

**GEOENVIRONMENTAL
REPORT ON
GROUND INVESTIGATION
AT
HENLEY ROAD,
CAVERSHAM**



REPORT STATUS SHEET

Client:	Signature Senior Lifestyle Developments
Report Title:	Geoenvironmental Report on Ground Investigation at Henley Road, Caversham
Report Number:	AG3094-19-AJ69
Report Status:	Validated Issue 1
Date:	February 2020



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1.0 INTRODUCTION

1.1 Objectives and Scope of Investigation

Applied Geology was commissioned by Signature Senior Lifestyle Developments (the Client) to undertake a desk study/Phase I assessment and Phase II ground investigation on existing residential plots off Henley Road, Caversham. Proposals for the site comprise the demolition of the three main residential dwellings and removal of site features currently present. The redevelopment will comprise the construction of a new four to five-storey care home facility, together with car parking and peripheral landscaping. Several semi-mature to mature trees, predominantly along the southern boundary and north-western corner of the site, are legally protected and will remain as part of the redevelopment.

It is understood that Signature Senior Lifestyle Developments obtained full planning permission for the current proposed development under application ref. 190835, granted on 19th December 2019, subject to compliance of forty-one conditions. The conditions which will be addressed and in part satisfied as a result of this current ground investigation are as follows;

- Condition 23: Assess the nature and extent of any contamination on site and assess the potential risks to human health, property, adjoining land, groundwater and surface waters. It is noted that this is a pre-commencement condition (including demolition and preparatory works).

Therefore, the objectives of the investigation were to;

- assess the potential for hazardous substances or conditions to exist at the site that might warrant mitigation or remediation appropriate to the intended end use proposed by the Client.
- establish geological conditions and geotechnical parameters to assist in the safe and economic engineering design of the proposed development.

Planning Conditions 24, 25 and 26 refer to remediation activities and will only be relevant if unacceptable risks to defined receptors are identified as part of this current investigation.

A Geo-Environmental and Geotechnical report has previously been produced by Jomas Associates Ltd on behalf of Henley Road Limited 3, in April 2013 (Report Ref. P941311/PS), for an alternative proposed end use. Whilst the findings of this report have been reviewed and considered in the scope of works as part of this current investigation within Section 3.1 of this report, reference should be made to this report for full details of their initial findings.

The terms of reference/brief for the works were mutually developed between Applied Geology and Clark Smith Partnership (Engineer to the Client) based on an initial scope of works proposed by CSP and are outlined in our proposal and estimate reference AG19-6749-02 dated 27th November 2019.

The scope of works undertaken by Applied Geology comprised:

- A site inspection and walkover survey.

- A review of the following desk study sources:
 - ❑ GroundSure – GeoInsight & EnviroInsight environmental databases
 - ❑ GroundSure – MapInsight historical OS maps
 - ❑ British Geological Survey (BGS) - published information & online borehole database
 - ❑ Multi-Agency Geographical Information for the Countryside (MAGIC) online database
 - ❑ Online aerial photographs
 - ❑ Environment Agency Web Site
 - ❑ Existing reports
- Ground investigation together with sampling, monitoring and a programme of laboratory testing.
- Assessment and reporting of the results of the works.

Underground service plans for the site were provided by Fed3 Projects on the 3rd December 2019.

It should be noted that this report only addresses the geo-environmental assessment of the site. A geotechnical assessment will be included in an updated (combined) report at a later date.

1.2 Report Layout

This report presents a brief description of the site, the desk study data and the factual results of the intrusive investigations carried out. An interpretation of the ground conditions and a discussion/assessment of the findings is presented in the later report text sections. The main text of the report has been produced in a concise format, including the use of data tables to summarise key information where possible. The report should be read in conjunction with the general procedures detailed in Appendix F and General Notes given at the end of the main text, which provide details of investigation techniques, assessment methodology and standards, health & safety and limitations and exceptions of the report. Drawings and factual data including exploratory hole records, laboratory testing results and desk study records are presented in the other Appendices.

2.0 SITE DESCRIPTION AND PROPOSALS

2.1 Site Description

The site is located off Henley Road in the Caversham suburb of Reading, c.2km north-east of Reading town centre. The Ordnance Survey grid reference for the centre of the site is 473003, 175194 as shown on the Site Location Plan in Appendix A.

The site is essentially rectangular in plan shape but excludes a small quadrant of the north-east corner and measures c.120m by 95m at the longest and widest extents covering an area of approximately 0.9Ha. The site slopes down steeply from Henley Road to the frontage of the existing dwellings, becoming less steep in the rear gardens of the existing plots. Review of the topographic survey undertaken by Jomas dated 11th March 2016 (ref P9413J811-rev1), indicates the elevations of the site differ from 47.50m AOD in the north to 36.50m AOD in the south.

The site is bound to the north by the A4155 Henley Road, off which are several residential estates and small commercial/industrial business. The site is bound to the east and west by similar residential properties whilst Berry Brook stream runs parallel to the southern boundary, beyond which are Caversham Lakes and a designated nature reserve.

A site walkover was carried out on the 21st November 2019. At the time of the walkover the site was noted to comprise three entire residential plots (199 to 203) and the rear garden spaces of plots 205 and 207. Aside from the existing residential houses several outbuildings and a number of sheds, greenhouse and pergolas were noted in the rear gardens of all five plots. The properties were noted to be set into a slope and appeared to be one to two storeys in the north (front) and two to three storeys in the south (rear). The existing residential dwellings appeared to be vacant and no internal access was made available to Applied Geology at the time of the walkover.

Areas of hardstanding (asphalt/ concrete/ compacted gravel) were generally limited to the small driveways noted at the front of the properties, whilst paving patio areas were noted in the rear gardens of the plots. All hardstanding was noted to be of poor condition. The ground surface across the remaining areas of the site comprised rough grass and vegetation which appeared to have undergone some localised terracing in plots 201, 203 and 205.

Two small man-made ponds were recorded in the rear gardens of plots 205 and 207 and two separate badger sets were identified in the rear gardens of plots 199 and 201. Mature, semi-mature trees and hedgerows were noted around the periphery of the existing plots and between 199 and 201. A tree survey was previously undertaken by Tracey Clark Tree Consultancy dated February 2019 (ref; TCTC-17327-PL-01) on behalf of the Client.

An underground sewer was present centrally within the rear gardens of all plots trending east to west, as presented on the exploratory hole location plan (AG3094-19-02 Rev 1). No manholes or evidence of its location was evident during the walkover or subsequent field works.

There was no evidence of any previous ground investigation works (trial pit scars and/or install covers).

There were no obvious visual or olfactory signs of gross contamination observed during the workover.



Photo showing the rear gardens of plots 199, 201 and 203 showing the natural topography of the site (facing north).



Photo showing the rear gardens of plots 205 and 207 and a photo of a series of existing onsite sheds.



Photo showing the front gardens of plots 199, 201 and 203.

2.2 Site Proposals

Upon demolition of the existing structures, the proposed development is to comprise a new four to five-storey care home facility (Use Class C2), together with associated car parking and peripheral landscaping. Access to the site is to remain off Henley Road.

The existing residential dwellings on plots 205 and 207 will be retained, however on much smaller plots with the majority of the rear gardens redeveloped as part of this scheme.

The proposals are shown across five separate drawings, Dwg ref AA7440 dated May 2018 by PRP, which are presented in Appendix A.

The majority of the hedgerows and vegetation which separate the plots will be removed as part of the redevelopment. Category A and B trees along the southern, western and northern extents of the site are legally protected and will be retained, a construction exclusion zone, as defined on Tracey Clark Tree Consultancy drawing dated February 2019 (ref; TCTC-17327-PL-01), applies.

3.0 DESK STUDY INFORMATION

3.1 Existing Reports

The site has been the subject of previous desk study assessments and site investigations by others between September 2016 and April 2018. It is understood that these previous reports were undertaken as part of a previous planning application (Application Number 161842). Copies of the following reports have been made available to Applied Geology in order to inform the current assessment;

- Arboricultural Impact Assessment at 199 – 207 Henley Road Caversham, Reading (By Jomas Associates Ltd, ref. P9413J811), dated September 2016;
- Results of Soakage Testing at 199 – 207 Henley Road, Caversham, Reading (By Jomas Associates Ltd ref. P9413J811/mw), dated September 2016;
- Ground Investigation and Infiltration Results at 199 to 207 Henley Road, Reading (By Jomas Associates Ltd ref. P9413J811), dated September 2016;
- Ecological Assessment for land south of Henley Road, Caversham (By Ethos Environmental Planning), dated September 2016;
- Geo-environmental Desk Study/ Preliminary Risk Assessment for 199 to 207 Henley Road, Reading (By Jomas Associates Ltd ref. P9413J811), dated 5th January 2018;
- Geo-environmental and Geotechnical Assessment for 199 to 207 Henley Road, Reading (By Jomas Associates Ltd ref. P9413J811), dated 30th April 2018.

The findings of the previous Preliminary Risk Assessment (Phase 1) and Geo-environmental and Geotechnical assessment have been referenced, and the pertinent information is summarised below. At the time of reporting, reliance had not been obtained on the aforementioned reports and therefore the data has not been incorporated in to this current investigation. It is however advised that the aforementioned reports are read in conjunction with the findings of this current investigation.

A Peter Brett 'Natural and Mining Cavities Database Search and Cavities Occurrence Assessment' was obtained by Clark Smith partnership in September 2018 and as such, the information can be relied upon. This desk-based report is also reviewed below.

Previous Desk Study information – dated January 2018

Jomas Associates Ltd undertook an initial Phase 1 Desk Study, reported in January 2018, under the instruction of Henley Road Limited 3.

The desk study information and accompanying plans indicate that the site boundary was compatible with that of the current Applied Geology investigation. However, the proposed end use was for the erection of 42 residential dwellings; 12 semi-detached properties and a 3-storey block of apartments and not a four to five-storey car home facility.

The desk study information indicated that site was largely undeveloped agricultural land until 1932, when it was designated in to five separate strips of north to south trending plots. Three detached residential properties were noted in the north with their

rear gardens extending southwards towards Berry Brook. By 1956, additional buildings were shown in the north-east and south-east corners of the site, respectively; with some expansion to the existing structures in the north. Jomas Associates stated that there were no further significant on-site changes up to the present day (2018).

The report identified that the surrounding area was of an agricultural land use and that a chalk and gravel pit were shown in close proximity to the site, but by 1913 were labelled as 'old'. The report suggested that by 1932, these former pits were infilled and a large part of the surrounding area to the north and west was developed into residential use. The report does not indicate any further changes until 1972, when a large gravel pit was mapped 500m south-east of the site. This gravel pit was noted as expanding with further pits being advanced in the immediate area until 2002, when the pits were flooded as man-made lakes.

The report states that the site slopes in the order of 11m to the south.

The desk study indicated that the site was likely to be underlain by Solid deposits of Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated), which was noted to be a Principal Aquifer. Superficial drift deposits were unlikely to be encountered.

The report identified the site as being located within an Environmental Agency Source Protection Zone 2 and 3, with a potable water abstraction point located c.600m north of the site.

The nearest surface water feature was identified as Berry Brook – along the southern border of the site.

The desk study data stated that the site was within an Environment Agency Zone 2 and 3 floodplain.

On the basis of the initial desk study an intrusive investigation was recommended.

Intrusive investigation work – dated April 2018

Jomas Associates Ltd undertook a ground investigation, reported in April 2018, under the instruction of Henley Road Limited 3. The previous investigation comprised;

- Eleven Window Sampler/ Driven Continuous Sampling boreholes (WS1 to WS11) to a maximum depth of 6.00m below ground level (bgl);
- Three Cable Percussion boreholes (BH1 to BH3) to a maximum depth of 20m bgl;
- Five California Bearing Ratio (CBR) tests, carried out using dynamic probe methodology.

The previous investigation identified cohesive Topsoil to between 0.10 and 0.40m bgl, overlying cohesive Head Deposits to depths ranging from 0.50 to 2.80m bgl with the Undifferentiated Chalk encountered at depth and proven to the base of the exploratory holes. In the south, medium dense gravelly sands were encountered beneath the Head Deposits and were proven to the base of the exploratory holes. No strata name was assigned to the sands and gravels. Groundwater was reported at

depths of between 2.00m and 8.70m bgl. The difference in level was determined to be the result of the natural topography across the site.

The results of the chemical analysis undertaken (10no samples) indicated no concentrations of any determinands detected in site soils in excess of the associated Generic Assessment Criteria (GAC) within a 'residential with plant uptake' end use scenario.

Asbestos in the form of loose chrysotile fibres was detected in one sample obtained from WS1 at 0.50m bgl (western boundary of the site).

The previous report identified that conventional foundations would be unsuitable for the proposed development and that a piled foundation solution within the underlying chalk should be considered moving forward.

5no CBR tests were undertaken using a Perth Penetrometer Probe and based on the lowest results an equilibrium CBR of 0.7% was recommended across the site. However, it was acknowledged that proof rolling any granular materials at surface would provide a greater result.

The report identified that buried concrete should be designed to Sulphate Class DS-1, with an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1.

Only one return gas monitoring visit was undertaken as part of the previous investigation. Results of this one visit identified the site to be classified as a Characteristic Situation 1/ NHBC Green, for which gas protection measures are not required.

Jomas Associates recommended that additional shallow sampling and analysis for asbestos be undertaken in the area of WS1 in order to delineate the source of the asbestos. Furthermore, a Flood Risk Assessment was recommended in order to determine the highest predicted relevant flood level for the site.

Natural Cavity Database Report – dated September 2018

The Peter Brett Associates (PBA) report identified a low risk of historical chalk mining on site. This is likely due to the relatively shallow groundwater encountered during the original Jomas intrusive investigation in April 2018. The report noted the nearest natural and mining related cavities to be located c. 890m west and 1.5km north-east of the site, respectively.

Based on the information reviewed as part of this assessment, PBA assigned a rating of moderate for the potential for solution features to be present at the chalk interface and a rating of high for solution features to be present at depth. However, PBA note that the potential for past chalk mining at the site is considered low, due to a high ground water table, despite the presence of a chalk pit adjacent to the north-west corner of the site.

PBA noted that should foundations be placed in the north of the site, where the chalk surface is understood to be shallow, then shallow foundations or piles would be considered acceptable, providing the chalk surface did not show signs of infilling or disturbance. Further south, where the ground conditions are understood to be much more variable and the chalk interface is at greater depths, then a piled foundation

taken into the chalk at depth would be considered more acceptable. PBA suggested that each pile position be probed to a minimum depth of 5m below the base depth of the pile ahead of installation, in order to check for voids. Alternatively, PBA suggested that the piles could be designed to support the structural loads entirely by shaft friction in the chalk, ignoring end bearing in case of future upward void migration from depth.

3.2 Applied Geology Desk Study

The Applied Geology desk study findings are summarised below with the full Groundsure Report and selected Historical Ordnance Survey Maps included in Appendix B.

Site History	• 1878-1879- The site and surrounding area are agricultural fields, with Micklands farm and Lowlands Farm c.250m to the north-east and south-west, respectively. An unnamed Road runs parallel to the northern boundary of the site (not known as Henley Road at this time) with a mapped chalk pit to the adjacent north-west and a gravel pit beyond. A second gravel pit is mapped c.600m to the west of the site. Berry Brook aligns the south of the site, with Berry Brook Ait (an island on the River Thames) located c.50m south-west. The River Thames is located c.1km to the south of the site. • 1897-1898- There are no further significant changes noted on site. The gravel pit to the north-west has undergone expansion. • 1910- 1913- There are no further significant changes noted on site. The chalk pit and gravel pits are labelled as 'old'. There has been further development to the settlements of Caversham and Lower Caversham. • 1932- 1938- The site has been developed and is divided into rectangular plots with access off the adjacent north Henley Road. The properties are positioned within the extreme north of the site with long rear gardens. The surrounding area has undergone extensive residential development with the expansion of Caversham. The former quarry pits to the north-west and west of the site have been redeveloped with residential properties. The former chalk pit is an area of soft landscaping. • 1951- 1956- A small shed like structure is present in the south-east corner of plot 207. There has been further expansion with further properties to the north and east along Henley Road. • 1968- 1973- A small shed/garage type feature has been constructed to the rear of plot 199. A large-scale gravel pit, approximately 750m in length and 100m wide is located c. 500m south of the site. • 1979- There are no further significant changes on site. The large-scale gravel pit has undergone further expansion and is in the order of 750m in length and 500m wide. • 1989- 1990- There are no further significant changes on site. The gravel pit is now labelled as a nature reserve. There are two further gravel pits noted c. 350m south and 800m south-east of the site. • 1990- 1994- There are no further significant changes on site. There is a fourth gravel pit labelled c. 750m south, south-west of the site, adjacent to the nature reserve (former gravel pit). • 2010- There are no further significant changes on site. The gravel pits are no longer labelled. It is assumed they are now all part of the nature reserve. • 2019- There are no further significant changes on site. The area of soft landscaping to the immediate north-west of the site has been redeveloped with a large residential apartment block. • Aerial imagery dated 2003 to 2018 does not identify any significant changes on site, however does identify that the adjacent west residential apartment block underwent construction in later months of 2003. This information was not shown on the available historical maps.
Anticipated Geology and	• The published BGS Map indicates the site is underlain by Solid Geology of the Upper Cretaceous Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated). Drift Deposits of the Lynch Hill Gravel

Ground Conditions	Member and Kempton Park Gravel Member are mapped across the northern and southern boundaries of the site, respectively. Alluvium and clays/silts of the Langley Silt Member are mapped across the centre and lower parts of the site. Head/Head Gravel Deposits of the Quaternary Period are mapped on slopes to the north-east further along Henley Road and these may be present on site. • A search of available (archived) borehole records held by the BGS indicates that there are four borehole records held within 1km of the site. The nearest is c.400m to the north at Micklands Primary School, whilst the remaining three are located c. 500 to 700m to the north-east off Hawthorne Road. These boreholes were advanced to depths of 4 or 5m and indicate a ground profile of topsoil (0.20 to 0.50m bgl) over Superficial Drift comprising firm gravelly silts/clays, over medium dense to dense sandy gravels of flint. Chalk of the Seaford Chalk Formation and Newhaven Chalk Formation was only encountered in the furthest borehole at a depth of 3.20m bgl. Groundwater was not encountered in any of these boreholes and so it is assumed to be a depth in excess of 5m in the underlying chalk. These borehole logs are presented in Appendix B. • As mentioned in Section 3.1, the results of the previous ground investigation undertaken by Jomas Associated (April 2018) identified a ground profile comprising Topsoil (up to 0.40m), over cohesive Head deposits (up to 2.80m) with the Undifferentiated Chalk proven to the base of the exploratory holes (20m bgl). Granular Drift Deposits were only encountered in the south of the site from 1.00m to 2.80m bgl and these too were proven to the base of the exploratory holes in this area (5.45m bgl. No strata name was assigned to the sands and gravels. Groundwater was recorded between 2.0m and 8.70m bgl. The variable difference in levels was as a result of the natural topography of the site. • The site is not in a radon affected area, with <1% of homes above the Action Level. No radon protection measures are therefore considered necessary for new properties.
Mining/Quarrying	• The site is not indicated to be within an area of underground coal mining activities. • The historical plans show a chalk pit adjacent to the north-west corner of the site from 1878 to 1910, when it was then labelled as 'old' and was only recently developed into a residential apartment block (under construction in 2003). Aside from this the GroundSure Geo-Insight report suggests that sporadic underground mining may have historically occurred onsite and in the immediate area. • Reference to the GroundSure Geo-Insight report (which contains information from the updated Peter Brett Associates' database of known natural and man-made chalk solution features) indicates that there are thirteen known natural cavity solution features within 1km of the site. The nearest of which is located c.722m west of the site. This generally coincides with the information provided by Peter Brett Associates (reviewed in Section 3.1 above). • There are records held of a Johnson Poole and Bloomer mining area within 1km of the site. Enquires were made with Groundsure/ Johnson Poole & Bloomer, which noted that there are no archival plans relating to the site. The nearest record is of Woodley Aerodrome, which is located c. 4km south of the site. No further information was provided. The response from Johnson Poole and Bloomer can be found in Appendix B. • The historical mapping of the site identified extensive historical quarrying for sand and gravel (likely to be for the Lynch Hill Gravel Member) to the north of the site from <1878 to 1910. These gravel pits appear to be small scale and localised. There is no evidence to suggest they were backfilled as later they developed on as residential housing in the 1930's. • During the 1960's a series of gravel pits were advanced (probably for the Kempton Park Gravel Member) c.500m south of the site. In the following years these pits were expanded and by 1989 they were flooded with water and became a marina and nature reserve. These quarrying operations appear to have been on a larger scale to those in the north,

	this is likely due to a greater thickness of sands and gravels encountered here.
Hydrology	- The nearest surface watercourse is Berry Brook a stream which runs parallel to the south of the site and is located on the flood plain of the River Thames, which is located c.1km south of the site. Caversham Lakes (former quarries) are located c. 300m to the south between Berry Brook and the Thames. - There is no river quality data available for the adjacent south Berry Brook. However, the River Thames has been graded as 'A' for biological and chemical quality since 2006 onwards. - The southern half of the site lies within a river and coastal Zone 2 and 3 category floodplain and the associated risk of flooding is high along the southern boundary dissipating to low further north. This report is not intended to be a full hydrological study and if a flood risk assessment is needed, additional analysis by others is recommended. - There are no records of historic/operational Licensed Discharge Consent for the site. The nearest recorded license was held by a quarry facility c.340m south of the site. The associated permit number is CTCR.0811 and the license was revoked in November 1992, however prior to that was held for 27 years. - There are no recorded surface water abstraction licenses within 250m of the site.
Hydrogeology	- The Kempton Park Gravel Member and Lynch Hill Gravel are classified as 'Secondary A Aquifer's' by the Environment Agency, whilst the underlying Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated) is classified as a 'Principal Aquifer'. If present on site, the Head and/or Alluvium would likely be classified as Unproductive. - The site lies in a Total Catchment Zone 3 Source Protection Zone. - The nearest recorded active groundwater abstraction license is located c.784m east of the site, held by Tarmac Aggregates Limited at Deans Farm for mineral washing. Approximately 210,860m³ of water is abstracted per annum. - The nearest potable water abstraction license is located c.1300m north-east of the site. - Based on the topography of the site, likely groundwater flow direction is to the south.
Other Environmental data	- There is one operational BP petrol and fuel site located c.130m (north) west of the site. - There is one electricity substation noted 11m south-west of the site on Ruskin Road. - There are two records of Part A(2) and Part B activities located within 200m of the site. The nearest is held by the BP garage for the unloading of fuel into storage tanks at the service stations. - There are no recorded hazardous or dangerous sites within 500m of the site. - There is one recorded pollution incident located c.375m south-west of the site, which involved the disposal of inert materials and wastes. The incident was assigned a Category 4 (no impact) for water, land and air. - There are no records held for any operational/historical landfills and other waste sites within 500m of the site.

Planning Application Search

Review of the Local Authority Planning Portal identified that the site has been subject to a previous 'historic' planning application, under reference number 161842. The proposals for the site comprised the demolition of the existing dwellings (plots 199 to 203) and the erection of up to 60 dwellings at 199 to 203 Henley Road and to the rear of 205 to 207 also. The new dwellings were to comprise 12no semi-detached houses with private gardens to the south of the site, and a three-storey block of apartments across the northern half of the site. Plans identified that the apartment block was to

comprise a basement car park under the entire building footprint. Access to the site was to remain off Henley Road, Caversham.

The application was originally received by Reading Borough Council on 28th September 2016. No desk-based studies or ground investigation reports were included as part of the online submission; however, it is likely that the Jomas Associates historic reports and investigations were undertaken as part of this application, based on the corresponding dates.

The application was officially refused by Reading Borough Council on 18th January 2017.

No relevant information was available for the original development of the site in the 1930's with the construction of the existing residential dwellings.

As mentioned, full planning permission for the proposed redevelopment was obtained on 19th December 2019 under the reference number 190835. The planning permission along with the associated conditions is presented in Appendix B.

4.0 CONCEPTUAL SITE MODEL

4.1 Diagrammatical Illustration

The Conceptual Model for the site, showing the main elements of the surface and subsurface conditions and including the potential contaminant sources, pathways and receptors identified from the desk study information is presented in Appendix A as Drawing No AG3094-19-03. The potential sources, pathways and receptors are defined in the following sections:

4.2 Sources

- Made Ground soils on site associated with the existing residential developments;
- Spillages/leakage of fuels/oils on site from domestic garages and parked cars (predominantly in the north of the site);
- Onsite and offsite ground gases associated with decomposition of organic material in Made Ground and potential Alluvium Deposits (if present);
- Sulphates in Made Ground and underlying natural strata.

The identified former quarries/pits (chalk and gravel) adjacent to the northern boundary of the site are not considered to represent a source of gross contamination, as there is no evidence to suggest they were backfilled as later developed upon as residential properties in the 1930's.

Similarly, the former gravel pits c.500m south of the site are not considered to represent a source of gross contamination as they were never infilled and instead became bodies of water.

The electricity sub-station located c. 11m west of the site is not considered to represent a plausible source of contamination; considering the recent age of the sub-station. PCB's were not used in sub-stations at this time.

The operational BP petrol and fuel site located c.130m (north) west of the site is not considered to represent a plausible source of gross contamination due to the distance from site and the anticipated depth to groundwater (approximately 8m bgl in the north of the site).

4.3 Pathways

- Human dermal contact (within areas of soft landscaping);
- Human ingestion via soil directly;
- Human inhalation of dust or vapours;
- Direct contact with buried concrete/water supply services;
- Leaching and/or migration through permeable soils (granular Made Ground/ granular superficial deposits/ Undifferentiated Chalk).

4.4 Receptors

- End users (Human Health);
- Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated) – Principal Aquifer (Controlled Waters);
- Berry Brook stream (Controlled Waters);
- Buried foundation/substructure concrete (Building Materials);
- Water supply services (Building Materials).

4.5 Source/Pathway/Receptor Linkage and Assessed Risk

Source-pathway-receptor (SPR) linkages are tabulated below together with the qualitatively assessed risk. The risk to ground workers and construction workers is not included here due to the short-term exposure times that they will be subject to and the assumption that good hygiene practices will be adopted on site and the appropriate use of relevant PPE/RPE will be adhered to when exposed to potentially contaminated soils. Comments regarding contamination issues with respect to ground workers and construction workers are included in the health and safety section of the Standard Procedures included as Appendix F.

Source	Pathway	Receptor	Risk*
Potential contaminants in any Made Ground (on site including asbestos)	Dermal contact, ingestion and inhalation of dust	End Users	Low
	Migration and leaching	Aquifer	Low
		Berry Brook	Low
	Direct contact	Water supply pipes	Low
Potential spillage/ leakage of fuels/ oils onsite	Dermal contact, ingestion and inhalation of dust	End users	Low
	Migration and leaching	Aquifer	Low
		Berry Brook	Low
	Direct contact	Water supply pipes	Low

Source	Pathway	Receptor	Risk*
Ground gas from onsite and offsite Made Ground and/or Alluvium Deposits	Migration into buildings, service ducts, etc (inhalation and/or explosion)	End Users	Low to Medium
Elevated sulphated in Made Ground and/or natural soils (onsite)	Direct contact	Buried contact	Low

*** Definition of Risk Categories**

Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.

Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.

Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.

High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 GROUND INVESTIGATION WORKS

5.1 Fieldwork

The following scope of fieldwork was undertaken:

- 9 No 150mm diameter Cable Percussion boreholes (ref. BH101 to BH109) to final depths of between 9.65 and 20.50m bgl;
- 4 No Driven Continuous Sampling boreholes (ref DCS101 to DCS104) to final depths of between 1.20 and 5.45m bgl;
- 4 No Machine Excavated Trial Pits (ref. TP101 to TP104) to final depths of between 2.24m and 3.90m bgl;
- 2 No Soakaway infiltration tests within trial pits TP101 and TP102;
- 6 No TRL DCP test (ref TRL101 to TRL106);
- 3 No hand dug pits (ref. HDP101 to HDP103) to final depths of between 0.60m and 0.70m bgl.

The boreholes, trial pit and hand pit records are included in Appendix C of this report together with a SPT summary and calibration certificates. The Soakaway and TRL DCP records are included in Appendix D.

Service plans were obtained prior to the commencement of site works and the exploratory positions were scanned using a CAT and corresponding signal generator prior to advancement by a suitable qualified engineer. The boreholes were initially advanced to 1.20m using insulated hand digging tools.

The Cable Percussion and Driven Continuous Sampling boreholes were positioned within the footprint of the proposed care home facility. Trial pit excavations and hand pits were advanced in areas of car parking and soft landscaping, respectively.

Six tests were undertaken using a Transport Research Laboratory Dynamic Cone Penetrometer (TRL DCP) in order to determine the in-situ CBR profile of the soils within proposed areas of hardstanding (access roads/ car parking). The results are plotted as number of blows versus depth penetrated bgl with equivalent CBR values for individual layers. The results are included in Appendix C.

Environmental samples were obtained from the majority of exploratory holes to allow subsequent chemical laboratory testing. Additional representative bulk and disturbed samples were collected from all strata to allow geotechnical laboratory testing.

The exploratory hole positions were selected and mutually agreed with Clark Smith Partnership prior to the commencement of the investigation. Due to the presence of several legally protected mature/semi-mature trees around the periphery of the site, exploratory positions were located outside any designated Root Protection Areas (RPA). Due to the presence of two separate badger setts within the rear gardens of plots 199 and 201, ecologists from Ethos Environmental Planning attended site to undertake surveys and subsequently map the location of the sett entrances, thus ensuring that no ecological receptors were compromised during works. Monitoring was undertaken for one month from 10th December 2019 to 7th January 2020 to ensure the setts were inactive, after which boreholes in close proximity (BH103 and BH109) were advanced.

An Exploratory Hole Location Plan is presented as Drawing AG3094-19-02 Rev 1 in Appendix A. The exploratory hole locations were located approximately by reference to physical features present on site and within the vicinity of the site at the time of the investigation.

5.2 Instrumentation and Monitoring

On completion of boring, 50mm diameter standpipes were installed in several boreholes across the site to facilitate groundwater level and ground gas monitoring and sampling. Standpipe details are as follows, with further details presented on the borehole logs in Appendix C.

Location	Response zone (m bgl)	Stratum
BH101	1.00 to 8.00	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)
BH102	2.00 to 10.00	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)
BH107	2.00 to 6.00	Head/Alluvium and Kempton Park Gravel
BH107	9.00 to 14.00	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)
BH108	1.00 to 6.00	Head/Alluvium and Kempton Park Gravel
BH109	3.00 to 8.00	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)

Washed silica gravel (6-10mm) was used as the filter medium. 50mm standpipes were all fitted with a push in bung and single gas tap and were finished with a flush metal cover cemented in place.

Ground gas and groundwater monitoring visits were undertaken on two occasions to date on the 28th January and 5th February 2020 during one period of falling atmospheric pressure. Each monitoring well was monitored for concentrations of

carbon dioxide, methane, oxygen, flow rate, differential pressure and groundwater level. The monitoring results are included as Appendix D.

A third and final monitoring event has been scheduled for 14th February 2020. The results will be presented and discussed in the updated geo-environmental and geotechnical ground investigation report.

Groundwater was purged and subsequently sampled during the second monitoring visit on the 5th of February from three selected cable percussion boreholes (BH102, BH107, BH108). Prior to this during the first phase of monitoring, all the installed standpipes were developed using Interia tubing and surge block. In all cases, groundwater levels recharged to almost original levels, quickly.

5.3 Laboratory Testing

Geotechnical laboratory testing was undertaken by specialist laboratory Terra Tek Site Investigation and Laboratory Services (UKAS lab no. 0126) on selected samples and comprised the following:

- 5 No natural moisture content tests;
- 5 No Atterberg limit tests;
- 8 No particle size distribution tests;
- 4 No BRE SD1 natural and pyritic suite tests;
- 20 No BRE SD1 natural suite tests;
- 2 No Chalk Crushing Values;
- 14 No Chalk moisture content, porosity and density tests.

Aside from the BRE testing, the remaining geotechnical laboratory testing will be discussed in the updated (combined) geoenvironmental and geotechnical report.

Chemical testing was undertaken by specialist laboratory Chemtest (UKAS lab no. 2183). The scope of testing was based on the desk study, walkover and site observations during the fieldwork.

Made Ground

Three samples of the Made Ground were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, cadmium, chromium (total, trivalent and hexavalent), copper, mercury, nickel, lead, zinc, selenium];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- Phenols (total);
- pH;
- Water soluble sulphate;
- Asbestos Containing Materials (ACM) Screen;
- Soil organic matter;
- Total Petroleum Hydrocarbons (TPH) by the TPHCWG method;
- Benzene, toluene ethylbenzene and xylene (BTEX); and
- Methyl tertiary butyl ether (MTBE).

Natural Soils

Ten samples of Topsoil and one sample obtained from the Head/Alluvium were tested for the following suite of contaminants;

- Selected metals suite [arsenic, cadmium, chromium (total), copper, mercury, nickel, lead, zinc, selenium];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- pH;
- Water soluble sulphate; and
- Soil organic matter.

Five samples of Topsoil were screened for the presence of any ACM.

Three samples of Topsoil were screened for the presence of petroleum hydrocarbons by the TPH 9 band method.

Four inert WAC tests were undertaken; on one sample of the cohesive Head/Alluvium and three on the underlying Undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation.

Laboratory test results are included as Appendix E.

Groundwater

Three samples of groundwater from boreholes BH102, BH107 (deeper well) and BH108 were analysed for the following suite of contaminants;

- Selected metals suite [arsenic, cadmium, chromium (total), copper, mercury, nickel, lead, zinc, selenium];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- pH;
- Water soluble sulphate; and
- TPH 9 band.

At the time of issuing this report, the results of the groundwater analysis were outstanding. These will be presented and discussed in the updated geo-environmental and geotechnical ground investigation report for the site. Given the sites history and the site findings significant contamination is not anticipated to be present in groundwater beneath the site.

6.0 GROUND CONDITIONS

6.1 Strata Encountered

Made Ground soils were only encountered across the northern half of the site in areas of existing development. Aside from the localised Made Ground, the investigation has typically recorded a sequence of superficial strata comprising Topsoil directly underlain by Head/Alluvium over Solid geology of the Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated). Exploratory holes located in the centre and south of the site recorded the Superficial Kempton Park Gravel Member between the Head/Alluvium and Chalk.

Full details of the strata encountered are given on the exploratory hole records presented in Appendix C. A generalised ground profile is presented below to summarise the information.

Stratum	Depth to Top of Strata (m bgl)	Depth to Base of Strata (m bgl)	Comments
Hard Standing	GL	0.10	Only recorded in DCS101.
Made Ground	GL to 0.10	0.30 to 1.10	Recorded in TP103, DCS101 and DCS102. Deepest in TP103 along the eastern extent of the site.
Topsoil	GL	0.15 to 0.60	Recorded across the centre and south of the site.
Head/Alluvium	0.15 to 0.60	0.60 to 4.20	Recorded in every exploratory hole with exception of TP103. The base of this stratum was not proven in the hand dug pits.
Kempton Park Gravel	1.40 to 4.20	2.00 to 8.30	Recorded across the centre and south of the site, excluding the hand dug pits. Recorded to greater depths in the south.
Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)	2.00 to 8.30	Proven to full depth of the investigation	Recorded in every exploratory hole, except for TP102 and TP102a and the hand dug foundation pits.

6.2 Hard Standing

DCS101 was positioned on the driveway of Plot 199 and encountered asphalt hardstanding to a final depth of 0.10m bgl.

This exploratory hole was broken out using a hand-held mechanical breaker.

6.3 Made Ground

Made Ground was encountered in exploratory holes located in the north (DCS101, DCS102 and TP103), in areas of existing development. These soils were encountered from surface in DCS102 and TP103 and beneath a nominal cover of asphalt in DCS101, as discussed above. This stratum was proven to a final depth of 0.30m bgl in DCS101 and DCS102, whilst a greater thickness of Made Ground was encountered in TP103 (1.10m bgl). There are a number of structures and evidence of some regrading/terracing to the rear of the existing properties onsite, hence locally Made Ground may be deeper.

In DCS101 and DCS102 this stratum comprised a soft light brown slightly gravelly sandy clay with a gravel content comprising flint, brick and chalk. The soils in TP103 however comprised a brown slightly gravelly clayey sand with a gravel content comprising brick, plastic, concrete, metal, flint, chalk and frequent cobbles and

boulders of flint. A relict masonry brick wall obstruction was encountered at a depth of 0.50m bgl along the western extent of the pit. This obstruction was easily removed by a JCB 3CX during advancement. The increased thickness of Made Ground in TP103 and presence of a relict brick wall, suggests a former structure was present in this area.

6.4 Topsoil

Topsoil was encountered in the majority of exploratory holes as a brown sandy clay with occasional roots, rootlets and flint gravels. The thickness of the topsoil layer ranged from 0.15m and 0.60m.

6.5 Head/Alluvium

Superficial clay has been encountered across the majority of the site, with the exception of BH102 and TP103 where Chalk was encountered directly beneath Topsoil and/or Made Ground. As shown on the published BGS maps, cohesive Head Deposits are mapped to the north-east of the site (along Henley Road) and Alluvium is mapped across the centre and south of the site. The clays encountered during this investigation were consistent and therefore no determination of whether the clay is Head or Alluvium could be made. For the purposes of discussion this stratum will be referred to as Head/Alluvium.

This stratum was proven to final depths ranging from 0.60m and 0.80m bgl in the north increasing to final depths of 1.40 to 4.20m bgl across the centre and south of the site. The base of the Head/Alluvium was not proved in the shallow hand pit excavations along the southern boundary.

The Head/Alluvium comprised very soft to soft (occasionally firm) sandy clay with occasional fine to coarse flint and chalk gravels. Organic rich materials or relict roots and rootlets were typically not encountered.

6.6 Kempton Park Gravel Member

Strata considered to represent the Kempton Park Gravel Member were encountered across the centre and south of the site (TP101, TP102, TP102A, BH103, BH104, BH105, BH106, BHH107 and BH108), directly beneath Head/Alluvium. This stratum was proven to depths ranging from 2.00m and 8.30m bgl, with greater thicknesses of sands and gravels noted in the south (BH104, BH106, BH107 and BH108), as shown on the cross-sectional drawing (AG3094-19-04) presented in Appendix A. This stratum was not proven in TP102 and TP102A (2.24m and 2.90m bgl), along the eastern extent of the site.

The Kempton Park Gravel Member generally comprised medium dense (occasionally loose) orangish/yellowish brown clayey/silty gravelly sand grading in to orangish/yellowish brown clayey/silty sand and gravel. In both BH106 and BH108 in the south, bands of firm yellowish/orangish brown slightly gravelly sandy clay were encountered at depths of 1.95 to 3.80, then 5.45 to 6.30m and 5.40 to 5.80m bgl, respectively. Collectively a gravel content comprising fine to coarse subangular to rounded flint and rare chalk was encountered with occasional cobbles and boulders of flint.

6.7 Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)

Strata considered to represent the Undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation were recorded in all exploratory hole positions except for the shallow hand pits (HDP101, HDP102, HP103) and two trial pits in the east (TP102 and TP102a). In the north of the site where Superficial Deposits were of nominal thickness (if present at all) this stratum was encountered from depths of 0.30 to 1.10m bgl; in the central area from depths of 2.00 to 4.30m bgl and in the south where a greater thickness of Superficial Deposits were encountered, this stratum was recorded from depths of between 6.30 and 8.30m bgl.

As part of the cable percussion and dynamic sampling drilling, the methods of sampling severely disrupt any structure present in the chalk strata, leading to the recovery of disturbed samples. As such, full engineering descriptions and the assignment of chalk grades has not been possible for these positions. However, a distinct weathering profile was identified in the trial pits, as discussed below;

Structureless Grade Dc Chalk was encountered beneath the Superficial Deposits (1.20m to 2.00m bgl) within TP101, TP103 and TP104. The strata comprised structureless creamy white to white slightly sandy slightly silty/ clayey low to medium density Chalk with occasional flint gravels and cobbles.

Grade Dm Chalk was encountered beneath the Grade Dc horizon in TP104 from 1.60 to 2.40m bgl. The grade Dm chalk comprised structureless cream white to white gravelly clayey chalk silt, with a gravel content comprising medium density Chalk and rare flint.

Chalk interpreted as structured in-situ was encountered directly beneath the Grade Dc and Grade Dm Chalk in TP103 and TP104. The depths to the top of the structured Chalk was a consistent 2.40m bgl in these two trial pits and this stratum was proven to the full depth of the investigation (3.70 to 3.90m bgl). Whilst the materials excavated were recovered as structureless, the sidewalls of the trial pits comprised very weak to weak off white to white Chalk with occasional flint gravels and cobbles. Due to the depth of this strata in the trial pit, no discernible fractures were recorded /measured.

6.8 Groundwater and Soakaway Tests

Groundwater strikes were encountered at various depths across the majority of the site as detailed in the table below. The only holes not to encounter groundwater were DCS101, DCS102, DC103, DCS104, TP101. TP102a, TP103 and TP104.

Location	Stratum	Depth of Strike (m bgl)	Depth of strike (m AOD)	Groundwater level after 20min (m bgl)	Comments
BH101	Undifferentiated Chalk	8.40	36.12	8.30	Strike
BH102	Undifferentiated Chalk	6.20	35.80	5.20	Slow inflow strike
BH103	Kempton Park Gravel Member	4.20	35.42	2.20	Slow inflow strike

Location	Stratum	Depth of Strike (m bgl)	Depth of strike (m AOD)	Groundwater level after 20min (m bgl)	Comments
BH104	Head/Alluvium	3.20	34.56	2.20	Slow inflow strike
BH105	Undifferentiated Chalk	4.80	33.06	4.40	Strike
BH106	Kempton Park Gravel Member	4.00	33.28	3.80	Strike
BH107	Head/Alluvium	3.40	33.60	2.50	Strike
BH108	Kempton Park Gravel Member	4.50	32.42	4.30	Strike
BH109	Undifferentiated Chalk	4.00	34.30	3.90	Strike
TP102	Kempton Park Gravel Member	2.50	34.50	2.50	Strike

Groundwater levels may fluctuate for a number of reasons, including in the short term the prevailing weather conditions immediately before and during investigation and monitoring works. Long-term seasonal variations should also be expected.

During the subsequent monitoring programme to date (2 visits), standing groundwater levels in standpipes were recorded and are summarised below.

Location	Stratum	Response Zone	Depth to groundwater (m bgl)	Depth to groundwater (m AOD)
BH101	Undifferentiated Chalk	1.00 to 8.50	8.39 to 8.42	36.10 to 36.13
BH102	Undifferentiated Chalk	2.00 to 10.00	5.71 to 5.81	36.19 to 36.29
BH107	Head/Alluvium and Kempton Park Gravel	2.00 to 6.00	1.43 to 1.51	35.49 to 35.57
BH107	Undifferentiated Chalk)	9.00 to 14.00	1.43 to 1.51	35.49 to 35.57
BH108	Head/Alluvium and Kempton Park Gravel	1.00 to 6.00	1.24 to 1.32	35.60 to 35.68
BH109	Undifferentiated Chalk	3.00 to 8.00	2.89 to 2.96	35.34 to 35.41

Relatively stable groundwater was recorded during the two subsequent monitoring visits at depths of between 1.24m and 8.42m bgl or 35.34m to 36.29m AOD. These results suggest that groundwater flows southwards and follows the natural topography of the site.

Preliminary soakaway tests were carried out in two trial pit locations (TP101 and TP102A). The soakaway tests were carried out in accordance with BRE Digest DG365 methodology and three test fills were undertaken over a course of two days. The results of the tests are included in Appendix D, including the calculations in accordance with BS 5930 (BSI, 1999).

Test ID	Stratum	Test results (m/s)
TP101 (Fill 1)	Kempton Park Gravel and Undifferentiated Chalk	2.38×10^{-5}
TP101 (Fill 2)		2.67×10^{-5}
TP101 (Fill 3)		1.86×10^{-5}
TP102A (Fill 1)	Kempton Park Gravel	5.44×10^{-5}
TP102A (Fill 2)		3.55×10^{-5}
TP102A (Fill 3)		2.74×10^{-5}

The Head/Alluvium recorded at the top of TP101 and TP102A can be considered practically impermeable so the infiltration rates calculated can be attributed to a combination of both the Kempton Park Gravel Member (gravelly sand) and the upper horizons of the Undifferentiated Chalk in TP101 and solely to the Kempton Park Gravel Member (gravelly sand) in TP102A.

As is normal and expected the infiltration rates generally reduced with successive fills of the test pits and it is recommended in BRE DG 365 that the results from the third fill is taken as being most representative for long term design purposes.

6.9 Contamination

Typically, aside from the general composition of the Made Ground material, no significant visual or olfactory indicators or potential gross contamination of the Made Ground soils were encountered.

No visual or olfactory evidence of contamination was recorded within the natural soils across the site.

6.10 Soil Gas

The full results of the two phases of ground gas monitoring undertaken to date are included in Appendix D. Methane concentrations below the limit of detection (<0.1%) were recorded together with carbon dioxide concentration of between 0.1% and 2.3%. Oxygen concentrations were recorded between 14.8% and 20.5% and flow rates were generally recorded at less than 0.1l/hr (limit of detection) however negative flow values of -0.1l/hr were recorded in BH107 and BH109 during the first visit and in BH102 during the second monitoring visits. Based on the highest recorded steady carbon dioxide and methane concentrations and the highest average flow rate from the three visits Gas Screening Values of 0.0023 l/hr (carbon dioxide) and 0.0001 l/hr (methane) are calculated.

7.0 GEOENVIRONMENTAL ASSESSMENT

7.1 Human Health Risk Assessment

The results of the chemical testing on soils have been assessed as described in Appendix F, with specific details as follows:

- Proposed end-use – new five-storey care home facility with gardens and/or landscaping (Use Class C2),

- Screening criteria – Residential with plant uptake, assuming 1% SOM; Assuming a single dataset based on the size of the site, the site's history, current land-use and the proposed redevelopment

There are no published generic screening criteria for a care home facility end use. It could be argued that the critical receptor is an adult worker present on site from the age of 16 to 65. Therefore, a commercial end use criterion would be considered appropriate. However, given the amount of landscaping present on the proposed development plan (Appendix A) and to reflect the end use as a care home, a more conservative residential with plant uptake criterion has been used to give an initial screen (and worst case).

The spreadsheets summarising the laboratory results and relevant screening values for each dataset are presented in Appendix E.

None of the determinands tested for were found to exceed the corresponding screening values for a Residential with plant uptake end use.

The results of the Total Petroleum Hydrocarbons (TPH) tests all returned values below the relevant human health screening values, however detectable levels of 710mg/kg were recorded in the Made Ground soils in DCS101 at 0.30m bgl. The concentrations were generally in the equivalent carbon fractions C₁₆-C₃₅, potentially indicating weathered diesel or motor oil leakage. This concentration is of a low-order and so not considered to be of concern.

Of the thirteen PAH tests undertaken, eleven were recorded at less than the detection limit (2mg/kg), the majority of which were within Topsoil and/or Alluvium. Two samples of the shallow Made Ground in DCS101 (0.30m bgl) and DCS102 (0.10m bgl) returned total PAH values of 18mg/kg and 2.1mg/kg. Within both test results fluoranthene and pyrene were generally the most abundant PAHs. These levels are considered low level and nominal and so no further consideration is required.

Laboratory screening for asbestos has not identified any ACM within the samples screened.

Based on the above assessments, it is considered that the site presents a low risk to end users with regards to Human Health.

7.2 Controlled Waters Risk Assessment

Three groundwater samples were obtained on 5th February 2020 from the following boreholes;

- BH102 at 7.00m bgl;
- BH107 at 10.00m bgl;
- BH108 at 4.00m bgl.

At the time of issuing this report, the chemical analysis of the groundwater results was outstanding and so the results of the chemical analysis on site soils has been used to assess the associated risk to Controlled Waters. The results have indicated concentrations of low order which fell well below the Residential with plant uptake screening values. Detectable levels of TPH were generally only identified in one

sample of Made Ground (DCS101 at 0.30m bgl), however this concentration was also of low order and below relevant screening criteria.

Based on the context of the site and also the absence of significant Made Ground or any visual or olfactory indicators of contamination and the absence of any elevated concentrations in the soils on site, the risk to Controlled Water is considered to be Low. This will be confirmed on return of the groundwater results and will be updated in the combined geo-environmental and geotechnical report.

7.3 Disposal of Soil Arisings

Under the Waste Framework Directive, naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development. Soils could be sent to a recycling centre or re-used onsite, if suitable, under the Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011). With respect of the chemical testing and Human Health risk, the Topsoil is considered suitable for retention and re-use on site. Determination of other suitability Criteria for Topsoil is outside the scope of this investigation.

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix F. The comments below only apply if surplus soil is sent off-site for disposal.

Inert WAC testing was undertaken on one sample of Alluvium and three samples of the Undifferentiated Chalk in the areas of suspected cut in the north of the site. The results demonstrate general compliance with the WAC limits for inert landfills. Should organic rich materials be encountered within the Head/Alluvium during construction, then some form of pre-treatment may be potentially required or the organic matter should be separated and disposed of at a non-hazardous landfill.

In regard to the waste disposal of the shallow Made Ground, the analytical results suggest that the soils would not be regarded as hazardous waste. Currently, no WAC are in place for non-hazardous waste.

7.4 Gas Protection

Based on the conceptual model, the ground conditions encountered and ground gas monitoring undertaken to date, the site may be characterised as Characteristic Situation 1 (CIRIA C665) or NHBC Green, for which no special precautions against ground gas are required.

The final classification will need to be confirmed upon completion of further monitoring events.

7.5 Buried Concrete

As defined by BRE Special Digest 1, Concrete Aggressive Ground, 2005 the Design Sulphate Class and the Aggressive Chemical Environment for Concrete (ACEC) has been assessed for the majority of the strata encountered. Following the results of the geotechnical testing, the characteristic values for each stratum have been determined and are detailed in the table below:

Strata	No of samples tested	Soluble Sulphate (mg/l) ^{*1}	Total Potential Sulphate (%) ^{*2}	Potentially Pyritic	pH	Design Sulphate Class	ACEC ^{*3}
Made Ground	3	190	-	No (none)	8.3	DS1	AC1
Alluvium	5	20	0.06	No (none)	7.6	DS1	AC1
Kempton Park Gravel Member	6	20	-	No (none)	8.1	DS1	AC1
Undifferentiated Chalk	14	10	-	No (none)	8.2	DS1	AC1

Notes:

*1: Characteristic values are rounded to the nearest 100mg/l.

*2: Characteristic values are rounded to the nearest 0.1%.

*3: Assumes mobile groundwater.

In accordance with the guidance in BRE SD1 the characteristic values for each stratum have been determined based on the highest result (where less than 5 samples tested) or the mean average of the highest 2no results (where 5 to 9 samples tested) or the mean of the highest 20% (where 10+ samples have been tested).

The analysis has found the Design Sulphate class for all strata to be DS1 with an ACEC of AC1.

Three groundwater samples, all obtained within the Undifferentiated Chalk are currently with Chemtest for chemical analysis, including testing for water soluble sulphates. The results are unlikely to differ from those recorded in the soil samples obtained from the Chalk, however this will be confirmed on return of the groundwater results and this section of the report will be updated in the combined geo-environmental and geotechnical report.

Further reference should be made to BRE Special Digest 1 for requirements in respect of types of cement and aggregate to be used and variations in type of concrete construction.

7.6 Water Supply Pipes

The TPH results do not generally exceed the UKWIR limits for the use of polyurethane (PE) or polyvinylchloride (PVC) water supply pipes. However, it should be noted that the full suite of testing required by the UKWIR guidance has not been undertaken as part of this investigation and such testing may be required by the Water Authority once pipeline routes are known. Further guidance on this subject is included in Appendix F.

7.7 Soakaways

Based upon the results of the soakaway tests presented in Section 6 above, the granular Kempton Park Gravel Member and underlying Undifferentiated Chalk, appear suitable from a geotechnical viewpoint for the use of pit soakaways to discharge surface run-off water into the sub surface.

It should be noted that consideration should be given to the topography of the sloping site in respect of where water discharged to the ground might travel and any potential for infiltrating water to 'daylight' lower down the slope (depending on soakaway location and elevation/level) either on site or on neighbouring land. There is some further dialogue and guidance on this in the CIRIA SuDS Manual. The EA should be contacted at the design stage in order to obtain a 'consent to discharge'. This may not be forthcoming where soakage will be into or just above the water table. In addition, planning approval will have to be sought for their use

The guidance in CIRIA C574 'Engineering in Chalk' recommends that soakaways in chalk should be located well away from foundations for structures and roads and quotes a minimum 10m for low density chalk and minimum 5m for medium density chalk or better.

7.8 Conclusions and Recommendations

The above risk assessments have established a low risk to human health and Controlled Water receptors. As such, no remediation is considered necessary prior to commencing demolition and construction. However, should any contamination be identified during the redevelopment, a specialist should be consulted to enable additional investigation and testing.

Although no evidence of ACM was encountered during the current Applied Geology investigation, others have identified Chrysotile fibres in one sample tested from the western boundary of the site. This suggests that if present, asbestos is localised at shallow depths in Topsoil or Made Ground and therefore may be the result of historic use of cement asbestos sheeting on former outbuildings/airborne fibres. As such, it is recommended that during the demolition and site strip phase of the redevelopment care is taken is taken, particularly in this area and when in contact with Made Ground soils. It is also recommended that a watching brief is undertaken during the site strip. All works should comply with current guidance and best practice. If visual asbestos is encountered during the works then a qualified asbestos / environmental consultant should be consulted.

Careful segregation of soils should be undertaken if proposing to send surplus soils off-site to landfill.

Gas monitoring (to date) has identified a low risk to end users in accordance with CIRIA C665.

Sulphate resistant concrete is not considered to be required for foundations across the site.

It is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements.

**Applied Geology Limited
Unit 23
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CV8 2LY**

Tel: 02476 511822

GENERAL NOTES

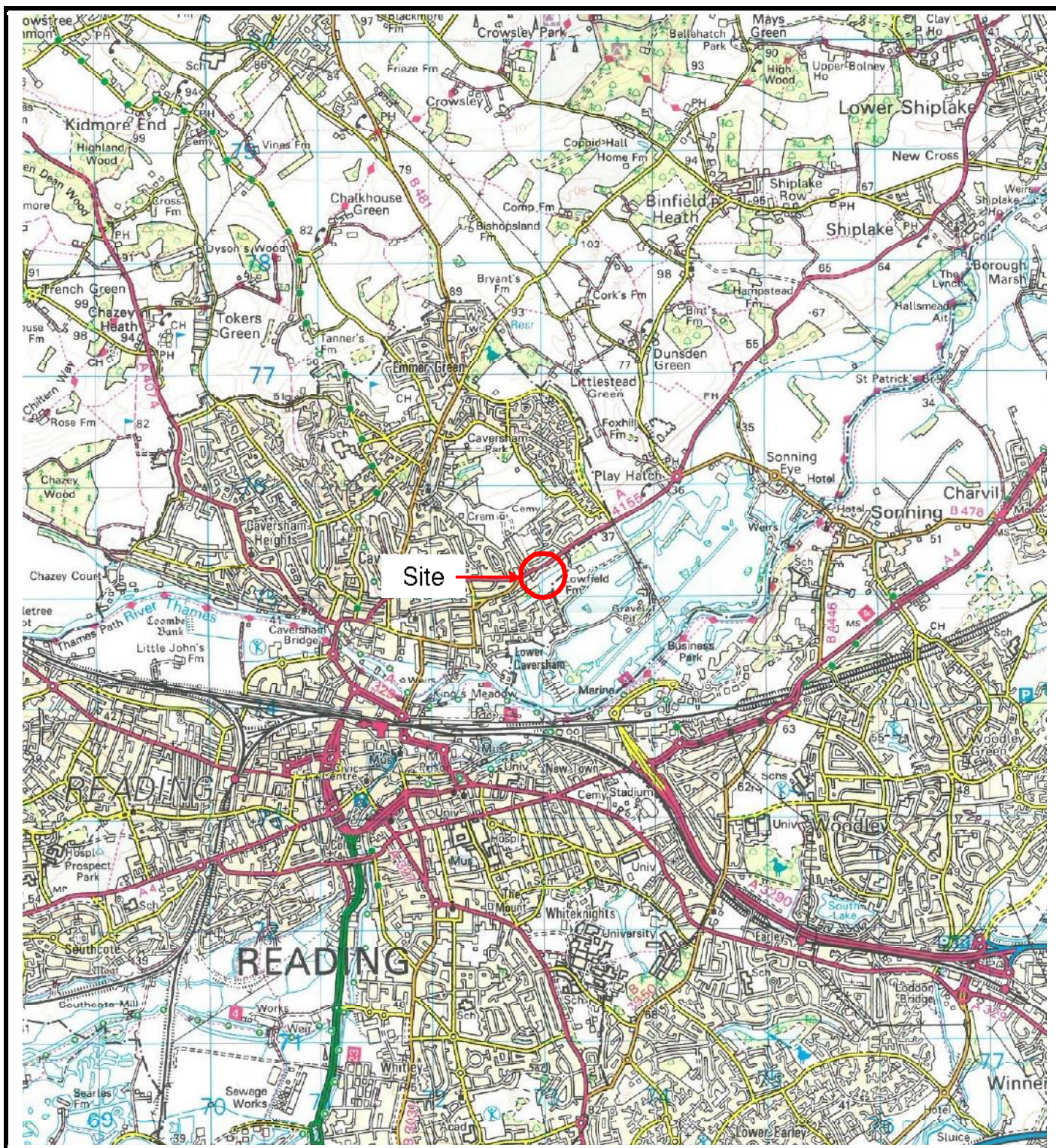
- A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.
- B) The services provided are defined within our proposal and are carried out in line with the terms of appointment between Applied Geology and the Client.
- C) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.
- D) Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy.
- E) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.
- F) The copyright of this report and other plans (and documents prepared by Applied Geology) is owned by Applied Geology and no such report, plan or document may be reproduced, published or adapted without the written consent of Applied Geology. Complete copies of the report may, however, be made and distributed by the Client as an expedient in dealing with matters related to its submission.
- G) This report is prepared and written in the context of the proposals stated in the introduction to the report and should not be used in a differing context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission. Therefore with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to Applied Geology for re-assessment and if necessary, re-appraisal.
- H) The survey was conducted and this report was prepared for the sole internal use and reliance of the Client. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Applied Geology. If an unauthorised third party comes into possession of this report they rely on it at their peril and Applied Geology owes them no duty of care and skill.
- I) Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of this data by the supervising geotechnical or geo-environmental engineers.
- J) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.
- K) The works performed are not a comprehensive site characterisation and should not be construed as being such.
- L) The findings of the geo-environmental risk assessment are based on information obtained from a variety of sources which Applied Geology believe to be correct. Applied Geology cannot and does not guarantee the authenticity or reliability of the information it has relied upon.
- M) The report represents the findings and opinions of experienced geo-environmental consultants. Applied Geology does not provide legal advice and the advice of lawyers may be required.
- N) Conditions at the site are subject to change from the time of the site inspection.
- O) It is possible that researches carried out by Applied Geology, whilst fully appropriate for a phase 1 desk study, failed to indicate the existence of important information sources. Assuming such indicators actually exist, their information could not have been considered in the formulation of Applied Geology findings and opinions.
- P) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.
- Q) Applied Geology operates as a Consultancy and does not operate its own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

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APPENDIX A



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APPLIED GEOLOGY

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Tel: 02476 511822
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Client:

SIGNATURE SENIOR LIFESTYLE
DEVELOPMENTS

Project:

HENLEY ROAD, CAVERSHAM

Drawn By:

JS

Checked By:

MS

Paper Size:

A4

Scale:

NTS

Date:

14.01.2020

NGR:

473003 175194

Title:

SITE LOCATION PLAN

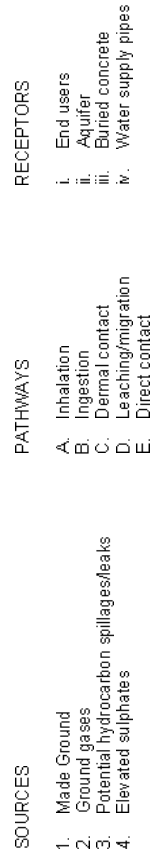
Drawing No:

AG3094-19-01

Revision:

0

SOUTH



RECEPTORS

- i. End users
- ii. Aquifer
- iii. Buried concrete
- iv. Water supply pipes

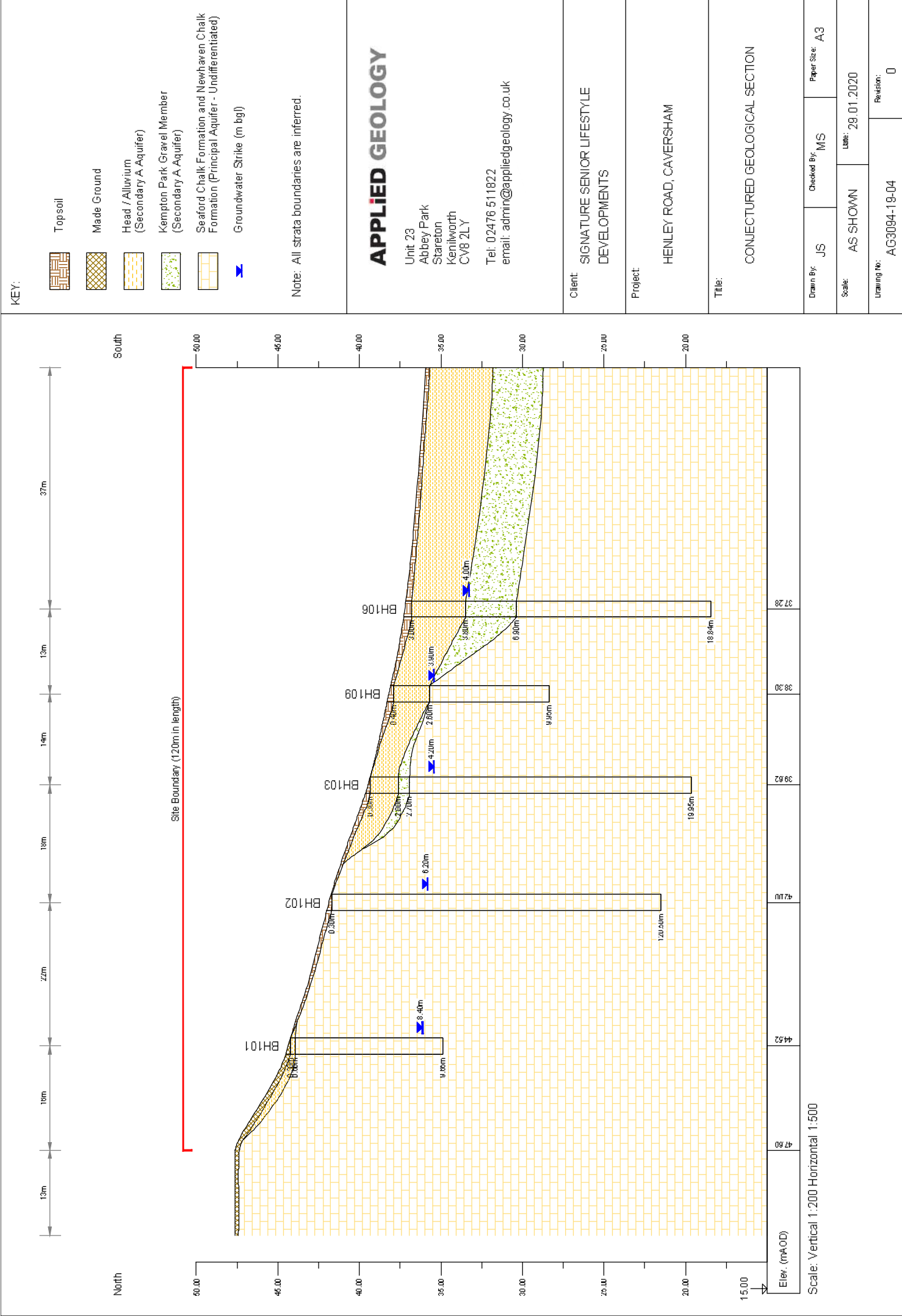
- Kempton Park Gravel Member
(Secondary A Aquifer)

Groundwater

Project: HENLEY ROAD, CAVERSHAM

CONCEPTUAL SITE MODEL

Drawing No: AG3094-19-03





Floor key

- Care Bedrooms
- Ancillary
- Communal area
- Roof
- Entrance



0m 10m 20m 30m

CDM REGULATIONS 2015. All current drawings and specifications for the project must be read in conjunction with the Designer's Hazard and Environment Assessment Record. All intellectual property rights reserved

Drawn SH
Checked SH
Date 05-2018
Scale @ A3 1:500

Henley Road Caversham

Lower Ground floor plan

AA7440
REV -

For Information

PRP



Floor key

- Care Bedrooms
- Ancillary
- Communal areas
- Entrance



0m 10m 20m 30m

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Drawn SH
Checked SH
Date 05-2018
Scale @ A3 1:500

Henley Road Caversham

Ground floor plan

AA7440
REV -

For Information

PRP



Floor key

- Care Bedrooms
- Ancillary
- Dementia Bedrooms
- Communal areas
- Entrance



0m 10m 20m 30m

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Drawn SH
Checked SH
Date 05-2018
Scale @ A3 1:500

Henley Road Caversham

First floor plan

AA7440
REV -

For Information

PRP



Floor key

- Ancillary
- Dementia Bedrooms
- Communal areas
- Roof
- Entrance



0m 10m 20m 30m

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Drawn SH
Checked SH
Date 05-2018
Scale @ A3 1:500

Henley Road Caversham

Second floor plan

AA7440
REV -

For Information

PRP



Floor key

- Ancillary
- Dementia Bedrooms
- Communal areas
- Roof
- Entrance



0m 10m 20m 30m

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Date 05-2018
Scale @ A3 1:500

Henley Road Caversham

Third floor plan

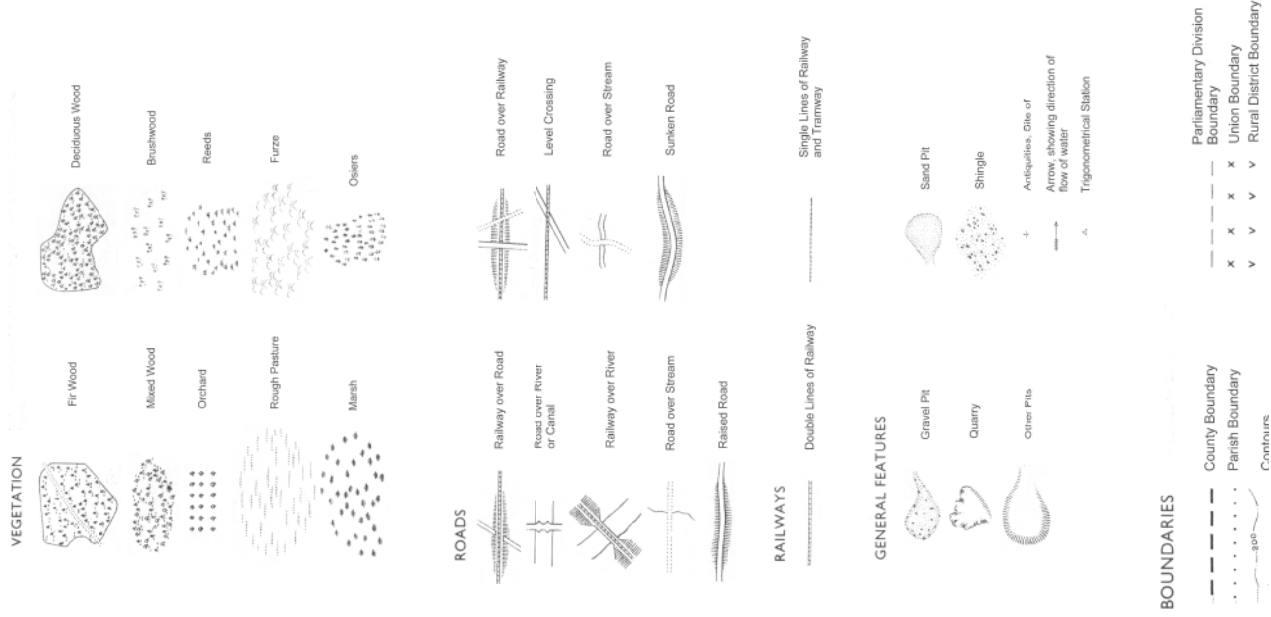
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REV -

For Information

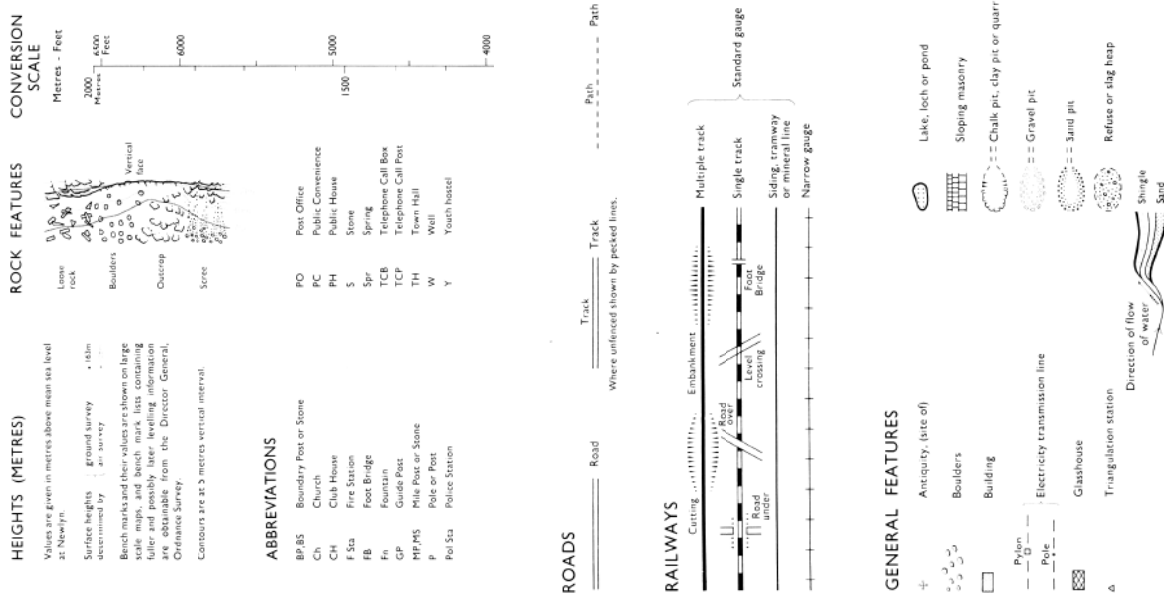
PRP

APPENDIX B

County Series 1:10,560 scale



National Grid 1:10,000 scale



County Series & National Grid 1:10,560 scale

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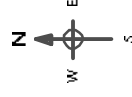
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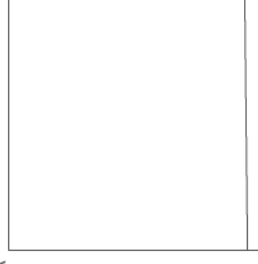
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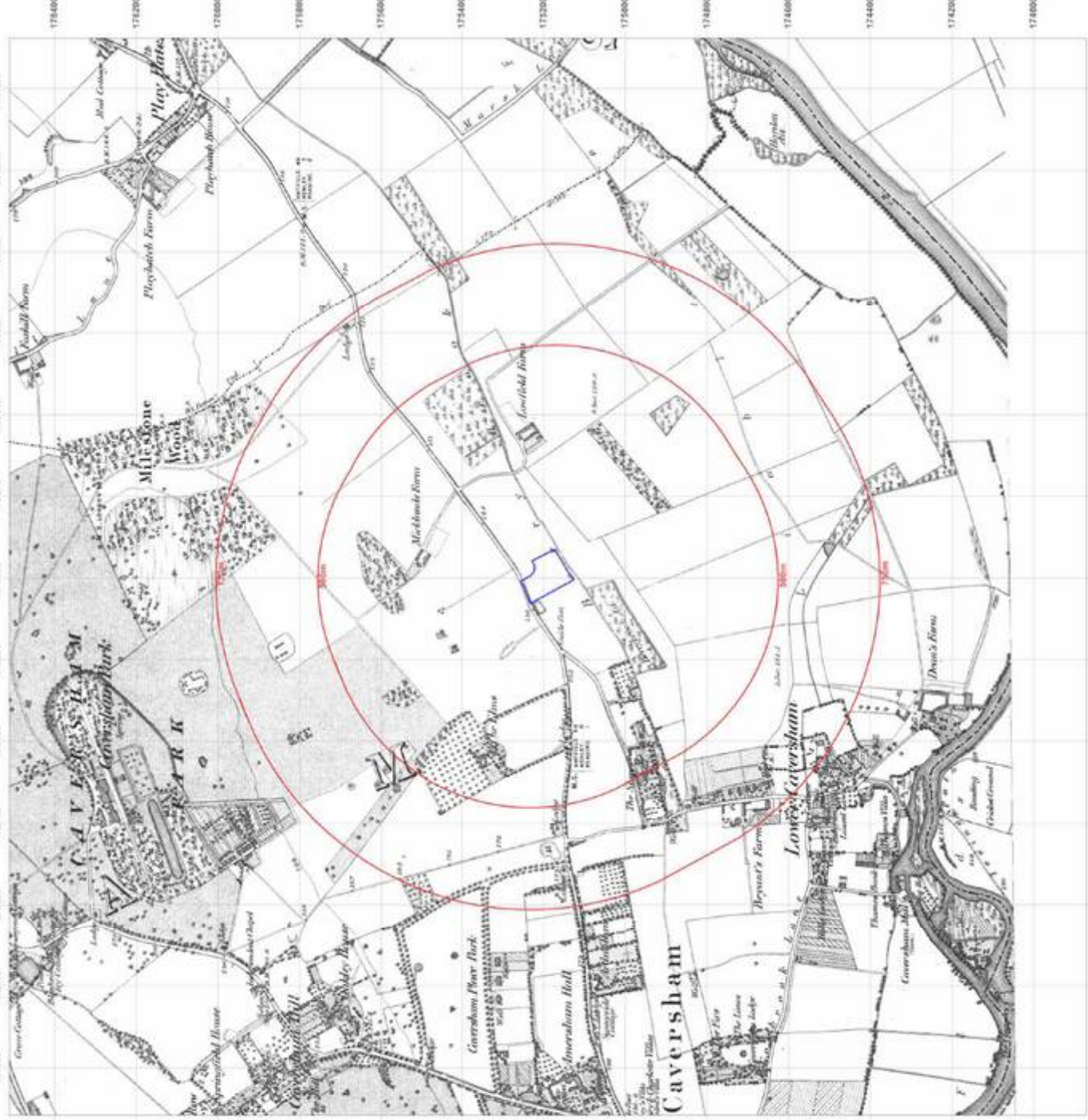


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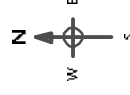
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Map Name: County Series

Map date: 1897-1898

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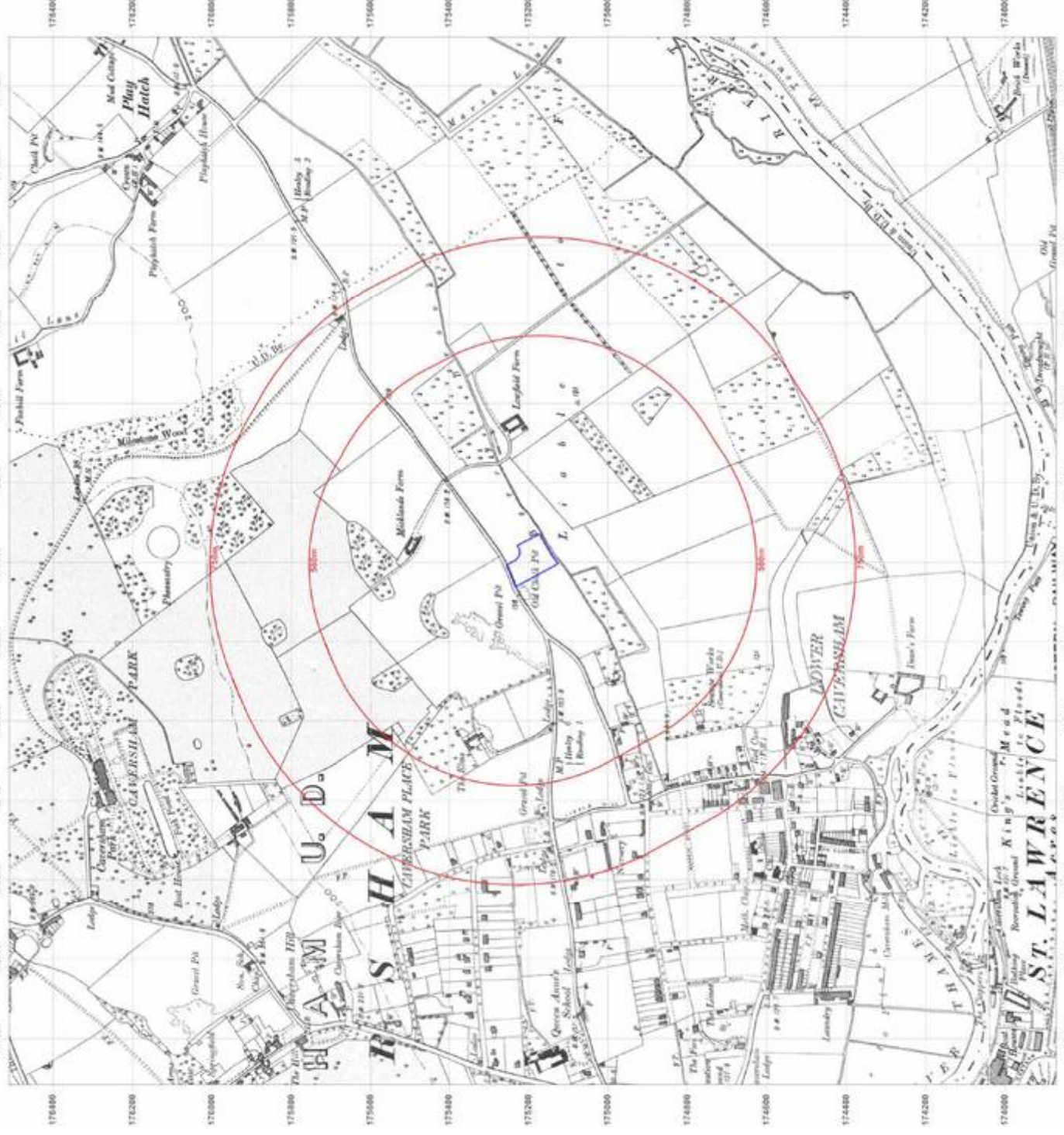


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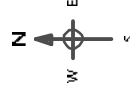
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Map Name: County Series

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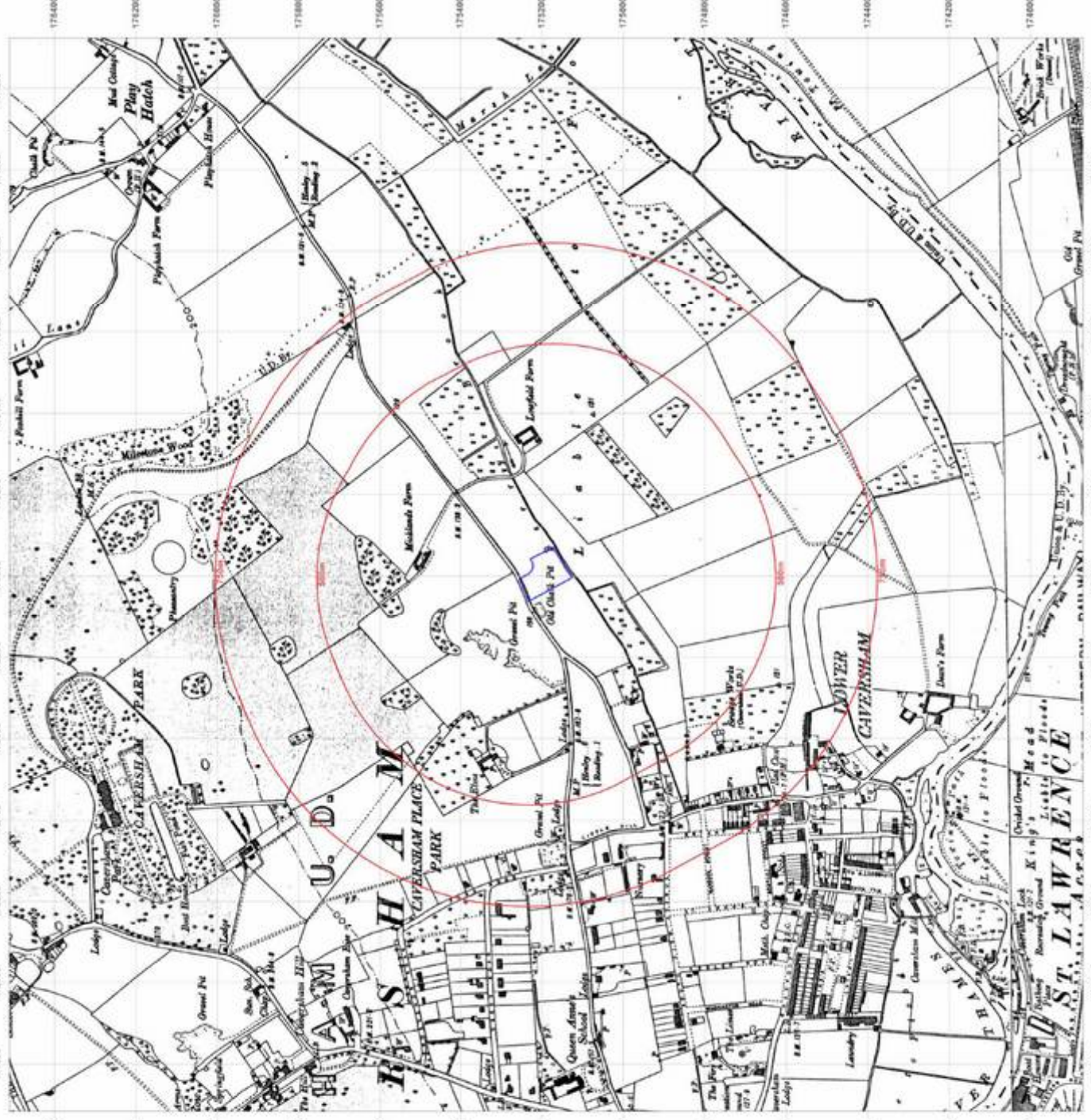


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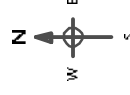
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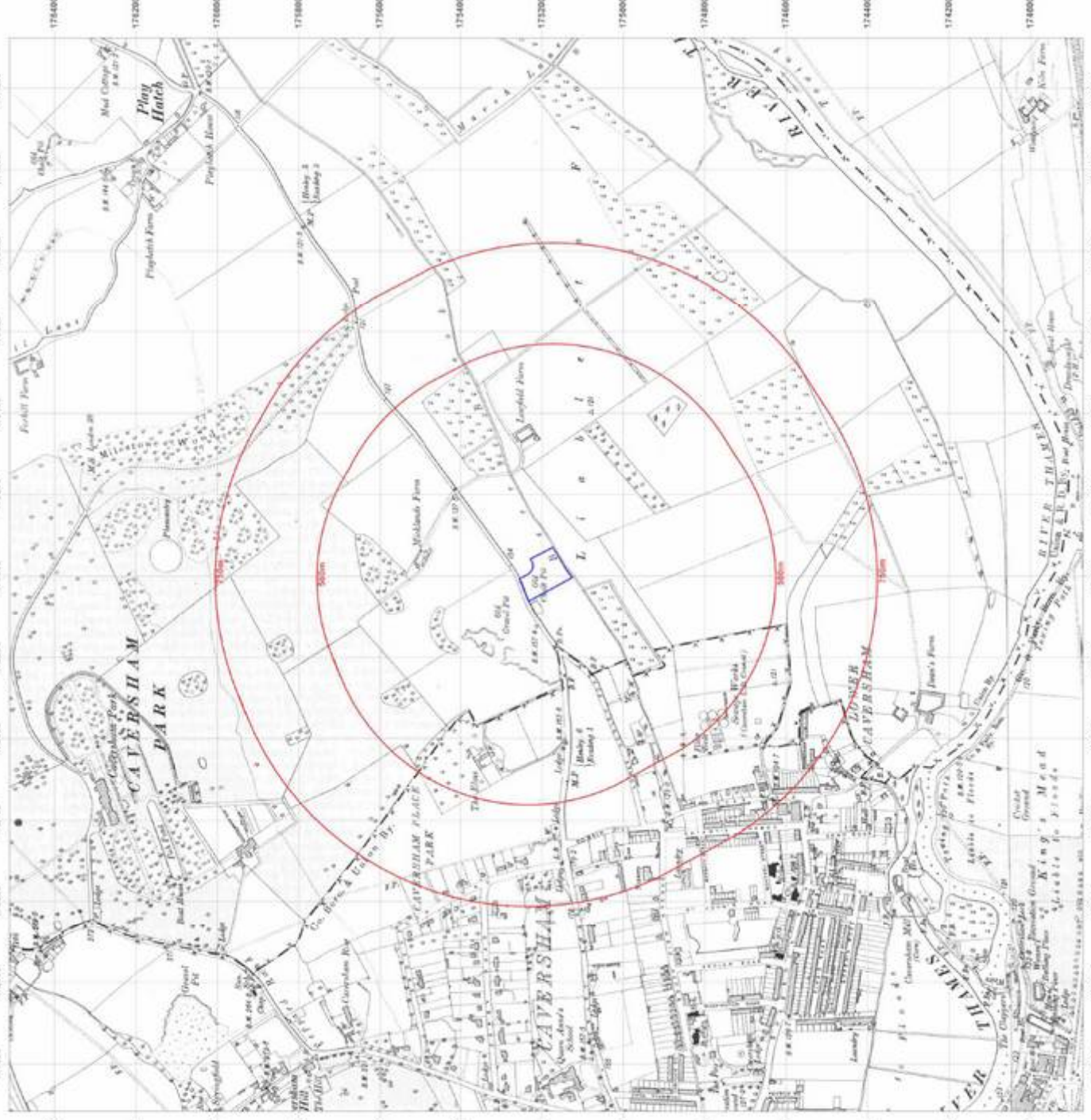


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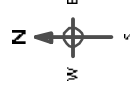
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Map Name: County Series

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Edition 1914	Edition 1913
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