- Horsham Pond via surface water drainage; and
- Material construction of buildings and infrastructure.

The outline planning consent for the site development allows for residential properties, communal open space and commercial development. Whilst the details for the proposed development have not been finalised, is it likely that some of the residential development will include low rise housing with private gardens. Preliminary plans suggest the residential development will be on the western part of the site, although this is not finalised. As a conservative assessment, this risk assessment therefore considered all potential contaminant linkages involving residential land users and soil contaminants i.e. direct ingestion of soil, ingestion of soil attached to plants as well as via plant uptake, inhalation of indoor and outdoor vapour and of dust tracked back into the house and finally ingestion of water carried by plastic water pipes through contaminated ground. In public open spaces, communal gardens and soft landscaping associated with commercial activities the pathways will be different, which generally results in lower levels of exposure and therefore risk.

Ground workers are at risk as a result from all of the above, except for those involving edible plants.

The site is underlain by the Tunbridge Wells Sand Formation mapped as a Secondary A Aquifer in the northwestern part of the site, and as unproductive aquifer[7] elsewhere including along the full length of the southern boundary. The site is not located within a potable water source protection zone. There are no surface water features that immediately bound the site or are located within 250 m of the site boundary.

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 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.

A CCTV undertaken in 2018 suggested that sections of the drains were damaged and may receive water from the site. This could allow a preferential pathway to the pond from shallow

[7] areas comprised of rocks that have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.

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.

10 Geotechnical Risk Assessment

10.1 Geotechnical Risk Register

The following geotechnical hazards have been identified as substantial risks;

- Presence of deep made ground.
- High groundwater table.
- Deep obstructions.
- Possible voids in former service ducts / tunnels.
- Deep excavations.
- Local stability issues on northern and eastern site boundaries.

The report also noted that the two active and one decommissioned surface water drains that extend through the east of the site could be a constraint if the locations are not accurately mapped.

D PHASE II - INTRUSIVE INVESTIGATION

11 Investigation Rationale

A total of 77 trial holes were excavated across the site. These included 54 No. machine excavated trial pits to depths up to 3m, 6No. rotary cored boreholes to depths of between 20.0m and 20.5m and 17No. windowless sampler boreholes to depths of between 0.8m and 3m.

The trial hole spacing was consistent with the recommended density of 25 to 50m for an exploratory investigation as according to BS10175 Section 7.7. A broadly non-targeted approach was adopted to allow for the use of a statistical assessment if required. However, due to the density of sampling, many areas identified as potential contaminated land sources in earlier reports were covered by this phase.

Gas monitoring wells have been installed in selected window sampling locations and have been located generally in accordance with the spacing requirements given in CIRIA C665[8].

The investigation rationale for the trial holes is summarised below:

Table 3 Rationale for Investigation Locations

Trial Hole/Test Location	Rationale	Proposed Depth (mbGL)	Notes
BH101-BH106	Provide Information on ground conditions and geotechnical parameters for pile design and location of groundwater and gas monitoring wells.	20	Deep groundwater monitoring wells installed within each borehole to depths between 14m to 20.2m. Gas wells to a depth of 2m were also installed within BH101 and BH103.
WS1-WS118	Provide information on the ground conditions, location of gas monitoring well and provide samples for contamination and geotechnical testing.	4	Positions terminated early at depths ranging from 0.8m to 3.0m due refusals n bedrock or below ground obstructions. Gas monitoring wells were installed within WS102, WS103, WS105, WS106, WS108, WS109, WS111, WS113, WS115, WS116 and WS118. WS114 was aborted due to a surficial obstruction.

[8] CIRIA C665 Assessing risks posed by hazardous ground gases to buildings

TP101-TP152	Provide information on the ground conditions, location of full scale soakage tests and provide samples for contamination and geotechnical testing.	3	Soakage tests were performed within TP147, TP126A and TP138. Locations that terminated early due to confirmed and potential below ground services were: TP101, TP104, TP129, TP137 Locations that terminated early due to refusal on bedrock were: TP103, TP105, TP107, TP108, TP111, TP112, TP120, TP121, TP123, TP127, TP133, TP135, TP136, TP139, TP143, TP145, TP146, TP148, TP150, TP151, Locations terminated early due to obstructions were: TP116, TP122, TP125, TP132,
B1-B4	Shallow pits to provide information on ground composition of the raised ground/bund on the north-eastern perimeter.	0.5-1m	B3 terminated at 1m due to encountered electrical cable caution tape.

A number of proposed trial holes were not excavated due to site restrictions as listed below:

- Access to TP109 prevented due to protective fencing assembled around large mature trees.
- TP114 southwest of Building 3 was not excavated due to the presence of below ground utility services at the location.
- TP119 north of Building was not excavated as access was restricted by heras fencing with a warning sign of live electricity services at the location.
- Only surface sampling was undertaken at TP141 due to proximity to site hoarding and presence of potential below ground services.

After completion of BH101 on 26th of January, the well installation became damaged on rebar and obstructions within deep made ground at this location as the casing was withdrawn. After repeated attempts to re-install the standpipe the borehole was aborted due to the obstructions and borehole collapse to 6 m bgl. BH101 was backfilled from 6 m bgl with bentonite to ground level. A second well BH101A was drilled adjacent to the aborted position to allow for the monitoring well installations.

Only a limited number of hand-held DCP tests were undertaken due to the extensive areas of disturbed ground and potential below ground utility services.

The site investigation locations are shown on Figure 5, Appendix B and a photographic record of the exploratory hole locations is provided as Appendix C.

12 Site Work

12.1 Date and Weather Conditions

The intrusive investigations were undertaken between 11th January and 1st February 2021. At the time of the investigation, the weather was overcast with periods of heavy rain and sub-zero temperatures.

Based on long term averages[9] 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.

12.2 Site Work Methods

12.2.1 Borehole Drilling

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 1.2 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.

12.2.2 Windowless Sampler

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 1.2 m bgl were excavated in all locations.

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[9]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.

12.2.3 Trial Pitting

Trial pits were dug by a backhoe excavator. The trial pits had a target depth of 3mbgl and were typically 2m wide by 0.5m long. 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.

12.2.4 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:[10] and BS EN ISO 14688[11].

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 13.4.

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.

12.2.5 Monitoring Well Installation

19 No. monitoring wells were installed during this investigation. 8 No. were installed within the rotary coring boreholes (two locations had nested shallow and deep monitoring wells) and 11 No. were installed within the windowless sample boreholes. The monitoring wells were constructed of 50mm 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

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[10] BS5930:2015+A1:2020 Code of Practice for Ground Investigation

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

water) to provide a seal. The monitoring wells were finished with bungs with gas taps and flush mounted or raised steel covers. Monitoring well installations are shown on the borehole logs and summarised in the following table.

Table 4: Borehole installation details

Borehole	Type G-gas W-water	Plain Well Screen (mbgl)	Slotted Well Screen (mbgl)	Bentonite Seal (mbgl)
BH101D	W	GL-8	8-14	0.3-1 2-4.5 7-9 14-20.1
BH101S	G	GL-1	1-2	
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 2-4 7-17 20-20.3
BH103S	G	GL-1	1-2	
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

12.2.6 Monitoring Well Development

The deep monitoring wells were developed on 5th 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 12.4 were employed to collect representative groundwater samples from the deep standpipes for analysis.

12.3 Field Tests

12.3.1 Standard Penetration Tests

Standard penetration tests were undertaken in the rotary coring boreholes within the overburden or where core recovery was poor. Uncorrected blow counts, 'N values', are recorded on the borehole logs in Appendix D. Where core recovery was good, SPTs were not undertaken in the rotary cored boreholes.

SPTs undertaken in the windowless boreholes at 1m centres in granular soils in accordance with BS EN ISO 22476-3;2005. Uncorrected blow count 'N values' and SPT hammer energy ratios are recorded on the borehole logs in Appendix D.

12.3.2 Perth Penetration Tests

Hand held perth penetrometer tests were undertaken in trial pits at depths between 1.0 m to 1.5m bgl. Uncorrected blow counts, 'N values', are recorded on the trial pit logs in Appendix D.

12.3.3 In-situ California Bearing Ratio Test – Dynamic Cone Penetrometer

6 No. in-situ CBR tests have been undertaken on undisturbed ground where it was deemed safe to do so (i.e. away from known below ground services) using a Dynamic Cone Penetrometer (DCP), recording blow counts over 900mm of penetration from test level. The test method and interpretation of the results have been undertaken in accordance with DMRB HD 29/08[12] using a modified DCP. The results are presented in Appendix D.

[12] HD22/08 Data for Pavement Assessment. Design Manual for Roads and Bridges; Volume 7 Pavement Design and Maintenance; Section 3 Pavement Maintenance Assessment Part 2

12.3.4 BRE365 Soakage Tests

3 No. soakage tests have been carried out in trial pits TP147, TP126A and TP138 in general accordance with BRE Digest 365[13]. However, due to site conditions (high groundwater) it was not possible to fill and test each location three times.

12.4 Ground Gas and Groundwater Monitoring

12.4.1 Groundwater sampling

Three rounds of groundwater sampling were undertaken during this investigation. The visits were completed on 8th-9th, 22nd-23rd February, and 8th-9th 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 results of the groundwater monitoring visits are provided in Appendix I and summarised in Section 13.3.

12.4.2 Land gas monitoring

Six rounds of land gas monitoring have been undertaken on 8th February, 22nd February, 8th March, 15th March, 22nd March and 6th April 2021. A seventh gas monitoring visit was undertaken on 16th 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 I and summarised in Section 32.

The wells were monitored for volatile organic compounds using a PhoCheck+ portable Photo-Ionisation Detector (PID).

12.5 Laboratory Analysis

12.5.1 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

[13] Building Research Establishment DG365 Digest Soakaway Design (2016)

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;
- Semi Volatile Organic Compounds;
- Asbestos Quantification; and
- Waste Acceptance Criteria tests.

The full laboratory test results are presented in Appendix E.

12.5.2 Chemical Water Analysis

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; and
- Speciated PAHs.

The full laboratory test results are presented in Appendix E.

12.5.3 Geotechnical Laboratory Testing

Selected samples of the soils have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford, in accordance with BS1377[14] and BS EN ISO17892[15]. The sampling technique, type, storage and transport and the number of laboratory tests have been undertaken where

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[14] BS1377 Parts 1-9:1990 Methods of test for Soils for Civil Engineering Purposes

[15] BS EN ISO 17892 Parts 1-12 Geotechnical Investigation and Testing. Laboratory testing of soil

possible in accordance with BS EN 1997-2:2007 and BS EN ISO 22475[16]. Undisturbed Class 1 (Category A) samples have been obtained where possible from the rotary coring boreholes using UT100 thin walled samplers. Full laboratory test results are provided in Appendix F.

13 Ground Conditions

Made ground conditions encountered were noted to vary between the land west and east of Building 3/36. On this basis the ground model summarised below, describes these two sections separately. Figure 5, Appendix B shows exploratory hole location relating to each area. The stratigraphy encountered is described on the trial hole logs in Appendix D.

13.1 Western Area

Table 5: Summary of soils encountered within the western half of the site

Depth From (m)	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 (56.18 / 57.83)	0.2 / 1.0 (55.38 / 57.53)	**MADE GROUND**	Variable MADE GROUND generally comprising grey demolition fill of fine to coarse and cobbles of brick and concrete and occasional blacktop and areas of red sandy gravelly fill with gravel of fine to coarse brick and concrete.
GL / 2.7 (57.03 / 54.36)	0.5* / 2.9 (56.73 / 53.41)	**REWORKED SOIL[18]**	Reworked soils comprising grey to brown clayey silt and silty clay with occasional fragments of fine to coarse brick or concrete.

[16] BS EN ISO 22475 Parts1-3 Geotechnical Investigation and Testing. Sampling methods and groundwater measurements

[17] Average strata thicknesses have not been quoted due to the variability across the site.

[18] 'Reworked' is a generic term used by LEAP to describe soils that are predominantly formed from the 'natural' superficial or bedrock deposits, but may have minor inclusions of anthropogenic material such as glass or brick/concrete gravels. These minor inclusions may have been introduced into underlying stratum during construction or demolition works. They are visually different from 'made ground' soils which are predominantly formed of construction or demolition waste, waste material, or clearly definable 'natural' soils that have been placed to an engineered specification e.g. above a marker layer or a chalk capping layer above a made ground layer.

0.3 / 1.7 (57.12 / 55.88)	1.1 / 3.7 (55.30 / 55.36)	**Interbedded CLAY and SILT**	Interbedded firm to stiff mottled grey and brown and orangish brown and silty CLAY and clayey SILT.
1.1 / 3.1 (55.30 / 53.21)	3.35 / 3.7 (52.96 / 53.86)	**Interbedded MUDSTONE, SILTSTONE & SANDSTONE**	Extremely weak to very weak reddish brown to dark grey interbedded occasionally laminated ferruginous MUDSTONE, SILTSTONE and SANDSTONE. Occasionally thin lignite layers encountered within the sandstone strata.
3.35 / 3.7 (52.96 / 53.86)	20.3* (37.26*)	**Interbedded MUDSTONE, SILTSTONE & SANDSTONE**	Weak reddish brown to dark grey interbedded laminated ferruginous MUDSTONE, SILTSTONE and SANDSTONE. Occasionally thin lignite layers encountered within the sandstone strata.

* - full depth of excavation

Figures 6, 7 and 8 show geological cross-section for the western part of the site. In general, the ground conditions encountered comprised either topsoil or made ground to depths between 0.40m to 1.0m over interbedded firm becoming stiff silty clays and clayey silts to between 1.1m and 3.7m bgl. The silts and clays were underlain by extremely weak to very weak interbedded mudstone, siltstone and sandstone to between 1.1m and 3.5m bgl below which the rock was classified as very weak becoming weak.

Topsoil was encountered within TP101, TP102, TP103, TP104, TP105, TP106, TP113, WS101 and WS118 only. These positions were generally located in the north western area where little previous development had taken place and in areas outside the footprint of the demolished structures (Building 18 and 38).

TP112, WS102 and WS105 were undertaken within the existing car park areas and blacktop hardstanding was present from ground level to 0.10m bgl. The blacktop within TP112 was underlain by a 100mm thick reinforced concrete slab. A fine to coarse gravel of crystalline rock was identified in WS102 from 0.1 to 0.40 m bgl.

Made ground, where present was relatively shallow <1.2m, However, areas of deeper made ground / reworked soil to depths between 0.50 to 2.90 m was encountered within BH105, BH106, TP111, TP113, TP115, WS103 and WS106 as shown in Figure 5 Appendix B. The deeper made ground typically coincided former building footprints (Buildings 18 and 38). The north-western portion of Building 18 recorded deeper made ground than the eastern half. TP115 located outside of a known building footprint (west of Building 17 former solvent store) recorded made ground to 1.90 m depths.

Concrete was encountered in BH105 from 2.50m to 2.70m bgl, this was thought likely to be a relict footing, as BH105 was located to the edge of a building footprint and TP147 located in the centre of the building footprint reported natural soils from 0.80 m bgl. WS104, located on the southeastern edge of the building refused at 0.80 m, this was also thought likely to be a relict footing due to the position of the trial hole[19].

Based on BH105, BH106 and one historical borehole record (KDC Contractors Ltd BH05) the depth to rock head appears to be slightly shallower in the northern part at 53.86 m AOD relative to the southern boundary at 53.21-53.67 m AOD. A number of the window samplers refused at shallower depths in the northern area namely, WS102 at 55.93 m AOD and WS105 at 55.27 m AOD.

13.2 Eastern Area

Table 6: Summary of soils encountered within eastern half of the site

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 / 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[18]**	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 beds and minor deposits encountered within the sandstone strata.

[19] Although we understand that slabs / footings to 1.0 m bgl should have been removed as part of the demolition works in 2015/16.

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 beds and minor deposits encountered within the sandstone strata.

* - full depth of excavation

Figures 9 and 10 show geological cross-section of the eastern part of the site. 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 <2.0m over large parts.

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 2.1m and 2.2m bgl at WS111 and TP128 respectively. Deep made ground was also encountered within TP136 and TP132 to the full depth of the excavation at 2.3m and 2.1m respectively. Deeper made ground may be present in these areas where the base depth of made ground was not proven.

The base of a water storage reservoir (for the fire suppression system) was proven in BH101 with a concrete slab recorded from 3.45 to 4.05 m bgl. Sample recovery was not achieved in WS107 between 1.0m to 2.4m, a brick or concrete fragment may have obstructed the window sampler liner rather than the presence of a void. WS107 refused at 2.4m on a concrete obstruction. WS107 was located in the footprint of the former boiler house. A concrete footing was encountered in TP118 at 1.40-1.60 m bgl.

Made ground shallower than 1m bgl was generally found outside of the former building footprints and was generally near to the sites eastern margin. 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 1.8m bgl in WS108. Organic odours were also noted in firm clays in TP116 from 1.20 to 2.00m 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.

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 ~6.0m bgl, although localised bands of extremely weak mudstones were also noted at depth.

13.3 Groundwater

Groundwater strikes were recorded in the following trial holes:-

Table 7: Groundwater Strikes in Western Area

Trial Hole	Depth to Groundwater strike mbGL (m AOD)	Stratum	Comments
TP108	0.2 (57.32)	Made ground	Surface water ingress from northern face of trial pit.
TP108	1.3 ((56.22)	Interface between made ground and reworked SILT	Significant water inflow
TP110	0.6 (54.50)	Base of made ground	Moderate water seepage
TP147	0.3 (55.86)	Made ground	Slight water seepage encountered from northern face of pit
WS102	0.4 (57.53)	Base of made ground	Groundwater seepage encountered.
WS103	0.25 (57.33)	Made ground	Groundwater seepage encountered.
WS104	0.7 (55.48)	Made ground	Water seeping in obstructing view of the bottom of the borehole.
BH105	9 (47.31)	Upper Tunbridge Wells Sand Formation	Groundwater observed during drilling
BH105	14.9 (41.4)	Upper Tunbridge Wells Sand Formation	Groundwater recorded at 14.9m rising to 12.3 after 30 minutes.
BH106	19 (38.56)	Upper Tunbridge Wells Sand Formation	Groundwater observed at 19m and rising to 16.2m after 30 minutes.

In the Western Area a perched water body was encountered in made ground within the footprints of the demolished buildings. Outside of these areas, the exploratory holes were recorded as dry and stable. This was also after a period of heavy rainfall. The clayey silts in these areas may limit water percolation. Groundwater strikes were recorded in the bedrock generally at depths below 9 m. These appear to correlate to siltstone in both BH105 and BH106, where fractures may facilitate groundwater movement.

Table 8: Groundwater Strikes in Eastern Area

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
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 2.1m to 1.6m 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 2.3m to 1.8m after 20 minutes
TP137	1.1 (55.26)	Made ground	Moderate water seepage encountered at 1.1m. Water level rose from base of pit at 1.6 m to 1.4m 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
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 3.2m upon completion and at 2.2m after 30 minutes.
BH104	16 (40.42)	Upper Tunbridge Wells Sand Formation.	Groundwater recorded at 16m upon completion and at 13.7m after 45 minutes.

The Eastern Area also recorded a perched water within made ground soils, although in some trial pits where Upper Tunbridge Wells Sand Formation was encountered seepages were recorded and these typically related to siltstone and sandstone fractions. The deeper boreholes also encountered groundwater within the Upper Tunbridge Wells Sand Formation, which appear to be at shallower depths than that in Western Area.

Table 9: Groundwater Monitoring Results

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)

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)	-

MG = Made ground; UTW = Upper Tunbridge Wells Sand Formation

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.

13.4 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: Summary of Visual and Olfactory Evidence

Hole ID	Depth (m)	Olfactory Evidence	Visual Evidence