2020), no asbestos was found and investigations carried out previously by others post-commencement of demolition recorded 11 positive asbestos identifications.

No visual signs of ACM were noted at surface during this phase of the investigation. On the basis of the visual inspections and laboratory testing, the risk of ACM contamination of surface ground resulting from the security breaches and removal of valuable metals from the retained building noted by WSCC in Section 2.2 is not considered to be significant.

5.2.2.3 Petroleum and Polyaromatic Hydrocarbons

Speciated PHC testing split by aromatic and aliphatic fractions and by carbon chain length, was carried out on 10 samples taken from made ground, reworked soils and natural deposits. The rationale for the analysis was based on olfactory or visual signs of hydrocarbons, noting that non-aqueous phase liquids, tars, heavy oil or strong hydrocarbon odours were not observed in any of the trial holes excavated during this phase of investigation.

A summary of total petroleum hydrocarbon concentrations detected is summarised below:

Table 15: Summary of petroleum hydrocarbon results

Matrix	Exploratory location and depth	Total >C5-C40 Aliphatic/Aromatic concentration (mg/kg)
Made ground	<i>TP124 – 0.90 m</i>	<i>1.5</i>
	<i>TP131 – 0.30 m</i>	<i>210</i>
	<i>TP150 – 0.30 m</i>	<i>24</i>
	<i>TP151 – 0.70 m</i>	<i>47.1</i>
	<i>TT208 – 0.50 m</i>	<i>1.2</i>
	<i>TT206 – 0.75 m</i>	<i>8.5</i>
	<i>TP204 – 2.80 m</i>	<i>833</i>
	<i>TP203 – 1.40 m</i>	<i>169</i>
	<i>TT214 – 0.40 m</i>	<i>15.7</i>
	<i>TT212 – 1.40 m</i>	<i>9.2</i>
	<i>TT209 – 1.20 m</i>	<i>124</i>
	<i>TT211 – 1.80 m</i>	<i>17.4</i>
Reworked Clay	TP117 – 0.60 m	387
Silt	TP126A – 1 m	1.1

Notes to table

1. Values in italics relate to samples located in the proposed commercial use area.

In all samples tested, none of the PHC fractions exceeded the resi HGP GAC.

Sample TP131 0.30 m contained blacktop fragments. No BTEX compounds were recorded at concentrations above the analytical limits of detection in any of the samples tested.

It should also be noted that the Phase III works comprised non targeted testing across the site to provide information on post demolition ground conditions, and did not specifically target areas where hydrocarbons had previously been encountered, nor where remediation of grossly impacted soils was known to have occurred. However, where trial holes coincided with these areas evidence of PHC was not recorded.

The additional investigation targeted areas previously remediated by KDC, PHC exceeding resi HGP GAC were not detected during this follow up work within the Phase 3 area.

5.2.2.4 Poly chlorinated biphenyls (PCBs)

PCB sampling followed the non-targeted approach with testing from Phase 3 on the following trial pits; TP125, TP127, TP126A, TP131, TP148. Although, TP131 and TP125 coincide with areas indicated in previous reports to contain electrical substations/transformers.

Five samples from Phase 3 were tested for total PCB content for waste classification purposes; none within Phase 3 had PCB exceeding the analytical limit of detection.

5.2.2.5 VOCs and SVOCs

One sample at TP126A was tested for the presence of VOCs and SVOCs. No VOCs above the 10 µg/kg detection limit were recorded. Several SVOCs were detected above analytical limits of detection, most of which related to PAH compounds and were not at concentrations above relative assessment criteria for their marker compounds for a residential end use.

5.2.2.6 Phenols

Speciated phenols were tested in two samples collected from an area of ground associated with former firewater runoff storage tank. No speciated phenols were detected at concentrations above analytical detection limits

5.2.3 Human health risk assessment

This investigation found that the made ground and reworked soils beneath the site are locally impacted with arsenic, lead and benzo(a)pyrene when compared with screening levels for a residential land use. Drawing Ref: 3750851-LW-241-XX-D-G-24101-C01, **Appendix B** highlights sample locations with contaminants above a residential GAC. Asbestos was identified in one location.

Previous investigations by KDC Contractors Ltd in 2015/16 also identified elevated concentrations of arsenic, beryllium, lead, copper and benzo(a)pyrene for a residential land use and asbestos in onsite soils. KDC has previously remediated PHC hotspots and these areas were targeted in the additional investigation and no exceedances for PHC were identified within Phase 3.

These determinands pose a risk to residential land users in uncapped areas i.e. gardens or soft landscaping. Contamination may impact human health through the direct ingestion, inhalation, skin contact and/or plant uptake pathways that would be present in a residential setting.

PAHs and PHC contamination may pose a risk to incoming water via permeation into the supply lines. LEAP has not been made aware of the proposed locations of services. The use of protective water supply infrastructure may be required by the water supplier if water services are to be placed within the made ground soils on site.

Some remediation to eliminate human health risk from potential asbestos fibres, heavy metals and benzo(a)pyrene would be required within all soft landscaped areas (private gardens and public open space) – See Section 5.7. A remediation strategy addressing these areas will also be required.

There remains the possibility that as yet unidentified contamination may be present, particularly north and south of the retained building where below ground services restricted investigations within these areas; including the possible below ground interceptors and historically decommissioned fuel storage tanks.

5.3 Controlled waters risk assessment

5.3.1 Groundwater risk assessment

5.3.1.1 Rationale and approach

The risk assessment for controlled waters follows the principles as set out by the EU Water Framework Directive (WFD) (2000/60/EC)⁶ as implemented via domestic regulations and guidance. WFD covers aspects of groundwater and surface water protection as well as drinking water supply policy. WFD sets out to 'Prevent' the input of hazardous substances into groundwater, and 'Limit' the entry of non-hazardous pollutants. This is to prevent deterioration in the status of groundwater bodies and to prevent sustained, upward trends in pollutant concentrations in groundwater.

The Environment Agency's Land Contamination Risk Management (LCRM)⁷ sets out the overarching process of risk assessment, including for controlled waters, with a tiered approach from initial risk assessment, options appraisal, through to remediation and verification. The methodology is supported by "The Environment Agency's approach to groundwater protection" (EA, 2018)⁸ and the associated guidance "Land contamination groundwater compliance points: quantitative risk assessments (EA, 2017)⁹.

The assessment completed below directly compares measured concentrations of groundwater samples against selected standard assessment criteria (WQS). Careful consideration is required to select the most appropriate WQS based on the controlled water receptor and the potential for hydraulic continuity between surface water and groundwater. The water quality standards (WQS) were selected using the rationale and assumptions provided in **Appendix M**.

Where the assessment below identifies exceedances of WQS, more detailed assessment would be required to determine if remediation is necessary. This may include the consideration of contaminant fate and transport, together with the technical feasibility of remediation and sustainability of remedial works.

⁶ Water Framework Directive 2000/60/EC.

⁷ Environment Agency. Land Contamination Risk Management (LCRM). <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁸ The Environment Agency's approach to groundwater protection, Version 1.2, February 2018

⁹ Land contamination groundwater compliance points: quantitative risk assessments, March 2017

5.3.1.2 Groundwater sampling results

Three rounds of groundwater monitoring of the deep groundwater wells installed within BH101-BH106 were undertaken between 8 February and 9 March 2021. BH105 and BH106 lie outside of the Phase 3 area of the development, and have been omitted within the discussion below. A single shallow groundwater sample was collected from BH101S on 6 April 2021, to ascertain if the phenol and xylene recorded in BH101D was from a shallow source. A summary of the recorded contaminant concentrations and the Tier 1 assessment criteria within Phase 3 are summarised below.

Table 16: Summary of groundwater test results above Tier 1 assessment criteria

Determinant (Total, unless otherwise specified)	Measured Range (µg/l)	Tier 1 Assessment Criteria (µg/l)		Samples that exceed Tier 1 Criteria
		UK Drinking Water Standard ² or other relevant standard as indicated	Annual Average Environmental Quality Standard	
METALS				
Copper	<5-13	2,000	1(bio)	BH101D 1 st round only BH101S
Mercury	<0.1-0.3	1	0.07	BH101D 1 st round BH101S
Nickel	<5-46	20	4 (bio)	BH101D All rounds BH102 2 nd and 3 rd round BH104 1 st and 2 nd round BH104 3 rd round BH101S
Zinc	<5-21	5000	10.9	BH102 3 rd round BH104 All rounds
Cyanide	<5-18	50	1	BH101S
PHC				
Total Petroleum Hydrocarbons (TPH)	<5 – 357	10 ⁻⁴		BH101D 2 nd and 3 rd Monitoring round BH101S
Phenols	<1 – 392	-	7.7	BH101 All rounds

Determinant (Total, unless otherwise specified)	Measured Range (µg/l)	Tier 1 Assessment Criteria (µg/l)		Samples that exceed Tier 1 Criteria
		UK Drinking Water Standard ² or other relevant standard as indicated	Annual Average Environmental Quality Standard	
PAHs				
Benzo(a)pyrene	<0.1 – 0.01	0.01	0.00017	BH101D 2 nd monitoring round BH101S
BTEX				
Xylenes ⁶	<1 – 75.3	3	30	BH101D 2 nd and 3 rd rounds BH101S
Others				
pH	6.1-12.4	6.5-9.5	6-9	BH101D All rounds BH101S BH104 2 nd and 3 rd round

Notes to Table

1. Range in Assessment criterion representing variation in dissolved CaCO₃ within waters
2. UK Drinking Water Standards, unless otherwise stated
3. WHO drinking water objective 2017 (2008 for petroleum hydrocarbons)
4. Assessment Criterion based on former target concentration for dissolved or emulsified hydrocarbons – now withdrawn.
5. Values in *italics* exceed UK EQS, values in **bold** exceed UKDWS
6. EA 2017 Hazardous substances to groundwater: minimum reporting values

Nickel was marginally above UK DWS in BH104 in the first two monitoring rounds and in BH101 (shallow).

Total TPH was recorded above a withdrawn screening criterion of 10 µg/l in BH101 (deep) during the second and third monitoring rounds (values ranging from 76.3 µg/l to 357 µg/l) and in BH101 (shallow) in the single sampling round (126 µg/l), but below published WHO TPH guidance values for speciated petroleum hydrocarbons in all samples tested.

Xylene was reported above an indicative minimum reporting value of 3 µg/l in BH101 (deep) in the second and third monitoring rounds (72.4 to 75.3 µg/l) and BH101 (shallow) (28 µg/l) only.

Benzo(a)pyrene was reported at analytical detection limit (0.01 µg/l) in BH101 (deep) on the second monitoring round and BH101 (shallow) during the additional monitoring round.

Potential contaminants that exceeded the published UK Environmental Quality Standards are copper (BH101D/BH101S), mercury (BH101D/BH101S), nickel (BH101D/ BH101S, BH102, BH104,), and zinc (BH102, BH104).

Phenol was detected above UK EQS in BH101D during all monitoring rounds, but not in the single shallow ground water sample collected from BH101S.

pH values fall outside of the published UKDWS or UKEQS ranges for groundwater sampled in BH101D/S and BH104.

5.3.1.3 Groundwater risk assessment

Previous investigations recorded some potential contaminants of concern at elevated concentrations above screening criteria in the shallow perched aquifer. Previous investigations discounted a risk to groundwater and did not investigate the groundwater quality of the deeper aquifer. This investigation has found that there is a shallow perched groundwater towards the base of the made ground layer, but also groundwater seepages in the upper layers of the Upper Tunbridge Wells Sand Formation (generally between 1-2 m bgl). However, there are differences between recorded groundwater elevations in the deep and shallow monitoring wells, which imply that there is limited connectivity between the shallow and deeper groundwater bodies and the weathered clays and silts at the top of the bedrock may limit vertical migration of potential contaminants of concern.

With respect to risks to the deep aquifer BH105 and BH106 located west of the Phase 3 area of the development are within the Secondary A Aquifer of the Tunbridge Wells Sand - sandstone and mudstone. BH101-BH104 are in the eastern half of the site (Phase 3), within the unproductive aquifer of the Tunbridge Wells Sand – mudstone.

The groundwater laboratory tests recorded nickel at concentrations above UK Drinking Water Standards in two locations in Phase 3 namely BH104, and BH101S. Nickel was reported at a concentration of 21 and 28 µg/l in BH104 and 46 µg/l in BH101S compared with the screening value of 20 µg/l. Nickel was not detected above UK DWS in BH101D. Soil testing of shallow made ground or reworked soils at these locations did not report nickel concentrations in soils above normal background concentrations (42 mg/kg) suggesting that a significant soil source is not present at these locations.

BH104 and BH101S are located in an area where the bedrock is mapped as unproductive strata. On the basis of marginal exceedances, low sensitivity of the aquifer (mapped as an unproductive aquifer) and absence of potable water abstractions proximal to the site, nickel is not considered to pose a significant risk to groundwater receptors.

Total TPH was detected marginally above the withdrawn screening criteria of 10 µg/l in BH101 shallow and deep (ranging between 79.3 to 357 µg/l). The TPH fractions were at concentrations below published WHO TPH guidance values. Given that the groundwater in the eastern half of the site is mapped as an unproductive aquifer, a non-aqueous phase liquid (NAPL) was not identified and exceedances of WHO TPH guidance values were not reported, the petroleum hydrocarbons reported in BH101S/D are not considered to pose a significant risk to groundwater receptors.

Xylene was detected at concentrations above the published UK Minimum Reporting Value (MRV) of 3µg/l in BH101D and BH101S, higher concentrations were reported in the deeper monitoring well (BH101D) with concentrations ranging from 72.4 to 75.3 µg/l compared to 28 µg/l in BH101S.

BH101 is located beneath a former firewater runoff storage reservoir and to the north of a diesel storage area that has been remediated by others. The exploratory holes excavated by LEAP at BH101 and to the north, west and south of the location (TP145-TP146) did not describe the presence of NAPL, malodours or significantly discoloured soils that may be a source of the xylene present in groundwater at BH101D/S. MRV are used for the protection of groundwater as a long term drinking water resource, the eastern half of the site is highly unlikely to be used for potable water supply.

On the basis of the above, the xylene concentrations reported in BH101D/S are not considered to pose a significant risk to groundwater receptors on the basis that an ongoing source is unlikely to be present, the aquifer is of low sensitivity (mapped as an unproductive aquifer), and the absence of potable water abstractions / source protection zones in the vicinity of the site and the other deep monitoring wells did not detect xylene.

Benzo(a)pyrene was detected at analytical detection limit (0.01 µg/l) in BH101D/S. The low concentration of this polycyclic aromatic hydrocarbon is not considered to pose a risk to groundwater receptors.

In summary, a soil source of nickel, PHC, xylene or benzo(a)pyrene was not identified in the locations where exceedances of groundwater Tier 1 screening criteria were identified. Although present in groundwater the risk is not considered significant to offsite groundwater receptors and groundwater remediation is not proposed.

We note that there are no published UKDWS for phenol, however phenol was reported at elevated concentrations in BH101D in all three monitoring rounds. It was not detected in shallow groundwater at BH101S. An onsite source of the phenol was not identified during this investigation and the risk to groundwater is not considered significant.

5.3.2 Surface water risk assessment

5.3.2.1 Surface water methodology

The generic controlled waters risk assessment was conducted in accordance with the principles of EA 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006 (EA 2006) and the 'prevent and limit' approach of the Water Framework Directive (2000/60/EC). Generic controlled waters risk assessments compare directly measured concentrations with standard assessment criteria.

Appropriate Water Quality Standards (WQS) are selected based on both a hierarchy of relevance to England and Wales and the receptor. In this case, the Horsham Pond located approximately 800 m is an offsite receptor, if a preferential pathway via onsite drains is active and so the following hierarchy of WQS were considered to be appropriate:

Surface Water

Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The metal-bioavailability tool (MBAT) has been used to calculate site specific predicted no effect concentration (PNEC) for the Horsham Pond, based on measured pH, dissolved organic carbon and dissolved calcium concentrations at the Horsham pond using pH = 7.1, DOC = 11 mg/l and calcium = 61 mg/l.

Benzo(a)pyrene has been adopted as a surrogate marker compounds for polycyclic aromatic hydrocarbons, as per Environment Agency guidance .

In the case of petroleum hydrocarbons, no current UK standard is available, so an initial assessment criterion of 10µg/l, based on the former target concentration for dissolved or emulsified hydrocarbons, is considered to represent a conservative tier 1 screening value for total petroleum hydrocarbons.

5.3.2.2 Surface water sampling results

The results of the laboratory analysis for samples collected from the surface sampling locations are summarised in Table 17, below. Laboratory test certificates are provided in **Appendix E**.

Table 17: Summary of water samples that exceeded UK EQS

Determinant (Total, unless otherwise specified)	Measured Range	Annual Average Environmental Quality Standard	Samples that exceed assessment criterion
Chromium (total)	<5 -40 µg/l	3.4 µg/l	LWS1 11 µg/l LWS2 31 µg/l LWS3 40 µg/l LWS4 23 µg/l
Zinc	<5-46 µg/l	39 µg/l (PNEC)	LWS6 46 µg/l
pH	6.6-11.3	6-9	LWS2 9.4 LWS3 10.1 LWS4 11.3
Benzo(a)pyrene	<0.01 to 3.02 µg/l	0.00017 µg/l	LWS1 0.44 µg/l LWS2 3.02 µg/l LWS3 0.22 µg/l LWS4 1.36 µg/l LWS5 0.02 µg/l LWS7 0.02 µg/l LWS11 2.58 µg/l
>C10-C12 Ali TPH	<5 – 38.9 µg/l	-	LWS2 12.2 µg/l LWS11 38.9 µg/l
>C12-C16 Ali TPH	<5-172 µg/l	-	LWS2 31.3 µg/l LWS7 8.2 µg/l LWS11 172 µg/l

Determinant (Total, unless otherwise specified)	Measured Range	Annual Average Environmental Quality Standard	Samples that exceed assessment criterion
>C16-C21 Ali TPH	<5-235 µg/l	-	LWS2 56.8 µg/l LWS8 5.1 µg/l LWS11 235 µg/l
>C21-C35 Ali TPH	<5-712 µg/l	-	LWS2 481 µg/l LWS8 87.7 µg/l LWS10 15.6 µg/l LWS11 712 µg/l
>C35-C40 Ali TPH	<5-124 µg/l	-	LWS2 55.2 µg/l LWS8 13.2 µg/l LWS11 124 µg/l
>C7-C8 Aro TPH	<1-1.30 µg/l	-	LWS9 1.3 µg/l
>C10-C12 Aro TPH	<5-23.9 µg/l	-	LWS2 13.7 µg/l LWS11 23.9 µg/l
>C12-C16 Aro TPH	<5-126 µg/l	-	LWS2 28.1 µg/l LWS7 7.1 µg/l LWS11 126 µg/l
>C16-C21 Aro TPH	<5-228 µg/l	-	LWS2 62.4 µg/l LWS4 5.7 µg/l LWS9 5.1 µg/l LWS11 228 µg/l
>C21-C35 Aro TPH	<5-765 µg/l	-	LWS1 29.6 µg/l LWS2 656 µg/l LWS4 81.8 µg/l LWS11 765 µg/l
>C35-C40 Aro TPH	<5-224 µg/l	-	LWS2 199 µg/l LWS4 40.6 µg/l LWS11 224 µg/l

The drain and surface water sampling identified total chromium at concentrations above the UK EQS screening value for chromium VI, in three locations on site and one upgradient off site location. All off site sampling points did not record elevated concentrations above UK EQS. We note that chromium VI was also analysed, but the analytical limit of detection (100µg/l) was above screening criteria. In all samples tested chromium VI was not detected above LoD.

Zinc was detected at concentrations above site specific predicted no effect concentration (PNEC) for the Horsham Pond in one sample only, at LWS6, located on the eastern railway embankment. No offsite sampling locations exceeded the PNEC.

Alkaline pH readings outside of the UK EQS acceptable range limits were identified in three locations on site, namely LWS2, LWS3 and LWS4. LWS2 is located upgradient of a blocked section of the north to south surface water drain and manhole covers were missing on LWS3 and LWS4.

Benzo(a)pyrene (used as a marker for other PAHs) is above analytical detection limits in all on site sampling locations, with the exception of LWS6, located on the eastern railway embankment. The highest concentrations were recorded in LWS2 (3.02µg/l) and LWS4 (1.36 µg/l). LWS2 is upgradient of a blocked section of the north to south surface water drain and LWS4 appears to be a redundant chamber that connects into the surface water drain. The upgradient sampling point LWS1 records benzo(a)pyrene at 0.44µg/l. Offsite the drainage ditch to the north of the Collyer's College playing field records benzo(a)pyrene at marginally above analytical detection limits (0.02 µg/l compared with 0.01 µg/l). All other down gradient monitoring points record benzo(a)pyrene at concentrations at less than analytical detection limits, with the exception of the Horsham Pond, where benzo(a)pyrene is at 2.58µg/l.

With respect to PHC, aliphatic and aromatic fractions are most commonly detected at concentrations above analytical detection limits in LWS2 (up gradient of a blocked section of the drain) and in LWS11, the Horsham Pond. The Horsham Pond records the highest concentrations of TPH aliphatic / aromatic fractions out of all sampling locations. The offsite, downgradient sampling locations (LWS7-LWS10) record aliphatic / aromatic fractions slightly above analytical detection limits, with the exception of LWS8, at the southern end of the Collyer's College playing field where 87.7 µg/l >C21-C35 Aliphatic TPH was recorded. Sampling locations further down gradient of LWS8 (excluding the pond) do not detect >C21-C35 or only at concentrations marginally above LoD.

5.3.2.3 Surface water risk assessment

The CSM identified a plausible preferential pathway via the surface water drains that extend through the eastern half of the site and connect to the Horsham Pond ~800m to the southwest of the site. However, this did not appear to be active.

The 2018 and 2021 CCTV surveys identified blockages, damaged sections and unmarked connections into the two surface water drains that extend through the site. The decommissioned drain mapped aligned northeast to southwest was not located. This may well have been 'grubbed' out as part of the demolition works, although this was not recorded on the KDC surveys made available to LEAP.

Elevated contaminants of concern in the onsite sampling locations were predominantly hydrocarbons, both aliphatic and aromatic PHC and PAHs. The surface water drain to the east of building 36 is locally contaminated at LWS2, but down gradient of this at LWS3 the PAH and TPH loading is much lower, suggesting that either the blockage is preventing the hydrocarbons impacted water moving downstream or it is leaking onto site.

LWS4 appears to be part of a redundant drainage system and is also locally contaminated. It was initially thought to be part of the decommissioned surface water drain. However, overlaying the Southern Water plans onto the 2020 GPR utility survey implies that it is not related to the old network. Notwithstanding this the 2021 CCTV survey shows that it discharges into the Southern Water surface water drains.

In the down gradient off-site monitoring locations most locations recorded TPH aliphatic / aromatic fractions and PAHs at less than analytical limits of detection. Where detected they were at considerably lower concentrations than the onsite sampling locations. This shows that the hydrocarbons detected in onsite sampling locations are not significantly impacting the offsite sampling points.

The Horsham Pond records high concentrations of PAHs and TPH, but based on the sampling upgradient of the pond it does not appear to have been contaminated from the Horsham Enterprise Park. We note there have been pollution incidents from Horsham Hospital that have previously impacted the pond.

5.4 Ground gas risk assessment

5.4.1 Rationale and approach

5.4.1.1 Ground gases assessment methodology

An initial assessment has been made using the method outlined in BS8485:2015. Gas concentrations and borehole flow rates are combined to provide gas screening values (GSV) for both carbon dioxide and methane. In this assessment the highest concentrations per monitoring well have been combined with the highest flow rates to provide a conservative Tier 1 assessment.

A gas screening value is assigned to the site / zone in conjunction with the conceptual site model and typical gassing levels associated with the identified source to characterise the gassing regime. Appropriate design protection measures are recommended in line with BS8485:2015.

We note that at this stage building designs plans have not been made available, as such proposed foundation designs, floor space areas, cut / fill assumptions are not known. These influence the outcome of the assessment and the type of design measures that may be required.

For the purpose of this assessment, we have assumed that the buildings on Phase 3 will be Type A structures (residential dwellings), as detailed in Table 3 of BS8485:2015+A1:2019.

We assume that residential structures within Phase 3 due to deep made ground will be founded on a CFA piled solution with a reinforced cast *insitu* suspended floor slab with minimal penetrations and buildings do not include basement structures.

When the foundation design is known the land gas risk assessment should be reviewed by a competent environmental consultant to check that the assumptions contained herein are aligned with the detailed design plans.

5.4.1.2 Vapour assessment methodology

If volatile organic compounds are detected at concentrations above analytical limits of detection in the laboratory testing a quantitative assessment will be undertaken to determine the potential significance to future land users. Results detected above analytical detection limits will be screened against tolerable indoor air concentrations (TAC_{indoor_air}).

$TAC_{\text{indoor_air}}$ are concentrations at which volatile vapours are considered not to pose a significant risk of harm to end-users in an indoor space. The comparison of measured VOCs against $TAC_{\text{indoor_air}}$ is a conservative assessment as it does not assume attenuation between the source and indoor air space.

Tolerable indoor air concentrations ($TAC_{\text{indoor_air}}$) have been calculated using the inhalation Health Criteria Values (HCV) and adult inhalation Mean Daily Intakes (MDI) used by SoBRA to calculate groundwater inhalation Generic Assessment Criteria (GAC).

The CLEA generic residential land use scenario was considered to be an appropriately conservative scenario. As such, the inhalation HCV were converted from $\mu\text{gkg}^{-1}\text{BW day}^{-1}$ to $\mu\text{g day}^{-1}$ by multiplying the HCV by 13.3 kg, which is the average body weight for a female across CLEA Age Classes AC1 to AC6 in the CLEA Software v1.071. The inhalation MDI for female children AC1 to AC6 was calculated by first determining the conversion factor of the inhalation rate for each Age Class from an adult inhalation rate of 20 m³, as described in Table 3.4 of SR2¹⁰. The average conversion factor across the six Age Classes was then applied to the adult inhalation MDI to calculate an average female child inhalation MDI for AC1 to AC6. The child inhalation rates selected were the updated ones used in the C4SL programme and also by SoBRA to calculate the groundwater inhalation GAC. The values are provided as a standard option in the CLEA Software v1.071.

The average daily exposure (ADE) was calculated as described in SR2. The MDI was subtracted from the HCV where it was threshold tolerable daily intake (TDI), unless the MDI was $\geq 50\%$ TDI, in which case the ADE was set at 50% of the TDI. For non-threshold effects, the MDI was not subtracted i.e. $HCV = ADE$.

Finally, the ADE was converted to an indoor air GAC. The ADE was divided by the average inhalation rate across AC1 to AC6 (8.767 m³day⁻¹) and converted for the daily building occupation period for the CLEA generic residential land use scenario (the average of 23 hours per day for AC1 to AC4 and 19 hours per day for AC5 and AC6) i.e. multiplied by the average indoor occupation period (1.108) in a day.

It may not be possible to calculate tolerable indoor air concentrations ($TAC_{\text{indoor_air}}$) for all contaminants at concentrations above analytical limits of detection due to limited peer-reviewed UK data for some volatile organic compounds. Where appropriate, surrogate $TAC_{\text{indoor_air}}$ values have been used as an alternative.

A direct comparison of volatile hydrocarbons with $TAC_{\text{indoor_air}}$ with measured vapour concentrations is taken as a preliminary screening exercise. Where compounds exceed $TAC_{\text{indoor_air}}$ a second assessment has been undertaken using Equations 10.1 10.4, 10.5 and 10.6 of SC050021/SR3 (listed below) to estimate indoor air concentrations (C_{air}), based on measured vapour concentrations (C_{vap}). Input parameters are provided in **Appendix H**. The 'predicted' indoor air concentrations will be compared to $TAC_{\text{indoor_air}}$, if predicted concentrations exceed $TAC_{\text{indoor_air}}$ then a potential hazard exists. This assumes that measured vapours are from a soil source, as no groundwater sources of TPH/BTEX were identified at BH106/WS106. The modelled numbers follow CLEA default parameters that assume a semi-detached house with the depth from base of floor slab to source is

¹⁰ Human health toxicological assessment of contaminants in soil Science Report – Final SC050021/SR2

0.50 m and the soil type is a silty clay. Note that in Equation 10.6 units have been converted to $\mu\text{g m}^{-3}$.

Equation 10.1

$$D_{eff} = D_{air} \frac{\theta_a^{3.33}}{\theta_T^2} + D_{water} \frac{\theta_w^{3.33}}{K_{aw} \theta_T^2} \times 10000 \text{ cm}^2 \text{ m}^{-2}$$

Where: D_{eff} is the effective chemical diffusion coefficient in soil, $\text{cm}^2 \text{ s}^{-1}$
 D_{air} is the diffusion coefficient in air at ambient temperature, $\text{m}^2 \text{ s}^{-1}$
 D_{water} is the diffusion coefficient in water at ambient temperature, $\text{m}^2 \text{ s}^{-1}$
 θ_a is the air-filled soil porosity, $\text{cm}^3 \text{ cm}^{-3}$
 θ_w is the water-filled soil porosity, $\text{cm}^3 \text{ cm}^{-3}$
 θ_T is the total air- and water-filled soil porosity, $\text{cm}^3 \text{ cm}^{-3}$
 K_{aw} is the air-water partition coefficient at ambient temperature, $\text{cm}^3 \text{ cm}^{-3}$

Equation 10.4

$$\alpha = \frac{\left[\left(\frac{D_{eff} A_B}{Q_b L_T} \right) \exp \left(\frac{Q_s L_{crack}}{D_{crack} A_{crack}} \right) \right]}{\left[\exp \left(\frac{Q_s L_{crack}}{D_{crack} A_{crack}} \right) + \left(\frac{D_{eff} A_B}{Q_b L_T} \right) + \left(\frac{D_{eff} A_B}{Q_s L_T} \right) \exp \left(\frac{Q_s L_{crack}}{D_{crack} A_{crack}} \right) - 1 \right]}$$

Where: α is the steady-state attenuation coefficient between soil and indoor air, dimensionless
 D_{eff} is the effective diffusion coefficient for unsaturated soils, $\text{cm}^2 \text{ s}^{-1}$
 A_B is the area of enclosed floor and walls below ground, cm^2
 Q_b is the building ventilation rate, $\text{cm}^3 \text{ s}^{-1}$
 L_T is the source-building separation, cm
 Q_s is the volumetric flow rate of soil gas into the enclosed space, $\text{cm}^3 \text{ s}^{-1}$ [25 to 150]
 L_{crack} is the foundation slab thickness, cm
 A_{crack} is the floor crack area, cm^2
 D_{crack} is the effective diffusion coefficient through the cracks, $\text{cm}^2 \text{ s}^{-1}$ [= D_{eff}]
 Note: Appendix 1, Equation A10 where the Peclet number approaches infinity

Equation 10.5

$$Q_b = (H \times A_{foot} \times Ex) \times 1000000 \text{ cm}^3 \text{ m}^{-3} \times \frac{1}{3600} \text{ s hr}^{-1}$$

Where: Q_b is the building ventilation rate, $\text{cm}^3 \text{ s}^{-1}$
 H is height of living space, m
 A_{foot} is the building footprint, m^2
 Ex is the building air exchange rate, hour^{-1}

Equation 10.6

$$C_{air} = \alpha C_{vap} \times 1000000 \text{ cm}^3 \text{ m}^{-3}$$

Where: C_{air} is the indoor air concentration, mg m^{-3}
 α is steady-state attenuation coefficient between soil and indoor air, dimensionless
 C_{vap} is the soil vapour concentration, mg cm^{-3}

5.4.2 Ground gas monitoring results

The gas monitoring results are provided in **Appendix G** and summarised in Table 18 below:

Table 18: Summary of land gas monitoring results

Monitoring Visit Date / Location Ref.	Target Strata (m)	Maximum Recorded Concentrations*							
		CO ₂ (%)	CH ₄ (%)	CO (%)	O ₂ (%)	VOC peak (ppm)	Peak Flow rate (l/hr)	Atmospheric Pressure (mB)	Was RZ flooded?
WS108	1.0-3.0 TWS	0.9	0.1	11	20.0	1.8	-5.1 (0.0)	997	Yes
08/02/21		1.5	0.1	1	19.7	1.5	0	1014	Yes
22/02/21		2.4	0.1	0	20.5	1.2	-0.2	1021	Yes
08/03/21		0.2	0.2	0	20.9	n.m.	0	1017	Yes
15/03/21		3.0	0.1	0	20.8	n.m.	4.1 (0.0)	1022	Yes
22/03/21		1.6	0.1	0	19.5	0.8	2.0 (0.0)	1017	Partially
06/04/21	1.0-3.0 TWS	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.
WS109		0.2	0.3	0	20.4	4.5	0	1013	Yes
08/02/21		0.5	0.1	0	21.1	0.1	0	1021	Yes
22/02/21		0.5	0.2	0	20.5	n.m.	0	1017	Yes
08/03/21		0.1	0.2	0	20.6	n.m.	0	1022	Partially
15/03/21		0.3	0.1	0	21.0	0.3	0	1017	Yes
22/03/21	0.5-1.5 MG	0	0	0	14.8	0.8	0.4	1001	Yes
WS111		0.1	0.1	0	20.3	0.6	-0.1	1013	Partially
08/02/21		0.1	0.1	0	20.7	0.3	0	1021	No
22/02/21		0	0.1	1	20.8	n.m.	0	1016	No
08/03/21		0	0.2	0	20.8	n.m.	0	1022	No
15/03/21		0	0.1	0	21.1	0.6	0	1017	No
22/03/21	0.9-1.9 TWS	0.1	0.1	3	20.5	3.1	0.8	1000	Yes
WS113		0.1	0.2	0	20.8	4.8	0	1013	Yes
08/02/21		0	0.1	0	20.7	2.5	0	1021	Partially
22/02/21		0	0.2	0	20.4	n.m.	0	1016	Partially
08/03/21		0	0.2	0	20.4	n.m.	0	1022	Partially
15/03/21		0.1	0.1	0	20.5	2.4	0	1022	No
22/03/21	1.0-2.0 TWS	0	0	0	16.2	0.8	17.7 (0.0)	1001	Yes
WS115		n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	1013	Yes
08/02/21		0.1	0	0	21.3	0.2	n.m.	1020	Partially
08/03/21									

Monitoring Visit Date / Location Ref.	Target Strata (m)	Maximum Recorded Concentrations*							
		CO ₂ (%)	CH ₄ (%)	CO (%)	O ₂ (%)	VOC peak (ppm)	Peak Flow rate (l/hr)	Atmospheric Pressure (mB)	Was RZ flooded?
15/03/21		0	0.2	0	21.3	n.m.	-0.1	1016	Yes
22/03/21		0	0.2	0	16.5	n.m.	-0.1	1022	Yes
06/04/21		0	0.1	3	17.9	1.2	10.1 (0.0) 0	1017	Yes
WS116									
08/02/21		0.7	0	0	16.1	0.1	-1.1	995	Yes
22/02/21	0.5-1.5	0	0.2	0	21.1	0.6	-0.1	1013	Yes
08/03/21	MG/TW	0.1	0	0	21.1	1.1	-0.1	1021	Yes
15/03/21	S	0	0.1	0	21.1	n.m.	0	1016	Yes
22/03/21		0	0.2	1	20.8	n.m.	0	1023	Yes
06/04/21		0	0.1	1	21.2	3.2	0	1016	Yes
BH101S									
08/02/21		0	0	0	16.2	3.1	0.3 (0.1)	1000	Yes
22/02/21		0.1	0.2	0	21.0	0.4	0	1013	Partially
08/03/21	1.0-2.0	0.1	0.1	0	21.2	1.4	0	1021	Partially
15/03/21	MG	0	0.2	1	20.8	n.m.	0	1016	Partially
22/03/21		0	0.2	0	20.8	n.m.	0	1022	Partially
06/04/21		0	0.1	0	19.7	5.4	0	1022	Partially
18/06/21		0	0.2	1	20.9	2	0	1006	Partially
24/06/21		0	0.3	1	20.8	1.3 (0.8)	0	1015	Partially
BH101D									
12/05/21	8-14	0.3	0.2	0	21	0	0	1004	Partially
25/05/21	TWS	0.0	0.1	6	18.8	0	0	1011	Partially
18/06/21		0.0	0.2	5 (1)	17.1	0	0	1006	Partially
24/06/21		0.0	0.2	17(2)	17.8	2.7	0	1015	Partially
BH102									
12/05/21	17.5-	0.3	0.2	0	18.8	0.2	0.1	1003	Yes
25/05/21	20.5	0.2	0.2	1	6.2	0	-4.6	1011	Yes
18/06/21	TWS	1.4	0.3	1	4.6	13.2	0.0	1006	Yes
24/06/21		0.4	0.4	2	5.5	9.3	5.0(4.0)	1015	Yes
BH103S									
08/02/21	1.0-2.0	0.1	0.1	0	16.0	1.2	-0.1	996	Yes
22/02/21	MG/TW	0.1	0.1	0	21.1	1.7	-0.1	1013	Yes
08/03/21	S	1.2	0.1	0	15.6	0.6	0	1020	No
15/03/21		0.2	0.2	0	20.3	n.m.	0	1016	Partially
22/03/21		1.0	0.2	0	14.9	n.m.	0	1023	Partially

Monitoring Visit Date / Location Ref.	Target Strata (m)	Maximum Recorded Concentrations*							
		CO ₂ (%)	CH ₄ (%)	CO (%)	O ₂ (%)	VOC peak (ppm)	Peak Flow rate (l/hr)	Atmospheric Pressure (mB)	Was RZ flooded?
06/04/21		0.9	0.2	0	17.6	3.2	0	1016	Partially
BH103D									
12/05/21	17-20 TWS	0.4	0.1	2	20.4	0.6	0.0	1003	Yes
25/05/21		0.4	0.1	0	20.3	0	0.0	1012	Yes
18/06/21		0.6	0.2	1	19.2	8.6	0.0	1006	Yes
24/06/21		0.4	0.2	1	19.5	0.2	0.0	1015	Yes
BH104									
12/05/21	10-16 TWS	3.7	0.1	0	7.2	0	0	1004	Partially
25/05/21		3.6	0.2	0	1.8	0	0	1012	Partially
18/06/21		4.3	0.4	1	0.3	0.5	2.0 (1.5)	1006	Partially
24/06/21		3.9	0.4	1	1.5	1.1	0.2	1015	Partially

* With the exception of Oxygen which is recorded as minimum; n.m. – not measured; Values in bracket steady state readings; MG = Made Ground; TWS = Tunbridge Wells Sand Formation; SS = Sub soil

Table 19: Atmospheric pressure trends during monitoring period

Monitoring Date	Visit	Atmospheric Pressure Trend on date of monitoring^
19/01/21		Rapid fall to a low on 21/01/21
08/02/21		Low, but rising after 09/02/21
22/02/21		Rising from a low on 20/02/21
08/03/21		Falling to a low on 11/03/21
15/03/21		High
22/03/21		Gradual fall to low on 26/03/21
06/04/21		Gradual rise from a low on 05/04/21
16/04/21		Falling from a high on 16/04/21
12/05/21**		Falling to low on 13/05/21
25/05/21**		Rising to high on 30/05/21
18/06/21**		High, falling to low on 20/06/21
24/06/21**		Falling from a high on 23/06/21

*<https://www.weatheronline.co.uk> for Gatwick Airport **from GasfluX units

Carbon dioxide concentrations in the shallow monitoring wells (WS108, WS109, WS111, WS113, WS115, WS116, BH101S and BH103S) varied between 0% to 3.0% across all monitoring rounds. The highest carbon dioxide concentrations were recorded in shallow wells within the weathered upper extents of the Tunbridge Wells Sand Formation, namely WS108 (3.0%). Wells screened within made ground recorded carbon dioxide

concentrations ranging from 1.2% (BH103S) to 0.1% (BH101S, WS111). Elevated concentrations of methane were not detected in the shallow monitoring wells, with typical values ranging from 0.1% to 0.2%. The highest methane concentration was detected within Phase 3 was BH102 and BH104 at 0.4% which is screened within the deeper extents of the Tunbridge Wells Sand Formation in the western half of the site.

The response zones of most of the shallow monitoring wells were fully or partially flooded during the early part of the monitoring period (8 Feb to 15 March 2021), but by the end of the first phase of monitoring (6 April 2021) fewer wells were fully flooded.

Borehole flow rates in the shallow monitoring wells ranged from -5.1 l/hr to 17.7 l/hr. These maximum values (positive and negative flow rates) were associated with flooded response zones. Only WS111 was not partially or fully flooded during the monitoring window and no flows were recorded at this location. The maximum positive flow rate was recorded in WS115 18 Feb 2021.

BH101D, BH102, BH103D, and BH104 were intended for groundwater level monitoring and sampling within the deep aquifer of the Tunbridge Wells Sand Formation. However, as positive, and elevated flow rates of carbon dioxide were reported in BH106 (outside of Phase 3) in January 2021, this location was included in the first phase of land gas monitoring (8 Feb to 6 April 2021). The remaining deep wells were also monitored on four occasions during the second phase of gas monitoring (12 May to 25 June 2021).

In the deep wells within Phase 3, typically low or slightly elevated concentrations of carbon dioxide were reported ranging from 0.0 to 4.3% (BH104). Excluding BH106, the highest carbon dioxide concentration of 6.1% was reported in BH105 on 12 May 2021, both located outside of Phase 3. Methane concentrations across all deep monitoring wells ranged from 0.3% to 0.1%.

Flow rates across Phase 3 ranged from -4.6 l/hr to 0 l/hr. A negative flow rate was reported in BH102 on 25 May 2021 and the response zone was flooded. BH105 also reported a negative flow rate of -4 l/hr on 25 May 2021, but this reduced to -0.4 l/hr after 240 seconds. This monitoring event coincided with rising atmospheric pressure.

In BH106, outside of Phase 3 area, seven days after the monitoring well was installed gas was observed bubbling through the ground, within the raised cover, which was flooded at surface. A gas reading of 13.6% carbon dioxide and a flow rate of 104 l/hr was recorded at BH106 on 19th January 2021. Methane was not recorded, oxygen was at low concentrations. The bubbling of gases through groundwater was observed to have ceased after about one week. During periodic monitoring, steady state flow rates ranged from 3.4 l/hr to 7.2 l/hr, with the exception of an initial peak in BH106 of 52 l/hr reducing to 7.2 l/hr after 15 seconds on 16 April 2021. Carbon dioxide concentrations ranged from 0.0% to 8.1% during this period.

Continuous gas monitoring devices were installed at BH106 and WS106 to better characterise the gas regime at BH106. The results are discussed in report LP2575 to which the reader is referred.

5.4.3 Ground gas risk assessment

The additional monitoring and data evaluation of the carbon dioxide released from BH106 (located outside of the Phase 3 area) is reported in LP2575, with summary comments included herein for information only.

Adopting the methods described in section 5.4.1, a semi-quantitative approach has been used to define a characteristic situation using in part gas screening values (GSV) from the monitoring undertaken across the Phase 3. An evaluation of the data to inform the approach has been undertaken, as per Section 16.2, above.

Monitoring results from flooded wells during periodic monitoring events have not been assessed, this includes negative flow readings as they are judged unrepresentative of a worst case scenario. Steady state flow rates are used on the basis that land gas sources are not considered likely to generate high volumes of gas that would create a sustained driving flow and that steady state values represent a conservative approach.

5.4.3.1 Gas screening values

Gas screening values for each borehole per monitoring round are provided in **Appendix I**. A summary of the highest GSVs for carbon dioxide and methane are summarised in Table 21 and 22, below noting wells outside of the Phase 3 area are shaded grey.

Table 21: Summary of maximum carbon dioxide gas screening values

Borehole	Date	Atmospheric Pressure	Strata	Gas Screening Value L/hr
				Carbon dioxide
WS102	06/04/21	1017	TWS	0.002
WS103	16/04/21	1022	MG/TWS	0.0048
WS105	-	-	TWS	Flooded on all occasions
WS106	15/03/21	1017	TWS	0.0266
WS108	06/04/21	1017	TWS	0.0016
WS109	22/03/21	1022	TWS	0.0001
	08/03/21	1021		0.0001
WS111	08/03/21	1021	MG	0.0001
WS113	06/04/21	1022	TWS	
WS115	08/04/21	1020	TWS	0.0001
WS116	-	-	MG/TWS	Flooded on all occasions
WS118	-	-	TWS	Flooded on all occasions
BH101S	22/02/21	1013	MG	0.0001
	08/03/21	1021	MG	0.0001
BH101D	12/05/21	1004	TWS	0.0003
BH102	-	-	TWS	Flooded on all occasions

Borehole	Date	Atmospheric Pressure	Strata	Gas Screening Value L/hr
				Carbon dioxide
BH103S	08/03/21	1020	MG	0.0012
BH103D	-	-	TWS	Flooded on all occasions
BH105	12/05/21	1005	TWS	0.0061
BH106^	16/05/21	995	TWS	3.68

[§] steady state or instrument detection limit due to flooded response zone; ^ based on maximum GasfluX data; green shading is GSV <0.07 (CS1 very low risk); red shading >3.5 to <15 (CS4 moderate to high).

Table 22: Summary of maximum methane gas screening values

Borehole	Date	Atmospheric Pressure	Strata	Gas Screening Value L/hr
				Methane
WS102	22/03/21	1024	TWS	0.0002
WS103	06/04/21	1017	MG/TWS	0.0001
WS105	-	-	TWS	Flooded on all occasions
WS106	15/03/21	1017	TWS	0.0152
WS108	06/04/21	1017	TWS	0.0001
WS109	22/03/21	1022	TWS	0.0002
WS111	22/03/21	1022	MG	0.0002
WS113	15/03/21	1016	TWS	0.0002
	22/03/21	1022		0.0002
WS115	08/03/21	1020	TWS	0.0001
WS116	-	-	MG/TWS	Flooded on all occasions
WS118	-	-	TWS	Flooded on all occasions
BH101S	24/06/21	1015	MG	0.0003
BH101D	12/05/21	1004	TWS	0.0002
	18/06/21	1011		0.0002
	24/06/21	1015		0.0002
BH102	-	-	TWS	Flooded on all occasions
BH103S	12/05/21	1004	MG	0.0002
	18/06/21	1011		0.0002
	24/06/21	1015		0.0002
BH103D	-	-	TWS	Flooded on all occasions
BH105	24/06/21	1015	TWS	0.0096

Borehole	Date	Atmospheric Pressure	Strata	Gas Screening Value L/hr
				Methane
BH106 [^]	16/06/21	1009	TWS	0.00718

[§] steady state or instrument detection limit due to flooded response zone; [^] based on maximum GasfluX data; green shading is GSV <0.07 (CS1 very low risk).

A check of the maximum values (maximum flow and maximum concentration irrespective of monitoring rounds) for each borehole in the Phase 3 area has been undertaken to confirm conservatism. The maximum value test is provided in **Appendix I**. The maximum test changes the characteristic situation (CS) for BH104, where a GSV of 0.086 l/hr is recorded i.e. the characteristic situation increases from very low risk (CS1) to low risk (CS2).

The gas screening values, based on a borehole per monitoring event value characterises the majority of the site as GSV1 very low risk with respect to carbon dioxide and methane, with the exception of BH106 (located outside the Phase 3 area), which is assigned a gas screening value of 3.68 l/hr moderate to high risk with respect to carbon dioxide.

However, it is evaluated at this preliminary design stage that the 'coal' in the sandstone layers at depth does not pose an unacceptable land gas risk to the proposed development. This is validated by the shallow monitoring wells installed in both made ground and the top of the Tunbridge Wells Sand Formation which have not resulted in high carbon dioxide or flow rates (in non-flooded wells).

This assessment is on the understanding that in the western area, proposed foundations shall be designed not create preferential pathways through the low permeability confining layer. In the eastern area the piled foundation solution comprising properly constructed CFA piles would not be expected to create active pathways and will also include reinforced cast *insitu* suspended floor slab with minimal penetrations as further mitigation.

This assessment shall be reviewed when detailed design plans are known.

5.5 Limitations and gaps in information

The Desk Study has utilised previous reports at the site, publicly available from the planning portal.

Access to areas to the north and south of the retained building were limited due to below ground services. The desk study highlighted the potential for a groundwater interceptor to be present to the immediate south of Building 3/36 and fuel tanks to the southwest (anecdotally reported to have been decommissioned).

Access along the southern boundary from the centre towards the south east corner was restricted due to present limited space, proximity to the railway lines, hardstanding and services. It is recommended that once hardstanding has been removed and it is safe to dig without risk of damage to services, formation inspections by a competent environmental engineer with possible further intrusive investigations are undertaken within these locations.

5.6 Geo-environmental conclusions

On the basis of the non-targeted ground investigation, made ground was found to generally extend up to 1-2 m in thickness, with deeper areas up to 4 m in the east (Phase 3), and is locally impacted with asbestos, arsenic, lead and benzo(a)pyrene. This is similar to the findings of the previous ground investigations that targeted potential sources of contamination. Made ground soils pose a potential risk to future land users from direct contact and ingestion pathways i.e. in soft landscaped areas.

On the basis of the additional targeted ground investigation within the KDC remediated areas, made ground was found to locally extend up to 3 m in thickness and comprise gravels of brick and concrete and a coarse subangular to sub round crystalline rock. The KDC areas investigated did not contain gross hydrocarbon contamination (NAPL or strong hydrocarbon odours). Laboratory testing did not identify elevated concentrations of BTEX or aliphatic / aromatic hydrocarbons at concentrations above generic assessment criteria for a residential end-use. On the basis of the above, it can be concluded that the KDC remediated areas do not pose a significant risk to human health from volatile vapours or hydrocarbon contamination.

Access to areas to the north and south of the retained building were limited due to below ground services although this is outside the Phase 3 area. The desk study highlighted the potential for a groundwater interceptor to be present to the immediate south of Building 3/36 and fuel tanks to the southwest (anecdotally reported to have been decommissioned).

Xylene was recorded in deep groundwater and shallow groundwater in BH101 at concentrations above published MRVs for groundwater. In the areas investigated by LEAP a potential hydrocarbon source was not identified. Xylene was not considered to pose a significant risk to groundwater receptors, that warrants remediation. Phenol was detected in the deep monitoring well at BH101 during all monitoring rounds and in BH105 in the last round. Phenol does not pose a risk to offsite groundwater receptors for the reasons highlighted for xylene in section 5.3.3.

However, a preferential pathway may exist via the existing surface water drains and historical ditches that extend through the site. A 2018 CCTV survey found sections of the surface water drains potentially damaged.

With respect to the surface water drains, there is a plausible pathway between the onsite drains and the offsite Horsham Pond, as CCTV surveys in 2018 and 2021 identified cracks, blockages and unmarked connections within the surface water drains. The cracks and unmarked connections could allow shallow groundwater to enter the drains. Targeted sampling of accessible onsite chambers identified localised onsite contamination with respect to polycyclic aromatic hydrocarbons and +C10 aliphatic / aromatic TPH fractions. The highest concentrations were located around blocked sections of the network or a redundant chamber.

However, manhole chambers sampled downstream of the site between the Horsham Enterprise Park and the Horsham Pond recorded negligible or low concentrations of PAH / aliphatic and aromatic TPH fractions. This suggests that the localised contamination identified on site is not migrating off site. The Horsham Pond itself reported high TPH and PAH concentrations.

Based on gas monitoring undertaken to this date, the site gas regime is currently assessed as CS1 for the majority of the site, with the exception of elevated gas flows and carbon dioxide emanating from BH106 outside of the Phase 3 area. Areas identified as potential land gas sources (deep made ground / infilled clay pits) a land gas risk was not identified.

Additional land gas monitoring included continuous monitoring at BH106 (deep) and WS106(shallow) and periodic monitoring at the remaining deep groundwater monitoring boreholes. The data evaluation concluded that the initial peak flows of carbon dioxide released from BH106 were likely due to a trapped pocket of carbon dioxide, within a sandstone layer beneath a layer of low permeable clay. Continuous gas monitoring showed a gassing regime very responsive to atmospheric pressure changes, supporting that conclusion. Ternary plots and oxygen vs carbon dioxide relationships indicated that the gas source generated in BH106 during the continuous gas monitoring was indicative of microbial respiration. Provided that in residential areas the foundation design does not create preferential pathways, the risk to the proposed residential properties is considered unlikely to require gas protection measures. Due to the presence of deep made ground, a piled foundation solution may be adopted the method used must adequately seal into the surrounding bedrock, so as not to create new pathways i.e. use of properly constructed CFA piles. Geotechnical aspects are considered in the previous LEAP reports.

5.7 Geo-environmental recommendations

The risk driver for remediation is exposure of future site users to heavy metals, benzo(a)pyrene as well as remaining potential for asbestos to be encountered within the made ground. The pathway for impact to future users is direct exposure to the outlined contaminants.

Where soft landscaping is proposed in areas of made ground then remedial works will be required to prevent potential risks to future land users. Where hardstanding is proposed this will break contaminant linkages and remedial measures will not be required.

In private garden areas, where made ground is present a capping solution comprising 600 mm of verified clean cover material, including a minimum of 150 mm topsoil, and clean corridors for service runs would act to break the pathway of exposure and render the material suitable to be reused on the site. Depending on the final development levels, this may require material to be removed and disposed off-site. Given the potential presence of asbestos, albeit limited, it is recommended that the formation level is inspected to confirm ground conditions prior to placement of capping layer. A visible marker layer (geotextile membrane) could be considered where made ground remains at formation level. Where asbestos containing materials are suspected at formation level further excavation may be required and/or the placement of a 150 mm hard to dig barrier in addition to the geotextile membrane. In public open space / soft landscaped areas the thickness of capping material may be reduced to 300 mm thick. Clean cover thicknesses should be extended to 900 mm depths if new trees are proposed or to 450 mm where shrub planting is proposed. Clean cover systems should be made with reference to CIRIA Special Publication 124:1996 *Barriers, liners and cover systems for containment and control of land contamination*.

Remedial measures for proposed soft landscaping use are not required where natural soils are present at formation.

Surveying and sampling of the surface water drains along the north-eastern boundary (where they enter the site) and along the southern boundary (where they exit the site) should be undertaken to confirm the integrity of the drainage system and the quality of water discharging through the site drains and to ensure that construction works do not result in downstream pollution.

The presence of asbestos within the made ground has been detected in this and previous investigations. Groundworks should be carried out following suitable health and safety protocols, for example, dust suppression measures and reassurance monitoring, as required.

The works should be planned with reference to the Joint Industry Working Group Asbestos in Soil and Construction & Demolition (C&D) Materials guidance titled “Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance (CAR-SOIL™).

In addition to the above this report recommends that:

- the land gas risk assessment is reviewed once detailed design plans are known for both residential and commercial land use areas. Limited further assessment may be required at that time by way of validation
- the existing Southern Water drains that extend through the eastern half of the site are damaged and where blockages, cracks, seepages are recorded then suitable remedial action should be undertaken. Including blocking of redundant inlets and full decommissioning of chamber S21 to prevent water discharging into chamber S8. Any repair works that affects the surface water drains shall only be undertaken after consultation with Southern Water Ltd

5.7.1 Validation of remediation

A final remediation method statement will be required to be prepared once the final site designs are complete. This method statement should be submitted to the appropriate regulatory authorities. It is advised that the local authority are advised of the intended build programme in order that they can phase the sign off of planning conditions as required.

The remediation strategy will require the importation of clean topsoil, and possibly subsoil. Imported soils should be tested at source by the supplier. The validation engineers should then make spot checks as and when necessary once material has been imported.

Provision should also be made for dealing with further localised hotspots of contamination which may come to light during construction. Any such soils should be inspected by the validation engineers and appropriate remedial action taken as necessary.

5.8 Waste disposal

It is anticipated that the proposed development will generate waste soils and materials will need to be removed from site as part of the construction process.

Where soils are to be disposed off-site, it is the duty of the waste producer, in this case the developer, to ensure that all waste is disposed of appropriately and that any that is sent to landfill is sent to an appropriately licensed one. All waste sent to landfill must be classified and must be pre-treated. There are various forms of pre-treatment that are acceptable. In this case it could include “reduction in volume”, which could be achieved by segregating the Made Ground and re-using part of it on site.

Where made ground soil is to be re-used on site then it is recommended that this is carried out under the CL:AIRE Definition of Waste Industry Code of Practice (DoWCoP) for re-use of soils¹¹.

Sixty-six soil samples (including locations west of Phase 3 area) were preliminarily assessed for waste classification purposes using HazWasteOnline® screening tool and the results are presented in **Appendix K**. It is considered that the made ground soils would be classified mainly as non-hazardous for waste disposal purposes, but localised areas hazardous material due to heavy metals, TPH and benzo(a)pyrene cannot be discounted. The non-hazardous threshold for TPH (1000mg/kg) was exceeded in the made ground sample at WS102 0.20 m and TP112 at 0.10 m. We note that benzo(a)pyrene:TPH ratio is <1000:1 in WS102 at 0.20 m, which lies outside of Phase 3. Hazardous waste concentrations for TPH and benzo(a)pyrene levels were also encountered in the made ground at WS105 0.25m, which is located outside of Phase 3. The heavy metal threshold was exceeded in made ground fill sample encountered below the blacktop and concrete hardstanding at TP112 0.35 m, which lies outside of Phase 3. Where asbestos fragments are identified they would be classed as hazardous waste. Twelve soil samples were recorded as hazardous waste due to pH concentrations reported above 11.5 pH units. This may be due to concrete in the sample producing an alkaline test result and not a true reflection of the soil pH.

Eight samples were tested for waste acceptance criteria to indicate whether it will be accepted at landfill. This indicates the waste would be accepted mainly as non-hazardous with potential inert acceptance of segregated natural and reworked natural soils. However, it is recommended that this is confirmed with the haulier and the receiving waste management site.

Further testing and inspection of soils will be required to confirm waste classification of material leaving the site. A watching brief ensuring previously unencountered asbestos is not removed as non-hazardous waste is recommended.

It is strongly advised that detailed discussions be held with remediation/groundworks contractors and that receiving landfill sites are identified in advance of commencing any waste removal.

¹¹ The Definition of Waste: Development Industry Code of Practice. Version 2 2011. CL:AIRE

APPENDIX A – SERVICE CONSTRAINTS

SERVICE CONSTRAINTS

1. Service Constraints for all Reports

1.1. This Report (the "Report") and any study, inspection, investigation, sampling, testing and or interpretation carried out in connection with the Report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) trading as Carbon Zero Consulting, Leap Environmental or RSK Geosciences, for the Client named in the first paragraph of the Report (the "Client") in accordance with the terms of an RSK Fee Proposal including RSK Environment Standard Terms and Conditions (the "Appointment") between RSK and the Client, unless otherwise stated in the first paragraph of the Report. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by a geo-environmental consultant at the time the Services were performed. Nothing in this Report shall be construed as imposing any fitness for purpose obligation. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.

1.2 Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services. RSK shall not be liable in respect of any action or proceedings arising out of or in connection with this Report whether in contract, in tort, for breach of statutory duty or otherwise after the expiry of six (6) years from either (i) the date of the Report or (ii) such earlier date as prescribed by law, unless varied in the terms of the Appointment.

1.3 Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent, or condone any party, other than the Client relying upon the Services. Should this Report or any part of this Report, or details of the Services or any part of the Services, be made known to any such party, and such party relies thereon, that party does so wholly at its own and sole risk, and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent geo-environmental consultant and/or lawyer.

1.4 The Client shall not, without the prior written consent of RSK, assign, transfer, charge, mortgage, subcontract, or deal in any other manner with all or any of the benefits provided in this Report. Unless specified in the Appointment, RSK shall not be obliged to assign the benefit of the Report whether by collateral warranty, third party rights pursuant to the Contracts (Rights of Third Parties) Act 1999, letter of reliance or otherwise. If RSK agrees to any assignment of the benefit of this Report, in whatever form, benefits to third parties through collateral warranties, third party rights or letters of reliance shall not be provided unless a fee for each right, warranty or letter is agreed. The form of wording used in the warranty or letter shall be provided by RSK for agreement by the Client. Any reasonable changes to the form of wording will be implemented by mutual agreement, however the terms in the warranty or letter cannot offer the third party any greater benefit than the Appointment offered to the Client.

1.5 It is the understanding of RSK that this Report is to be used for the purpose described in the introduction to the Report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the Report is used, or the proposed use of the site change, this Report may no longer be valid and any further use of or reliance upon the Report in those circumstances by the Client without the review and advice of RSK shall be at the Client's sole and own risk. RSK shall not be liable for any use of this Report for any purpose other than that for which it was provided.

1.6 The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions contained in this Report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the Report in the future shall be at the Client's own and sole risk.

1.7 The observations and conclusions described in this Report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out, or required by the Appointment between the Client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this Report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, fuel storage, persistent bio-accumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.

1.8 The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of desk based publicly available information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services and the limitations below:

- a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the Client or third parties, including laboratories and information services, during the performance of the Services.
- d. The Client has identified in writing to RSK, the information, reports, findings, surveys and preliminary works RSK may not rely upon when providing the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK, and including the doing of any independent investigation of the information provided to RSK, save as otherwise provided in the terms of the Appointment between the Client and RSK.

1.9 Any site drawing(s) provided in this Report is (are) not meant to be an accurate base plan for scale measurement but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for accurate setting out and should be considered indicative only.

1.10 Should RSK be requested to review the Report after the date of issue of this Report, RSK shall be entitled to additional payment at the existing rates, or such other terms as agreed between RSK and the Client.

2. Service Constraints where the Report provides an intrusive assessment of ground conditions:

2.1 The intrusive environmental ground investigation aspects of the Services are a limited sampling of soil from the site, at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this Report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together

with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope agreed between the Client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species (not tested) are not present.

2.2 The comments given in this Report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development, site usage, timescales or the Client's specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an indicative assessment of ground conditions on site. There may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

2.3 Where the Services include Investigation of an exploratory nature or relating to physical ground works, any costings and prices provided in the Report are estimated and provided for guidance purposes only. The actual cost and time quantities shall be remeasured and shall be dependent upon the ground or other conditions, constraints present, and number and depth of the investigation locations, which shall influence the number of samples and tests required, and the quantities of soil being classified.

2.4 Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works. However, this Report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.

2.5 Unless stated otherwise, only preliminary geotechnical recommendations are presented in this Report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed. Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this Report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode7, although this is subject to the restrictions imposed on the investigation, as listed above. For geotechnical design, Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this Report will not meet the requirements of a Geotechnical Design Report (GDR) and should therefore be used for preliminary guidance only.

3. Service Constraints where the Report relates to Surface Water Management:

3.1 The Surface Water Management Inspection (SWMI) Report, documents provided, observations, actions, and recommendations, with respect to the management of potential pollution issues to surface waters, made during the site Inspection visit, are those present at the time of the visit, and may not represent those recorded by others on the same day.

3.2 The comments given in this Report and the opinions expressed are based on the weather, ground and ground water conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not

been disclosed by the inspection and therefore could not be taken into account. In addition, groundwater levels and flows, may vary from those Reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

3.3 RSK places a degree of dependence upon oral information provided by site representatives, which is not readily verifiable through visual inspection, or supported by any available written documentation. RSK shall not be held responsible for conditions or consequences arising from relevant facts that were not fully disclosed by facility or site representatives at the time this Report was prepared.

3.4 This Report is a live document, to be continually reviewed and updated as the development progresses or other changes occur on site. RSK can only maintain the currency of this Report through the Client requesting support with supplementary site visits or attendance at meetings ahead of key stages of the development in relation to surface water management. Our risk rating assesses a number of risk factors in line with the source-pathway- receptor model and is therefore subject to constant change.

3.5 Standard design drawings are indicative. Material types, dimensions and construction details will need to be adjusted by the Client to suit the specific conditions / flows on Site.

3.6 The full responsibility for implementing the site-specific protection and maintenance measures to protect the surface water system as stated in this Report, remains with the Client and their site management team. Additional control measures may be required to achieve the objectives set out in the Surface Water Management Plan to be implemented and financed by the Client.

4. Service Constraints where the Report relates to Waste Management:

4.1 In accordance with the definition provided in the Waste Framework Directive (WFD), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not considered waste if re-used on the site of origin for the purposes of development. Soils such as made ground that are not of clean and natural origin (irrespective of whether they are contaminated or not) and other materials such as recycled aggregate, do not necessarily become waste until the criteria above are met. Excavation arisings from the development may therefore be classified as waste if surplus to requirements and/or unsuitable for re-use.

4.2 It is the duty of the waste producer, to ensure that all waste is accurately classified prior to waste disposal. Technical Guidance WM3 (EA, 2018) sets out in its Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. Unless otherwise stated, the waste assessment presented in this Report should be considered as preliminary and further testing and assessment of the waste under the provisions of a Waste Sampling Plan may be required to obtain the necessary level of data required for basic characterisation of the waste in support of disposal.

4.3 Unless stated otherwise in the Report, information relating to historical operations at the site was not reviewed as part of the assessment by RSK. In addition, unless otherwise stated in the Services, RSK was not present during the collection of the samples nor had any input on the chemical testing suite. Therefore, the waste assessment and classification detailed in this Report are based solely on any information that were provided to RSK (e.g., laboratory chemical data, exploratory hole records) and were completed without prejudice for our Client.

4.4 RSK's assumes that any ground investigation data, chemical testing results etc., that were provided by the Client to inform the waste assessment and supporting review were carried out in accordance with current best practice and relevant guidance/ standards, where applicable. Thus, the comments given in this Report and the opinions expressed are based solely on the information provided by the Client. However, it is noted that there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account as part of the RSK assessment.

5. Service Constraints for Construction Environmental Management Plan Reports:

5.1 This Report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

5.2 The measures and comments outlined in this Report and any opinions expressed are based on the plans provided at the time and discussions with relevant parties. However, there may be conditions pertaining to the site that have not been disclosed by investigations and therefore could not be taken into account.

5.3 This CEMP is a live document and is subject to change throughout the project, as and when necessary, to ensure management of environmental aspects remains relevant, and to ensure continued compliance with legislation and commitments as they may change. RSK understands that this CEMP will be reviewed by the Client every six months and updated as and when necessary.

5.4 It is the full responsibility of the Principal Contractor/ Client to ensure that their works do not contravene legal requirements, and adherence to this CEMP alone cannot be a full defence regarding legal action against the Principal Contractor.

6. Service Constraints where the Report relates to Ground Gas Membrane Verification:

6.1 This Report is limited to the verification of the gas resistant membrane/vapour membrane/radon barrier after installation and no inspections were undertaken of the substrate (i.e. prepared ground). The Report therefore does not constitute as a full verification of ground gas protection system.

6.2 The comments given in this Report and the opinions expressed, are based on the condition of the ground gas membrane as encountered at the time of inspection by suitably qualified personnel. RSK cannot accept liability for any subsequent change to the status of the gas membrane by follow-on trades or other construction activity.

6.3 Where not designed by RSK, the verification of protection measures is carried out with reference to the gas protection design provided by the Client. RSK assume the scope of gas protection measures as determined by third parties to be correct and to have achieved any required approval from authorities.

6.4 The Ground Gas Design Report/Remediation Strategy and Verification Plan contains details of the procedures to be adopted for inspection and validation of the works. However, it should be noted that responsibility for the correct implementation of the strategy lies with the appointed contractor. RSK cannot be held responsible for any remedial works that are carried out without the agreed procedures involving either direct supervision by RSK, or inspection and validation of the works by a representative from RSK.

7. Service Constraints for Environmental Due Diligence (EDD) Reports:

7.1 The comments given in this Report and the opinions expressed are based on the information obtained and reviewed as part of the desk-based assessment. However, there may be conditions pertaining to the Site that have not been disclosed by the assessment and therefore could not be taken into account. Furthermore, no intrusive investigations, monitoring or sampling have been undertaken to confirm the environmental status of the site, therefore any comments relating to ground conditions and subsurface contamination are based solely on a review of desk-based information.

7.2 This Report describes the results of the EDD exercise. The scope of this EDD Report, where appropriate, covers legal or regulatory compliance with respect to UK or international regulations associated with environmental matters.

7.3 As with any EDD exercise, there is a certain degree of dependence upon information provided by the target company. The EDD does not include a site walkover / visit or liaison with site representatives unless identified in the Services. Therefore, the assessment is based on the available desk study information. Also, there is a certain degree of dependence upon oral information provided

by site representatives, which is not readily verifiable through visual inspection, or supported by any available written documentation. RSK shall not be held responsible for conditions or consequences arising from relevant facts that were not fully disclosed by facility or site representatives at the time this EDD exercise was performed.

7.4 This Report, including all supporting data and notes (collectively referred to hereinafter as "information"), was prepared or collected by RSK for the benefit of its Client.

7.5 The comments given in this Report and the opinions expressed are based on the information obtained and reviewed as part of the desk-based assessment and the site inspection visit. However, there may be conditions pertaining to the Site that have not been disclosed by the assessment and therefore could not be taken into account. Furthermore, no intrusive investigations, monitoring or sampling have been undertaken to confirm the environmental status of the Site therefore any comments relating to ground conditions and subsurface contamination are based solely on a review of desk-based information and observations collected during the site inspection visit.

8. Service Constraints for Ground source heat energy Reports:

8.1 It is understood that this is a desktop survey only and that there are no requirements for a site walkover, service utility survey, or provision of service plans. These services can be provided upon request if required.

8.2 At a later stage, it is possible that a thermal response test (TRT) will need to be completed, for which a test borehole will have to be drilled, and these would be costed at the time. RSK can provide all aspects of subsequent site work for a GSHP system if required.

9. Service Constraints for Water Abstraction Borehole Reports:

9.1 The Report aims principally to only identify and assess the suitability of the site for a water abstraction borehole. This Report should be considered in the light of any changes in legislation, statutory requirements, and industry practices, that have occurred subsequent to the date of the Report.

9.2 Unless stated in the Report, the opinions expressed in this Report including all comments and recommendations provided are on the basis of the information obtained from a desk-based assessment.

APPENDIX B – FIGURES AND DRAWINGS

Key:

Units (x244):

Inc. x12 M4(3) Apartments

- 1B2P Apartment x41
- 2B3P Apartment x50
- 2B4P Apartment x35
- 3B4P Apartment x6
- 3B5P Apartment x10

4B6P House x24
(3 Storey - *Lovell Osbourne)

3B6P House x24
(2.5 Storey - *Lovell Berkshire)

3B5P House x25
(2.5 Storey - *Lovell Painswick)

2B4P House x16
(2 Storey - *Lovell Henbury+)

2B4P Coach House x13

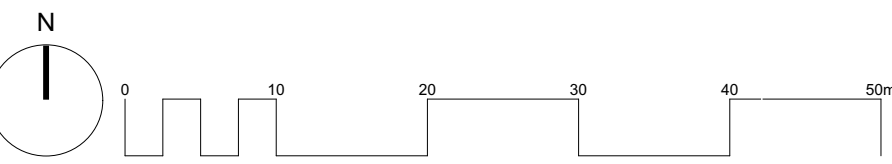
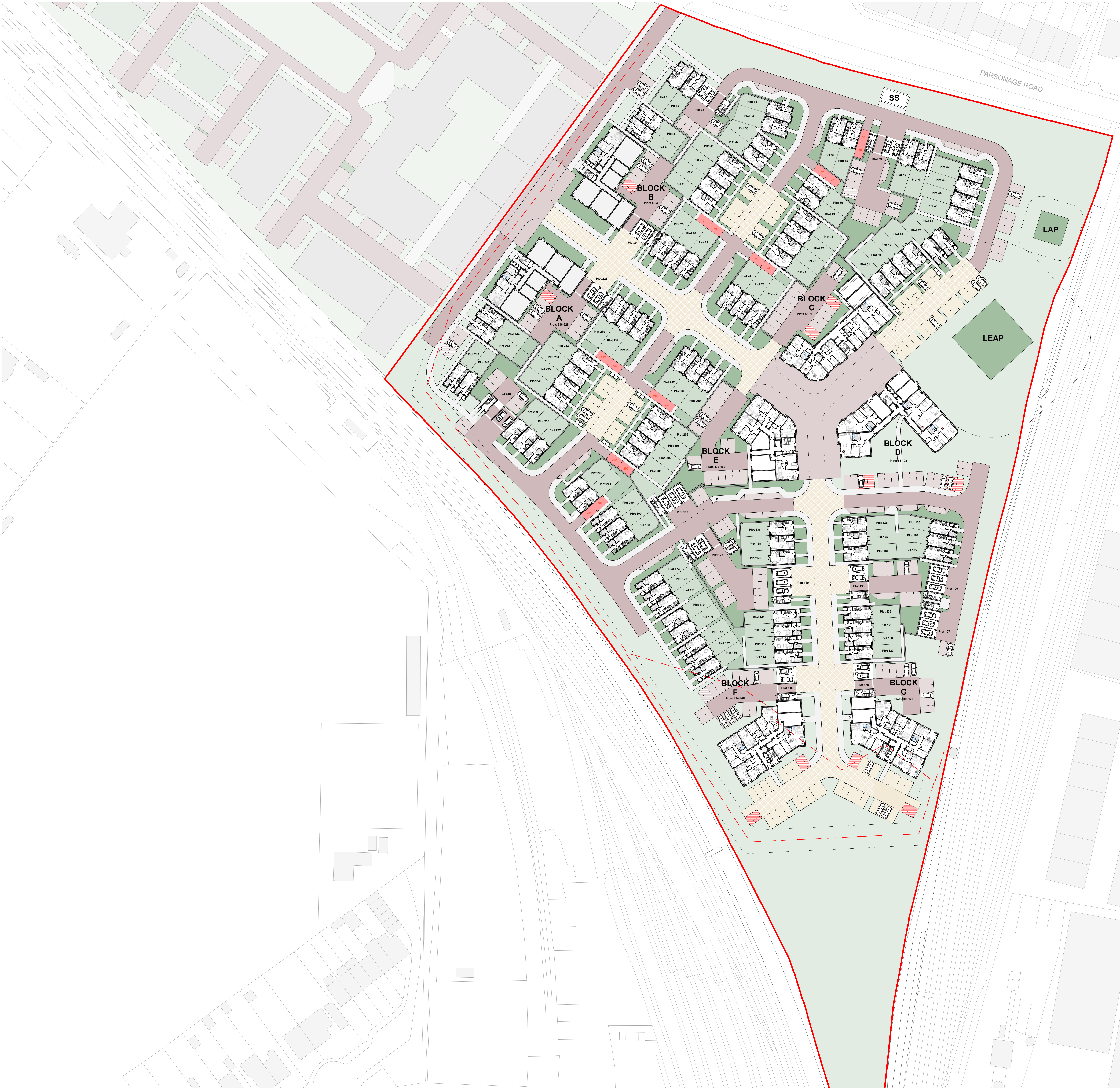
* Layout based on the Lovell house type

Parking (x327):

- M4(3) Unallocated Parking Bay (x14)
- M4(3) Allocated Parking Bay (x12)
- Allocated Standard Parking Bay (x16)
- Standard Parking Bay (x285)

Public Open Space:

- Circa. 13,582sqm (excluding boulevards)



Please Note:

This drawing can only be used for planning purposes. Dimensions to be checked on site and any discrepancies are to be highlighted to the Architect prior to construction.

Topographical / Ordnance Survey information shown has been prepared by a third party. HGP accept no responsibility for accuracy or completeness of the survey.

This drawing is to be read in conjunction with all other project drawings, construction notes and/ or project specifications including those by other project consultants and specialists. All discrepancies should be reported immediately.

Design subject to detail development / approval. Measurements and accommodation schedules are subject to amendments following coordinated input by others. Costings cannot be finalised until approval / confirmation by relevant authorities and client.

MUSE

Former Novartis Site, Horsham
Block Plan

PROJECT	JOB NO
Novartis Site, Horsham	23.166
SCALE	DATE
1:500@AO	28.08.24
DRAWN BY/CHECKED BY	REVISION
PDJ	PDJ
DWG#	STATUS
17100-HGP-XX-XX-D-A-0102	PRELIMINARY

PO3 Road Network	28/11/24	TM	ME
PO2 Second Issue	25/11/24	IC	ME
PO1 Initial Issue	15/11/24	ME	ME
Rev Description	Date	DB	CB

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