



**GEOTECHNICAL AND
GROUND CONTAMINATION
RISK ASSESSMENT REPORT**

**WATERMEAD
HENFIELD ROAD
COWFOLD
WEST SUSSEX**

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Report Section		Prepared By	Approved By
Preliminary Ground Contamination Risk Assessment		Stuart Card BA (Hons)	Alex Minchell-Bewick BSc MSc DIC AISEP MEnvSc CEnv
Factual Section		Tom Hughes BA MA	Rebecca Webb BSc FGS
Geotechnical Assessment		Adam Cormack HNC FGS	Steven McSwiney BA mod Geol MSc FGS
Quantitative Ground Contamination Risk Assessment		Stuart Card BA (Hons)	Alex Minchell-Bewick BSc MSc DIC AISEP MEnvSc CEnv

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This report is not intended to be either an ecological, archaeological or flood risk assessment. An appropriate specialist should be consulted about any concerns that may arise in this regard.

Head Office:

Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
East Sussex
BN6 8SG

Telephone:

01273 483119

Email:

contact@ashdownsi.co.uk

Company Registration No.
242 6786



EXECUTIVE SUMMARY

The following presents a summary of the main findings of the report. It is emphasised that no reliance should be placed on any individual point until the whole of the report has been read as other sections of the report may put into context the information contained herein.

It is proposed to develop the site at Watermead, Henfield Road, Cowfold, West Sussex. The exact layout proposals are yet to be finalised, but it is understood that the development will comprise several houses with associated gardens, communal soft landscaped areas and associated access roads.

The northern part of the site comprises an area of grassland containing clumps of trees and a dried-up pond. The southern part of the site contains three large interlinked light industrial buildings and a number of outbuildings. A vehicle repair garage and car sales yard are located a short distance to the south-east of the site.

The site comprised part of an open field at the time of the earliest inspected historical map, dated 1875. By the early 1980s the site is shown on its approximate current layout.

Reference to geological datasets indicates that the site is expected to be underlain by the Weald Clay Formation. The ground investigation confirmed the underlying soils to comprise a shallow thickness of made ground, overlying Weald Clay Formation deposits.

The Weald Clay Formation is classed as an Unproductive Stratum. The site does not lie within a SPZ. Groundwater was not encountered during the short period of the intrusive works.

The preliminary contamination risk assessment identified potential pollutant linkages relating to proposed end users of the site.

The ground investigation did not identify any of the potential contaminants to be present at concentrations considered to pose an unacceptable risk to either end users of the site or controlled waters beneath the site. No remedial measures or further contamination risk assessment works are considered to be necessary.

The report should be submitted for approval as part of a planning application for the site and to any other relevant regulator and/or warrantor.

Precautions against shrinkage and heave for any new foundation system could assume a medium volume change potential for the fine-grained Weald Clay Formation.

A net allowable bearing capacity of 150kN/m² may be assumed for pad or strip foundations up to 1.00m in breadth that are constructed directly onto the Weald Clay Formation soils of at least stiff consistency.

A DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed as a minimum for the design of concrete in contact with the ground.

Ground floors should be suspended unless the conditions set out within this report can be met.

Design equilibrium California bearing ratios and moduli of subgrade reaction are presented in the report. The subgrade is not likely to be susceptible to frost heave.

Infiltration testing within the Weald Clay Formation soils recorded infiltration rates ranging between $3.91 \times 10^{-5} \text{m/sec}$ and $2.25 \times 10^{-7} \text{m/sec}$.

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1. INTRODUCTION

It is proposed to develop the site at Watermead, Henfield Road, Cowfold, West Sussex. The exact layout proposals are yet to be finalised, but it is understood that the development will comprise a series of houses with associated gardens, communal soft landscaped areas and associated access roads. A copy of the feasibility layout is presented in Appendix A.

Ashdown Site Investigation Ltd. was requested to undertake a ground investigation, provide advice to assist with the structural design and to prepare a ground contamination risk assessment to accompany a planning application for the site.

The scope of the works covered by this report, and the terms and conditions under which they were undertaken, were set out within the offer letter Q15399, dated 29th May 2025. The instruction to proceed was received from the client, Earlswood Homes (South East) Ltd.

The specific objectives of the works were to:

- a) Establish the expected geology, hydrogeology and hydrology at the site;
- b) Ascertain the development history and current site use;
- c) Develop a preliminary conceptual model of the site identifying potential pollutant linkages relating to end users of the proposed development works, to controlled waters beneath and in the vicinity of the site, or to other off-site sensitive receptors, if identified;
- d) Investigate the shallow ground and groundwater conditions in the area of the proposed development;
- e) Provide advice/parameters to assist others in undertaking design of spread foundations, ground floors, road pavements and soakaways;
- f) Test for the presence of contaminants identified by the preliminary conceptual model; and
- g) Develop a quantitative conceptual model of the site identifying pollutant linkages relating to end users of the proposed development works, to controlled waters beneath and in the vicinity of the site, or to other off-site sensitive receptors, if identified.

Copies of the historical maps and geo-environmental data referred to in this report are presented within Appendix H.

2. SITE CONTEXT

2.1 Walkover Survey

The site is located off Henfield Road, Cowfold, West Sussex, and is centred on the approximate Ordnance Survey national grid reference 521240, 122212. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively.

The northern part of the site comprises a mainly grass surfaced area dotted with groups of mature trees. A dried up, partially overgrown pond was located in the middle of this area and in the south-west was an L-shaped mound of soil, with mature trees growing from it. Animal burrows were noted within the mound.



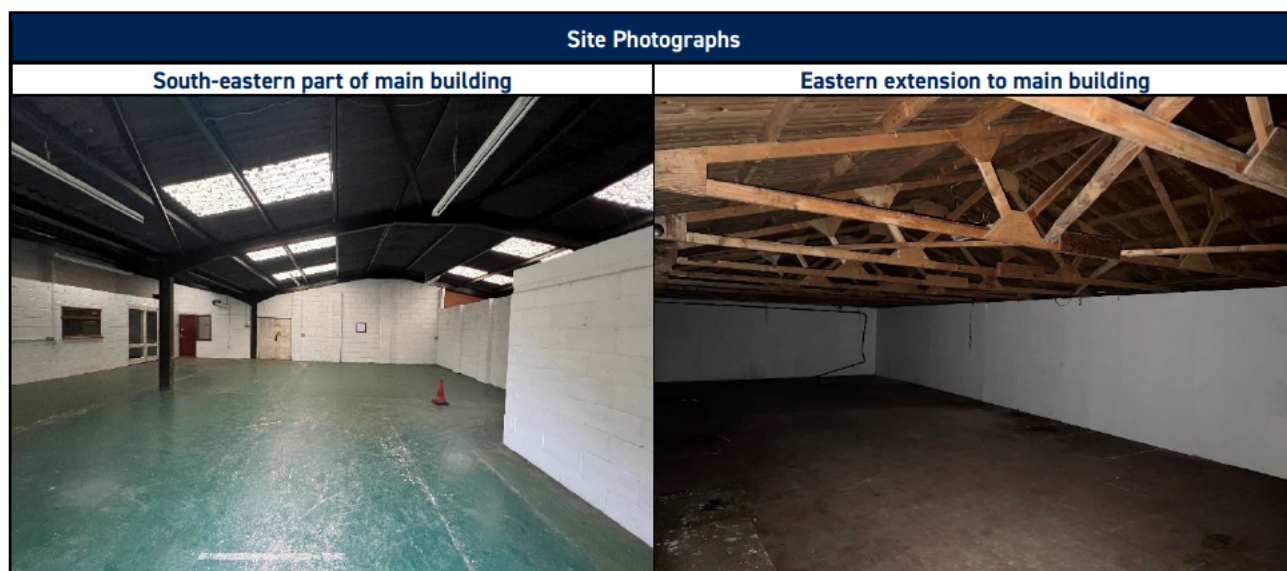
The southern part of the site contained three large commercial/industrial buildings in an L-shape configuration, with a number of smaller outbuilding type structures to the south. A small gravel parking area and access track surrounded the buildings.

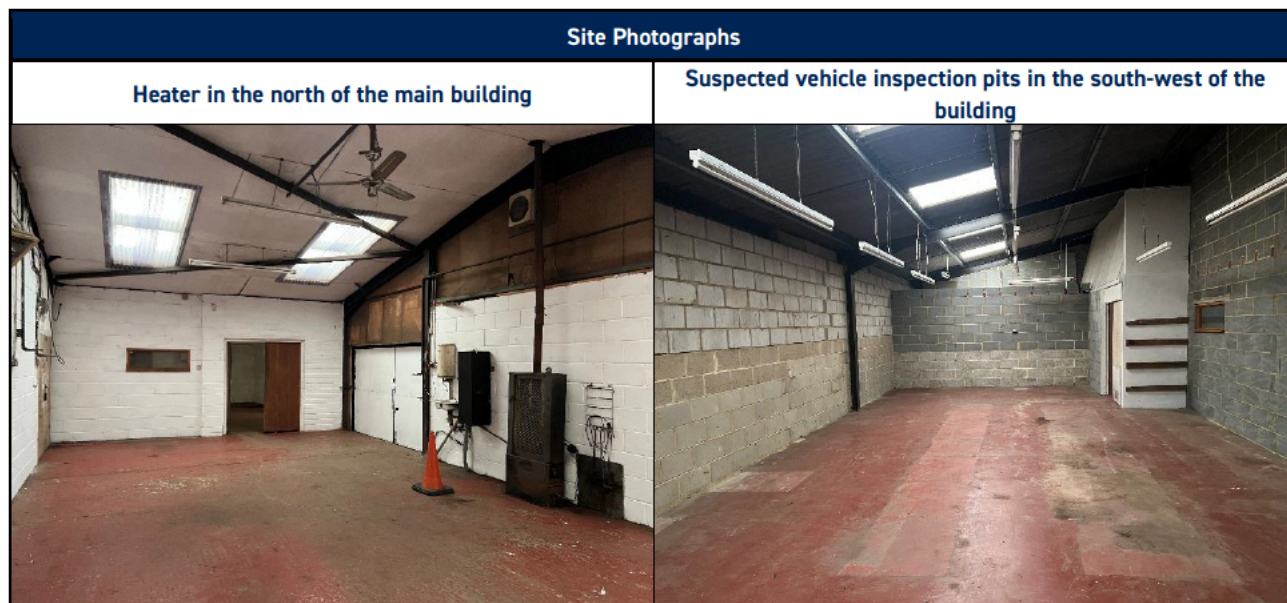


The large buildings were interconnected and were noted to have suspected asbestos cement roofs, facias, guttering and downpipes.

The buildings were empty at the time of the walkover, and all had solid concrete floors which appeared to be in good condition.

A heater was present in the northern extent of the largest section of building. In the south-west of the building scarring on the floor had the appearance of backfilled vehicle inspection pits.





The outbuildings in the south of the site were mainly of wooden construction, though some suspected asbestos cement panels were noted on roofs and walls.

Fragments of broken suspected asbestos cement were noted on a bench within the westernmost shed.





The southern part of the site was bounded by houses to the east. A field was present along the entire western boundary. To the immediate south were houses and to the south-east was "SMG Cowfold", a car sales yard, vehicle workshop and MOT centre. Further housing was present to the north and east of the northern part of the site.



2.2 Geological Data Review

2.2.1 Expected Geology and Aquifer Designation

The stratigraphic unit that may be expected to underlie the site has been established by reference to British Geological Survey (BGS) mapping and the BGS Lexicon of Named Rock Units. The expected stratigraphy is presented in the following table.

Table 1. Expected Strata and Aquifer Designation

Type	Stratum	Aquifer Designation
Bedrock	Weald Clay Formation	Unproductive Stratum

The Weald Clay Formation forms part of the Wealden Group. The formation is of Hauterivian to Barremian age (126.3 to 133.9 million years old; Early Cretaceous). The Weald Clay Formation comprises dark grey thinly-bedded mudstones (shales) and mudstones with subordinate siltstones, fine to medium grained sandstones, including calcareous sandstone (e.g. Horsham Stone Member), shelly limestones (the so called "Paludina Limestones") and clay ironstones. The formation is recorded by the BGS to range in thickness up to 460m.

2.2.2 BGS Borehole

No British Geological Survey (BGS) boreholes are identified within 250m of the site.

2.2.3 Natural Ground Subsidence

Table 2. Natural Ground Subsidence from Groundsure Data

Section	Groundsure Hazard Rating	Groundsure Comment
Soil Volume Change Potential (Shrink-Swell)	Low	Ground conditions predominately medium plasticity.
Running Sands	Negligible	Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.
Compressible Deposits	Negligible	Compressible strata are not thought to occur.
Collapsible Deposits	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Landslides	Very Low	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Ground Dissolution of Soluble Rocks	Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

2.2.4 Ground Cavities and Sinkholes

Table 3. Ground Cavities and Sinkholes from Groundsure Data

Section	Groundsure Comment
Natural Cavities	No records are identified within 500m of the site.
Mining Cavities	No records are identified within 500m of the site.
Reported Recent Incidents	No records are identified within 500m of the site.
Historical Incidents	No records are identified within 500m of the site.

2.2.5 Mining and Ground Workings

Table 4. Mining and Ground Workings from Groundsure Data

Section	Groundsure Comment
BritPits	Cowfold Brick Field is identified to be located ~361m north-west of the site. Given the distance from the site and the nature of the underlying geology, the brick field is not considered to pose a viable source of ground gases that could impact the site.
Surface Ground Workings	A sewage farm is identified to be located 240m south-east of the site. Given the distance from the site and the nature of the underlying geology, the sewage farm is not considered to pose a viable source of ground gases that could impact the site.
Underground Workings	No underground workings are identified within 1km of the site.
Underground Mining Extents	No records are identified within 500m of the site.
Historical Mineral Planning Areas	No records are identified within 500m of the site.
Non-Coal Mining	The site is identified to be in an area where underground mining for iron ore may have occurred in the past or current mines may be working at significant depths to modern engineering standards. More information is presented below.
JPB Mining Areas	No records are identified on site.
The Coal Authority – Non-Coal Mining	No records are identified within 500m of the site.
Researched Mining	No records are identified within 500m of the site.
Mining Record Office Plans	No records are identified within 500m of the site.
BGS Mine Plans	No records are identified within 500m of the site.
Coal Mining	No records are identified on the site.
Brine Areas	No records are identified on the site.
Gypsum Areas	No records are identified on the site.
Tin Mining	No records are identified on the site.
Clay Mining	No records are identified on the site.

The geological units of the Wealden Group, including the Weald Clay Formation, were locally mined for iron during the early Roman period, the Medieval period and significantly between the 15th and 18th centuries.

The mining activities were associated with hammer and furnace ponds, and forges. The locations of many of the workings are unknown, the works mostly having been dismantled and sites overgrown with woodland. Many of the old ponds in the Weald may be representative of old hammer or furnace ponds.

The historical extraction was mostly from open pits excavated from surface, but during the Medieval period, extraction in the eastern Weald was increasingly from mine pits. These mine pits were typically five metres in diameter and up to twelve metres deep. The pits were worked in sequence with spoil from one pit used to in-fill the one before. In the western part of the Weald, the principal method of extracting iron ore was also the mine pit but smaller in scale; the pits consisted of a vertical shaft up to 2.5 metres in diameter and the base of the shaft would have been widened out.

In addition to the Brick Field identified in the table above, the British Geological Survey GeoIndex Onshore viewer records the presence of Browning's Farm Pits some 950m to the north-west of the site, and the Brook Hill and Brook Hill House Pits some 800m to 890m to the approximate north and north-east of the site. A search of the Wealden Iron Research Group database (www.wirgdata.org) revealed no records of iron workings within 1km of the site. The risk posed to the development is considered to be negligible to very low.

Further assessment of the mining hazards can be undertaken, if required, to provide more detailed comment specific to the site.

2.2.6 Radon

Table 5. Radon

Section	Groundsure Comment
Radon Affected Areas	The site is reported to be within an area where less than 1% of properties are at or above the action level requiring radon gas protection measures to be installed in new buildings.
Radon Protection Measures	No radon protection measures are reported by the British Geological Survey to be necessary in the construction of new dwellings or extensions.

2.2.7 Soil Chemistry

Table 6. BGS Estimated Background Soil Chemistry

Contaminant	Estimated Value (mg/kg)
Arsenic	25-35
Bioaccessible Arsenic	-
Lead	600-1200
Bioaccessible Lead	360-720
Cadmium	1.8
Chromium	60-90
Nickel	15-30

2.3 Hydrogeological and Hydrological Data

2.3.1 Groundwater Abstractions

There are no active abstraction licences within 2km of the site. The closest historical abstraction licence is recorded to lie 1622m to the south of the site and was for general use.

2.3.2 Surface Water Abstractions

No surface water abstraction licences are indicated within 2km of the site.

2.3.3 Potable Abstractions

No potable abstraction licences are indicated within 2km of the site.

2.3.4 Groundwater Source Protection Zones (SPZ)

The Environment Agency defines SPZs as those areas where groundwater supplies are at risk from potentially polluting activities and accidental releases of pollutants. SPZs are primarily a policy tool used to control activities close to water supplies intended for human consumption.

The site does not lie within a SPZ.

2.3.5 Surface Water Features

A former pond is located in the northern part of the site and the nearest recorded significant surface water feature is a water course, located 145m south of the site.

2.3.6 Flood Risk

The table below summarises the flood risk data provided by the Groundsure report. It is noted that this does not constitute a flood risk assessment.

Table 7. Flood Risk

Section	On Site	Within 50m of the Site
Risk of Flooding from Rivers and Seas (RoFRaS)	None Identified	None Identified
Historical Flood Events	None Identified	None Identified
Flood Defences	None Identified	None Identified
Areas Benefitting from Flood Defences	None Identified	None Identified
Flood Storage Areas	None Identified	None Identified
Environment Agency Flood Zone 2	None Identified	None Identified
Environment Agency Flood Zone 3	None Identified	None Identified
Surface Water Flooding	Highest Risk: Negligible	Highest Risk: Negligible
Groundwater Flooding	Highest Risk: Negligible	Highest Risk: Negligible

3. GEO-ENVIRONMENTAL DATA

3.1 Historical Industrial Sites

The following sections summarise past land uses of the site and the surrounding area extracted by Groundsure from historical maps.

3.1.1 Historical Land Use

The data identifies smithies 40m east and 69m north-east of the site, and an unspecified depot 25m south-east of the site.

The data is extracted from the 1:10,560 and 1:10,000 scale maps. A review of the large scale 1:2,500 shows that the smithy (only one identified land use) is actually closer to 90m north-east of the site (Diagram 1 and Diagram 2). The area labelled as a depot is not clearly shown as a depot on the 1911 map (the 1962 map is recorded as identifying the area as a depot). However, in 1956 (Diagram 2) the area is shown as a timber yard.

Diagram 1. Location of Smithy on Historical Maps (1911)

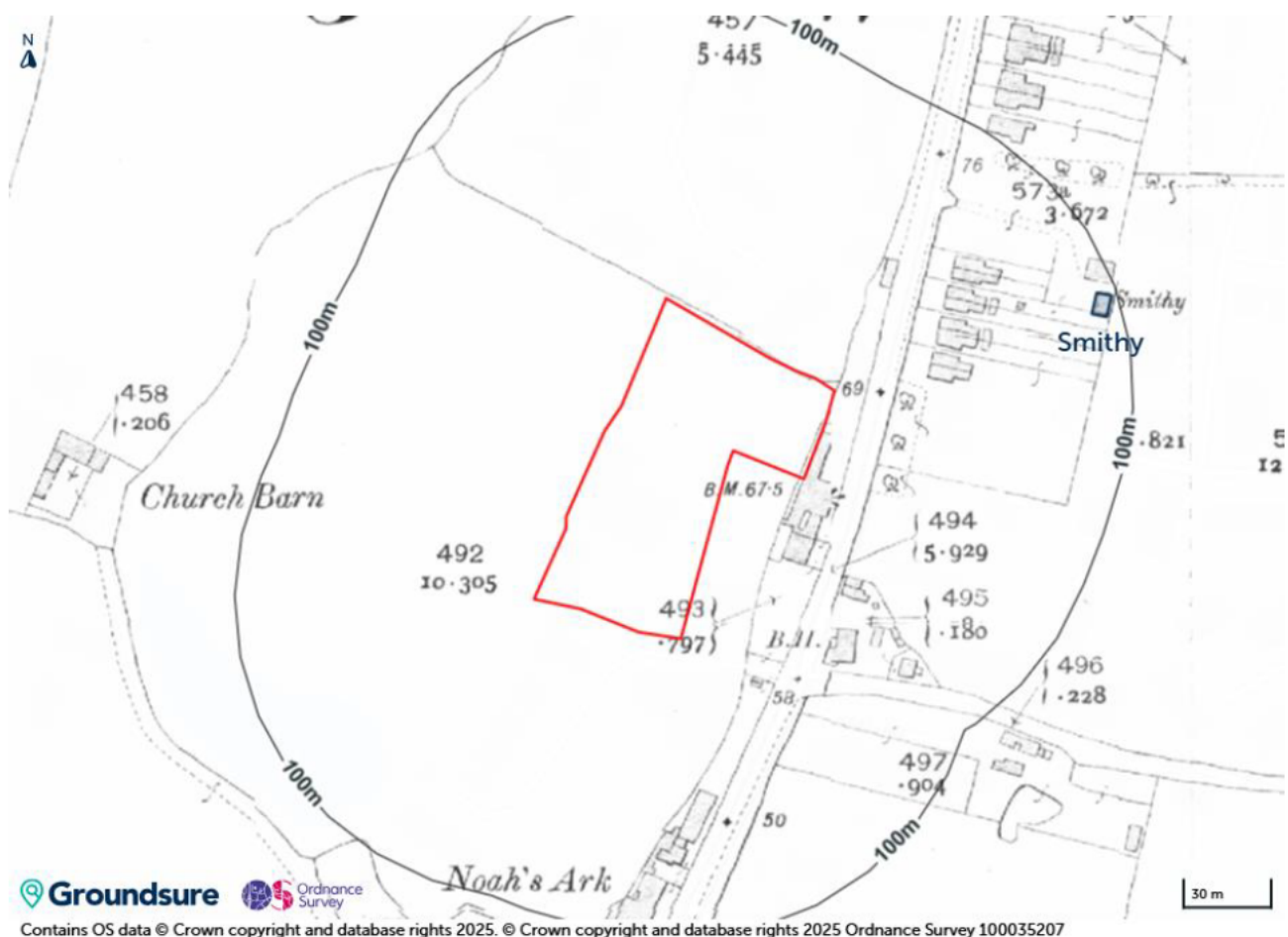
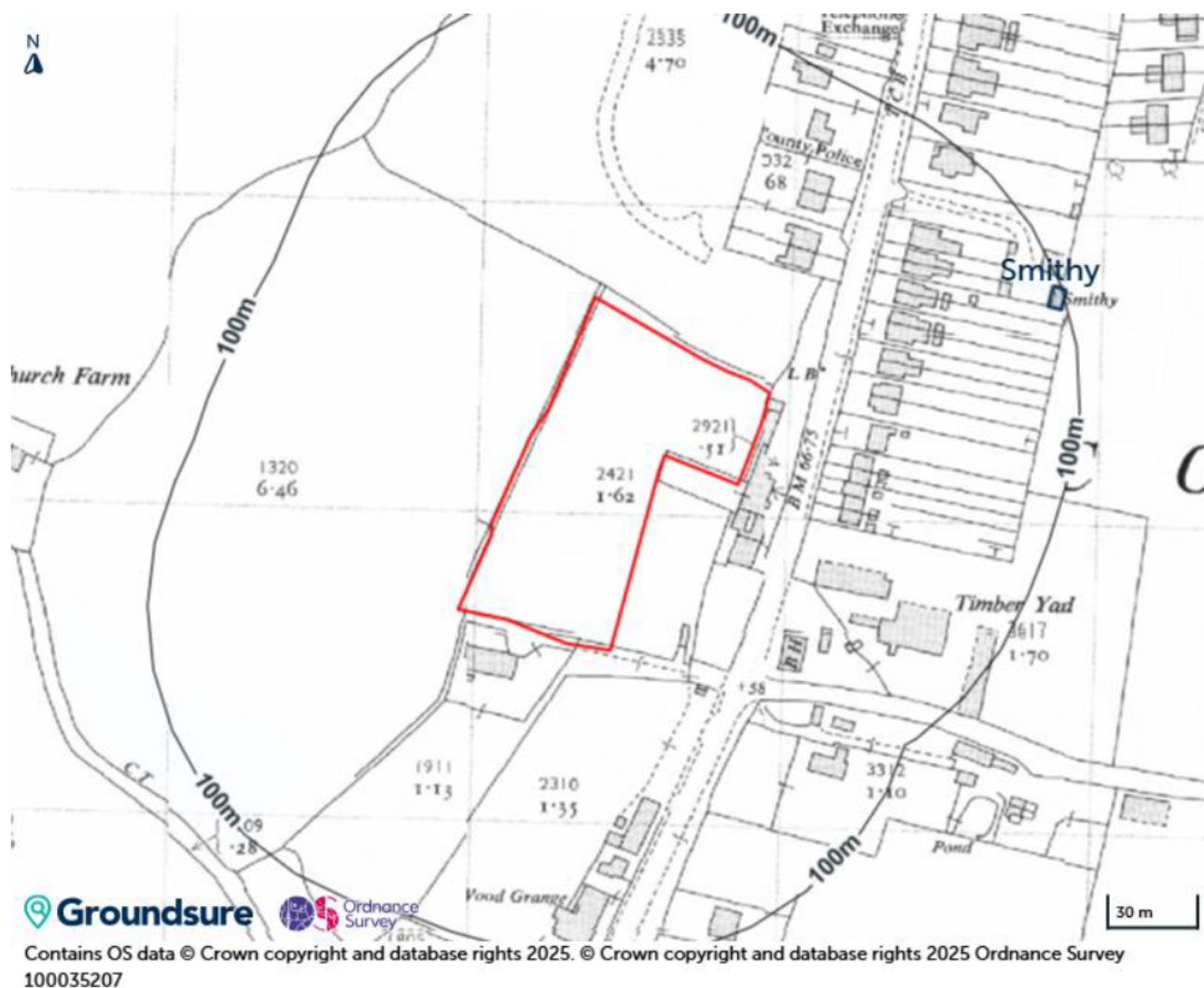


Diagram 2. Location of Smithy on Historical Maps (1956)



Given the distance of the smithy, it is not considered to represent a potential source of contamination.

Given the location of the timber yard (shown on later maps as a builder's yard) some 25m east of the site on the far side of the Henfield Road, it is also not considered to represent a potential source of contamination.

3.1.2 Historical Tank Database and Energy Features

No historical tanks or historical energy features are identified within 100m of the site.

3.1.3 Historical Petrol Station and Garages

A historical petrol station (1972 map) is identified 30m south-east of the site, this is shown within an area identified as a historical garage (1983 onwards and still present) located 8m south of the site, as shown in Diagram 3 to Diagram 5.

Diagram 3. Historical Petrol Station and Garage (Land Use Map)



Diagram 4. Historical Petrol Station (1972 Map)

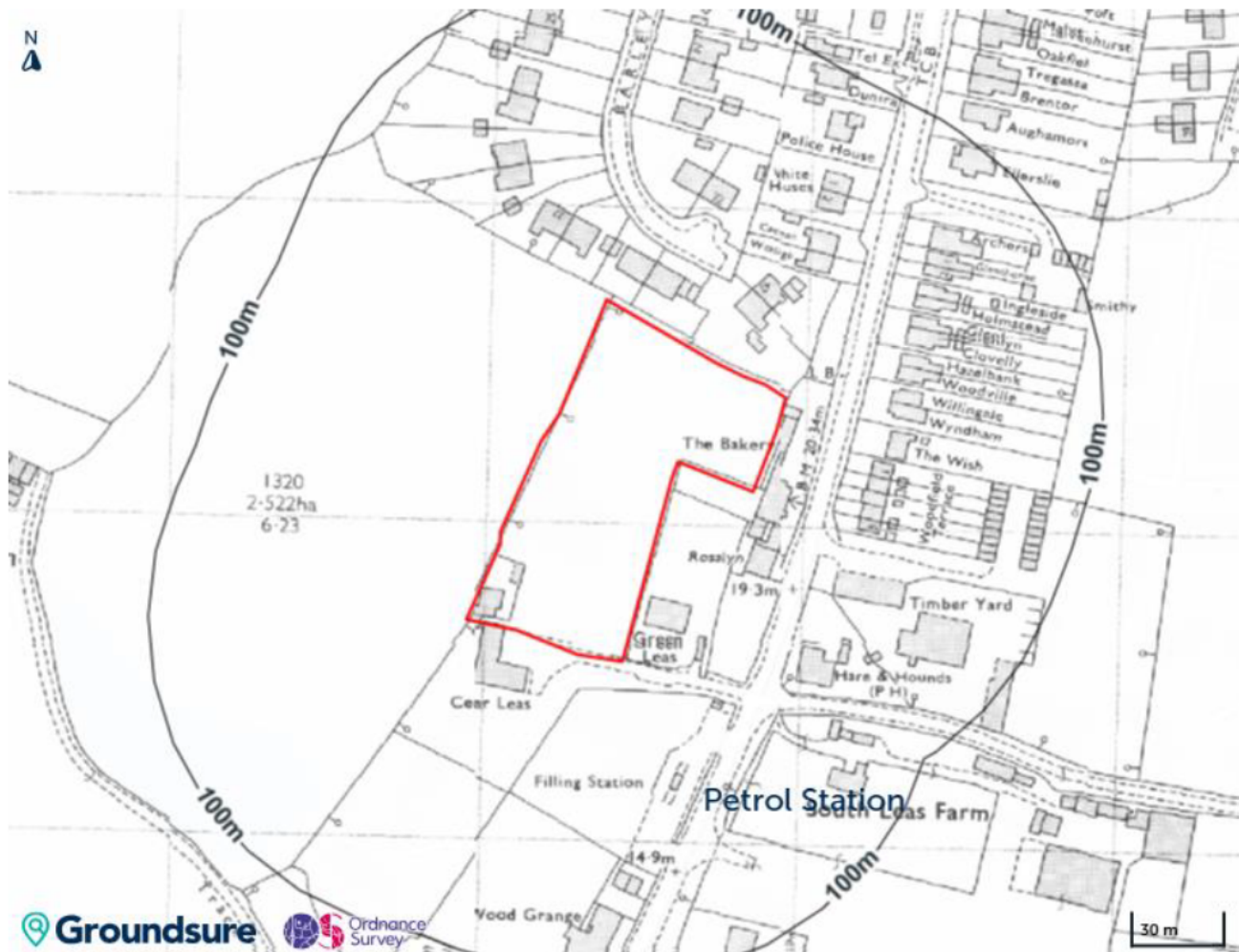
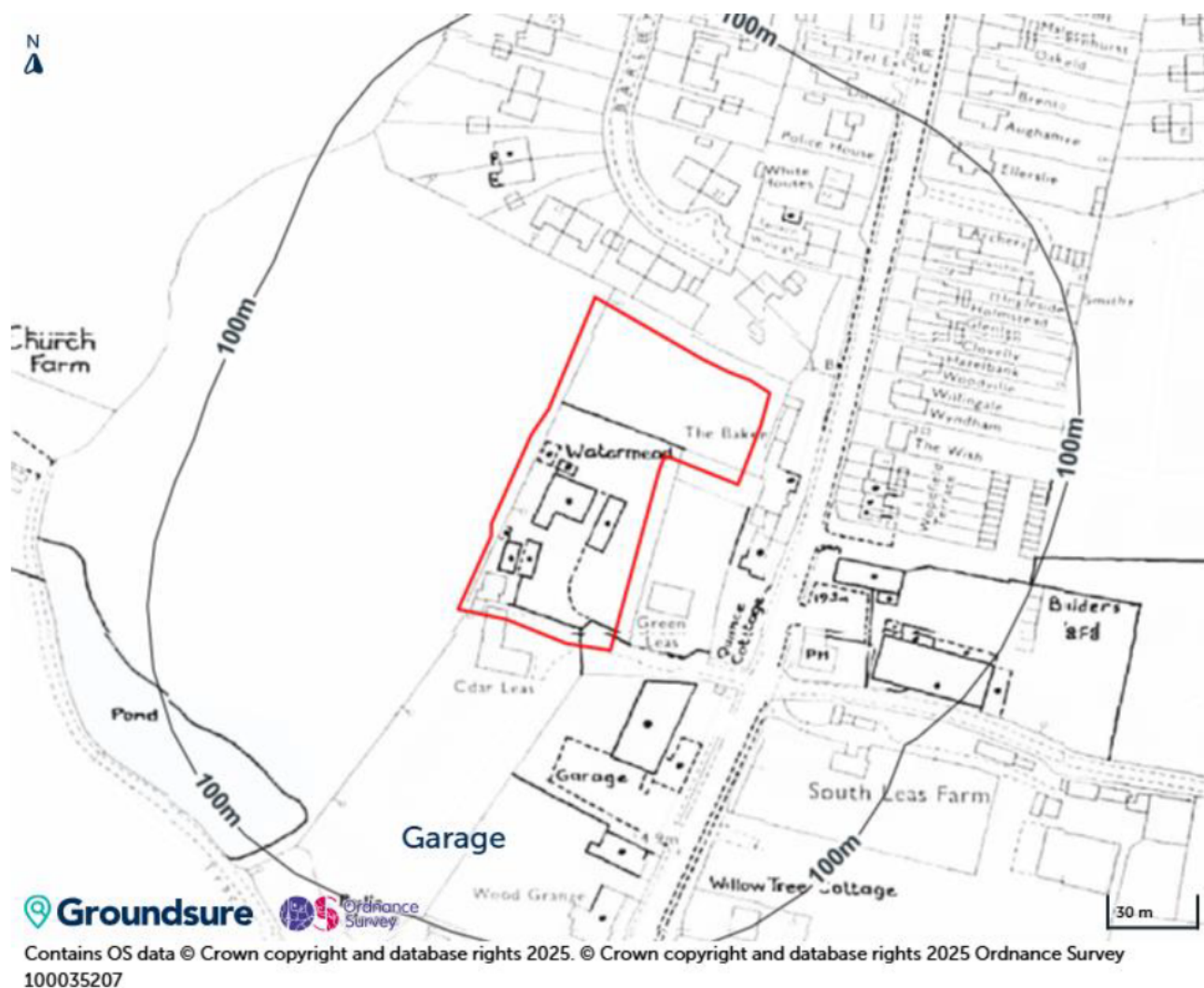


Diagram 5. Historical Garage (1983 Map)



3.1.4 Historical Military Land

No historical military sites are identified within 100m of the site.

3.2 Landfill and Other Waste Sites

The following table summarises the location of waste sites either on the site or within the surrounding area (within 250m of the site).

Table 8. Landfill and Other Waste Sites

Section	Groundsure Comments
Active or Recent Landfills	No active or recent landfills are identified within 250m of the site.
Historical Landfill (BGS Records/LA/Mapping Records EA Records)	No historical landfills are identified within 250m of the site.

Section	Groundsure Comments
Historical Waste Sites	No historical waste sites are identified within 250m of the site.
Licensed Waste Sites	No licensed waste sites are identified within 250m of the site.
Waste Exemptions	Three exemptions are identified within 100m of the site: Burning waste in the open (17m south of the site), and use of waste on construction (54m north-east and 95m north-east). Given the nature of the exemptions, they are not considered to represent potential sources of contamination.

3.3 Current Industrial Land Use

The relevant current industrial land uses are discussed in the table below.

Table 9. Current Industrial Land Uses

Section	Groundsure Comments
Recent Industrial Land Use	The data identifies the garage 16m south-east of the site as a new vehicle sales yard (as discussed in Section 2). The data also identifies a vehicle repair, testing and servicing site and a works at a location 73m south-east of the site which is the location of the timber yard and builders yard discussed in Section 3.1.1.
Current or Recent Petrol stations	The former petrol station 40m south of the site is identified, with the status noted as "Obsolete".
Electricity Cables / Gas Pipelines	No underground high voltage cables or high-pressure pipes are identified within 100m of the site.
Sites determined as Contaminated Land	No sites determined as contaminated land are identified within 100m of the site.
Control of Major Accident Hazards (COMAH) Sites	No COMAH sites are identified within 100m of the site.
Regulated Explosive Sites	No regulated explosive sites are identified within 100m of the site.
Hazardous Substance Storage/Usage	No consents have been granted for hazardous substance storage/usage within 100m of the site.
Historical Licensed Industrial Activities (IPC)	No records are identified within 100m of the site.
Licensed Industrial Activities (Part A(1))	No records are identified within 100m of the site.
Licensed Pollutant Release (Part A(2)/B)	No records are identified within 100m of the site.
Radioactive Substance Authorisations	No records are identified within 100m of the site.
Licensed Discharges to Controlled Waters	A discharge for treated effluent is identified 71m north-west of the site. Given the distance from the site and the nature of the discharge it is not considered to pose an unacceptable risk to the site.
Pollutant Release to Surface Water / Public Sewer	No records are identified within 100m of the site.
List 1 / List 2 Dangerous Substances	No records are identified within 100m of the site.
Pollution Incidents (EA/NRW)	Two incidents from 2022 involving sewage are identified 46m east and 55m south of the site. Given their distance they are not considered to represent a potential source of contamination.

Section	Groundsure Comments
Pollution Inventory Substances / Waste Transfers / Radioactive Waste	No records are identified within 100m of the site.

3.4 Sensitive Land Use

The site is located within a nitrate vulnerable zone (NVZ). The development proposals are not considered to pose an unacceptable risk to the NVZ.

3.5 Railway Infrastructure and Projects

No current railway or associated features are identified within 250m of the site.

4. HISTORICAL MAP AND IMAGERY REVIEW

Historical Ordnance Survey maps and imagery covering the area of the site have been reviewed and are summarised in the following table.

It is noted that maps and images present information applicable at the time of production of the maps or image captures, that maps are subject to surveying and cartographic errors and images to atmospheric conditions at the time of their capture. It is possible that significant developments may have taken place on or within the vicinity of the site that are not shown on the inspected maps and images.

'In the Vicinity of the Site' generally refers to features of relevance within approximately 250m of the site boundary but may also include more distant features if considered to be pertinent to the assessment of the development history.

Table 10. Summary of Significant Features Identified on Historical Maps and Images

Map/Image Details	On-Site	In the Vicinity of the Site
1875 1:2,500	The site comprises part of an open field.	A number of buildings are shown to the east of the site fronting Henfield Road further to the east.
1896 / 1897 1:10,560 / 1:2,500		A sewage farm is shown 250m south-east of the site. A clay pit and an associated brick field are shown 350m north-west of the site.
1911 / 1912 1:2,500 / 1:10,560		The brick field to the north-west is shown to have been extended into the location of the clay pit and is now approximately 300m north-west of the site. A smithy is shown ~90m north-east of the site.
1956 1:2,500		A house is shown to the south-west of the site. A timber yard is shown 25m south-east of the site.
1972 1:2,500	A small structure is present in the south-western corner of the site.	A filling station is shown 30m south-east of the site. Housing is now present to the north of the site, with further housing along the south-eastern boundary of the site.

Map/Image Details	On-Site	In the Vicinity of the Site
1983 1:2,500	Buildings are now shown in the southern part of the site on their current footprints, with additional outbuildings present slightly further to the north.	The filling station to the south-east is no longer shown and a garage is shown in this area. The timber yard is now labelled as a builder's yard.
1993 1:2,500	The additional outbuildings are no longer shown. The pond in the northern part of the site is now shown.	
2001 1:10,000		The sewage farm 250m to the south-east of the site is no longer shown. Whilst the excavation for the brick field to the north-west of the site is no longer clearly defined on the maps, it is now represented as a wooded area and has potentially never been backfilled.

5. PRELIMINARY CONTAMINATION RISK ASSESSMENT

5.1 Introduction

The risk assessment considers the potential sources of contamination identified, the receptors that may be present in view of the development proposals and the contaminant pathways by which these may be linked. A complete pollutant linkage is only deemed to exist where all three are present and a site is considered suitable for use where no complete pollutant linkages are identified.

Where a complete pollutant linkage is deemed to be present, an assessment of the level of risk associated with the pollutant linkage has been carried out in line with current guidance¹.

The level of risk is determined using the risk matrix presented in the following table. Classifications of probability, consequence and risk are presented in Appendix B.

Table 11. Risk Assessment Matrix

		Probability			
		Very Low	Low	Moderate	High
Consequence	Very Minor	Negligible	Very Low	Low	Low/Moderate
	Minor	Very Low	Low	Low/Moderate	Moderate
	Moderate	Low	Low/Moderate	Moderate	High
	Severe	Low/Moderate	Moderate	High	Very High

5.2 Contaminant Pathways Identified

The development is to comprise new residential buildings together with areas of private garden.

Pathways associated with gas and vapour intrusion into new buildings are considered to be valid, along with direct contact and dust related pathways, and pathways associated with the consumption of home grown produce.

The site is expected to be underlain by the Weald Clay Formation which is classed as an Unproductive Stratum. The Weald Clay Formation is likely to yield a very low to negligible infiltration with any leachable contaminants unlikely to come into contact with sensitive groundwater receptors. No potable drinking water abstraction points are noted within 1km of the site and the site is not located within a SPZ. As such, there are not considered to be viable pathways linking potential contamination on the site with sensitive groundwater.

The lined and dry pond in the north of the site is not considered to be a significant groundwater receptor at risk from contamination.

Should the proposed development plans be altered, a revised risk assessment may be required.

¹ Contaminated Land Risk Assessment: A guide to good practice, CIRIA C552, 2001.

5.3 Potential Contamination Sources Identified

The following potential sources of contamination have been identified by the preliminary contamination risk assessment:

- Historical light industrial use of the large buildings, including potentially for vehicle or plant maintenance.
- Made ground in the southern part of the site from historical demolition and construction of driveways and hard standing.
- Existing car repair garage and historical filling station to the south-east of the site.
- Potentially elevated background concentrations of heavy metals.

The potential contaminants associated with these sources are set out in the conceptual model.

It is assumed that the mound of soils (discussed in Section 2) will be removed as part of the development and has therefore not been identified as a potential source of contamination.

It is also noted that an asbestos survey of existing structures and infrastructure² was beyond the brief of this report. The risk assessment assumes that, should asbestos be identified within buildings or infrastructure, with particular reference to the features identified in Section 2, any such materials will be managed in accordance with current legislation and guidance to ensure this does not represent an ongoing risk to end users and, specifically, to ensure that asbestos materials are not introduced into the underlying soils.

5.4 Preliminary Conceptual Model

The preliminary conceptual model for the proposed development is presented in Appendix C.

² As defined under Section 5(a) of the Control of Asbestos Regulations, 2012.

6. SITE WORKS

6.1 Introduction

The intrusive site works comprised a series of dynamic sampler boreholes, together with accompanying in-situ geotechnical testing. The intrusive work was carried out between 24th June 2025 and 25th June 2025, with the coring of hard surfacing and walkover being undertaken ahead of the boreholes. The exploratory hole locations are shown on Figure 2.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records given in Appendix D, which also includes explanatory notes to assist in their interpretation.

6.2 Exploratory Holes

The following table summarises the intrusive works undertaken at the site.

Table 12. Summary of Intrusive Works Undertaken

Designation	Depth (m bgl)	Method
WS01	3.00	Dynamic Sampler
WS02	3.00	Dynamic Sampler
WS03	3.00	Dynamic Sampler
WS04	3.00	Dynamic Sampler
WS05	3.00	Dynamic Sampler
WS06	3.00	Dynamic Sampler
WS07	3.00	Dynamic Sampler
WS08	3.00	Dynamic Sampler
WS09	3.00	Dynamic Sampler
WS10	2.00	Dynamic Sampler

6.3 Sampling

Samples of soil were taken from the exploratory holes at the depths shown in the exploratory hole records. The types of samples taken are indicated on the exploratory hole records. Details on the sample types are provided in the explanatory notes.

Where appropriate, samples were stored in cool boxes with cooling blocks to maintain temperatures below 4°C until transferred to refrigerators upon return to the office and subsequently forwarded to the external accredited chemical testing laboratory.

6.4 In Situ Strength Testing

The types and depths of in situ testing, together with the test results, are either given on the exploratory hole records or are summarised separately in Appendix D. Further details on the in situ testing methods are provided in the explanatory notes.

6.5 In Situ Infiltration Testing

Falling head soakage tests were undertaken in two boreholes in general accordance with Kent County Council guidance³. The results of the testing along with the infiltration rate calculations are included in Appendix F.

6.6 Laboratory Testing

Laboratory testing was scheduled by Ashdown Site Investigation Ltd.

Geotechnical testing was undertaken by Ashdown Site Investigation Ltd. Chemical testing was undertaken by a laboratory with recognised (UKAS and MCERTS) accreditation for quality control.

Results from the laboratory tests are provided in Appendix E.

³ The Soakaway Design Guide published by Kent County Council, 2000.

7. GROUND CONDITIONS

7.1 Stratigraphy

7.1.1 Surface Covering

Boreholes WS01 to WS04, WS07 and WS10 were excavated through a surface cover of topsoil some 30mm to 200mm in thickness.

Within boreholes WS05, WS06 and WS08, located within the existing building, concrete some 120mm thick was recorded.

No surfacing materials were encountered in borehole WS09.

7.1.2 Made Ground

Within boreholes WS03 and WS05 to WS10, made ground generally comprising slightly gravelly clay with varying sand content, was recorded to depths of between 0.20m and 0.50m below ground level. The gravel fraction comprised variable quantities of brick, flint, concrete, crystalline rock, ironstone and ash/clinker-like material, with a brick cobble also recorded in borehole WS06.

No made ground was recorded underlying the topsoil within boreholes WS01, WS02 and WS04.

7.1.3 Weald Clay Formation

Underlying the topsoil/made ground, the investigation progressed into undisturbed stiff and very stiff clay deposits, locally with a gravel content comprising variable quantities of subangular to subrounded fine mudstone and ironstone, with siltstone and sandstone also noted at times.

These deposits continued to the final investigation depth of 3.00m below ground level and are considered to represent the Weald Clay Formation indicated to underlie the site on BGS geological maps.

Within borehole WS10, the soils below a depth of 1.45m were recovered as being clayey gravel of sandstone/siltstone with ironstone. The borehole could also not be progressed below a depth of 2.00m and the adjacent probe terminated at a depth of 1.10m below ground level. It is possible that these soils represent a horizon of rock deposits within the Weald Clay Formation.

7.2 Stability

With the exception of boreholes WS10, which recorded instability within the coarse grained recovered soils, each of the exploratory holes was recorded to remain stable during the course of drilling.

7.3 Groundwater Conditions

Each borehole was recorded at being dry during the short period of the intrusive works.

8. GEOTECHNICAL ASSESSMENT

At the time of preparation of this report no specific development proposal for the site had been finalised. It is however, understood that the development will comprise a series of houses with associated gardens, communal soft landscaped areas and associated access roads.

A copy of the feasibility layout is included as Appendix A.

At the time of writing, no details were available concerning the specific loads likely to be applied to the foundations.

8.1 Foundations

8.1.1 Soil Shrinkage/Heave Potential

The fine-grained soils of the Weald Clay Formation have been classified as clays, and with modified plasticity indices in the range of 24% to 41%; the soils may be expected to exhibit a medium to high volume change potential.

The test results for the majority of samples indicate the soils would be expected to exhibit a medium volume change potential. Only one plasticity index result out of 10 results was recorded to have a modified volume change potential marginally exceeding 40%, the lower bound value for the high volume change potential range. Overall, across all samples tested, the average modified volume change potential was 31%, which is broadly in the middle of the range for medium volume change potential (20% to 40%). It is therefore, considered that the design of precautions against shrinkage and heave for any new foundation system (spread footings and ground beams etc.) could assume a medium volume change potential for the fine-grained Weald Clay Formation soils and take into account current guidance such as that given by the Building Research Establishment (BRE)⁴ or the National House Builders Council (NHBC)⁵. It is nonetheless recommended that designers consult with any relevant regulators to agree that a medium volume change potential can be employed for design purposes.

Whilst this report has been prepared to provide advice to assist designers in undertaking detailed design, the report itself does not represent a detailed design statement. Detailed foundation design, including assessment of foundation type, minimum founding depths for spread foundations, and requirements for placement of void formers et cetera, should take into account the findings of this report and the presence of trees (previous, present and proposed). In connection with the latter, it is recommended that an arboricultural survey of the site that identifies the species and maturity of the existing or recently felled trees in the areas of the proposed new buildings should be provided to engineers responsible for the foundation design. Information on proposed planting schemes that may affect foundation design should also be provided.

8.1.2 Spread Foundations

8.1.2.1 Foundation Depths for Spread Foundations

Foundations should be constructed to bear below soils that are likely to be affected by significant soil volume changes caused by seasonal changes in moisture content to avoid damage to foundations that

⁴ www.bre.co.uk : BRE Digests 240, 241 and 242, Low rise buildings on shrinkable clay soils, parts 1, 2 and 3; and BRE Digest 298, The influence of trees on house foundations in clay soils and BRE Digest 412, Desiccation in clay soils.

⁵ <http://www.nhbc.co.uk/> : NHBC Standards, Chapter 4.2.

could otherwise arise. In addition, all made ground and any soils disturbed by the construction or removal of any previously existing foundations or services should be regarded as being variable in nature and state of compaction and, as such, unsuitable as a founding medium for shallow footings. New footings should be constructed so as to bear below made ground/disturbed natural soils and soil subject to seasonal soil volume changes, whichever is the deeper, and onto undisturbed, competent, natural deposits.

Summary guidance on suitable minimum foundation depths to protect against the effects of seasonal soil volume changes is presented in the table below but designers undertaking detailed design of foundations should follow the detailed guidance such as that provided within Chapter 4.2 of the NHBC Standards.

Table 13. Indicative Minimum Foundation Depths

Tree Type	Water Demand of Tree	Tree Distance to Tree Height Ratio (D/H)									
		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.25
		Minimum Foundation Depth Required in Medium Volume Change Potential Soils (m)									
Broad Leaf	High	†			2.50	2.35	2.20	2.00	1.70	1.35	0.90*
	Moderate	2.00	1.85	1.70	1.60	1.45	1.30	1.15	0.90*	0.90*	0.90*
	Low	1.50	1.40	1.30	1.15	1.05	0.90*	0.90*	0.90*	0.90*	0.90*
Coniferous	High	†			2.30	1.95	1.60	1.25	0.90*	0.90*	0.90*
	Moderate	2.00	1.70	1.40	1.10	0.90*	0.90*	0.90*	0.90*	0.90*	0.90*

* Minimum foundation depth required to protect against soil volume changes.

† Foundations deeper than 2.50m require specialist design to protect against soil volume changes.

Where specialist foundation design is required (foundation depths exceeding the maximum permitted by the guidance) then piled foundations are likely to be needed, though commercial considerations may also dictate that piled foundations may be more economic even in comparison with conventional spread foundations constructed to depths less than the maximum permitted by guidance. Further works including deep boreholes would be required if structural engineers or quantity surveyors decide that piled foundations should be adopted.

Details on the water demand and mature height of common trees is given within Table 3 of Chapter 4.2 of the NHBC standards which should be referred to when assessing minimum foundation depths required for the proposed development. A summary is provided in the table below.

Table 14. Indicative Summary of Water Demand and Mature Height of Common Trees

Tree Type	High Water Demand		Moderate Water Demand		Low Water Demand	
	Tree	Height (m)	Tree	Height (m)	Tree	Height (m)
Broad Leaf	Elm	18 – 24*	Acacia	18	Birch	14
	Oak	16 – 24*	Alder	18	Elder	10
	Poplar	15 – 28*	Apple	10	Fig	8
	Willow	16 – 24*	Ash	11 – 23*	Hazel	8
	Eucalyptus	18	Laurel	10	Holly	12

Tree Type	High Water Demand		Moderate Water Demand		Low Water Demand	
	Hawthorn	10	Beech	20	Honey Locust	14
			Blackthorn	8	Hornbeam	17
			Cherry	8 – 17*	Laburnum	12
			Chestnut	20 – 24*	Magnolia	9
			Lime	22	Mulberry	9
			Maple	8 – 18*	Tulip Tree	20
			Pear	12		
			Plane	26		
			Plum	10		
			Sycamore	22		
			Tree of Heaven	20		
			Walnut	18		
			Whitebeam	12		
Coniferous	Cypress	18 – 20*	Cedar	20		
			Douglas Fir	20		
			Larch	20		
			Monkey Puzzle	18		
			Pine	20		
			Spruce	18		
			Wellingtonia	30		
			Yew	12		

* Dependent on particular species.

8.1.2.2 Bearing Capacity for Spread Foundations

For design purposes, a net allowable bearing capacity of 150kN/m² may be assumed for spread (pad or strip) foundations up to 1.00m across bearing within the Weald Clay Formation soils of at least stiff consistency. The quoted bearing capacity is expected to limit settlement to less than 25mm.

In view of the risk associated with the underlying geology at the site for potential mining hazards, it is recommended that as a minimum all stripped formation levels should be inspected by a suitably qualified person for evidence of historical backfilled shafts as a precaution, and the inspections should be appropriately documented.

8.2 Ground Floors

In view of the presence of soils of medium volume change potential, it is recommended that ground floors should be suspended.

Current guidance⁶ suggests that ground bearing floor slabs may, however, be considered where:

⁶ <http://www.nhbc.co.uk/> : NHBC Standards, Chapter 4.2.

- 1) All made ground is removed from beneath the building footprint;
- 2) The depth of foundations required to protect against seasonal soil volume changes close to trees is less than 1.5m; and
- 3) Further works demonstrate that close to the time of construction, no significant soil desiccation is present.

Where the above criteria cannot be met ground floors should be suspended.

If ground bearing floors are adopted it is recommended that the potential for differential movement, both between the floor slab and walls and across the floor slab itself, should be anticipated. Such floors should be fully debonded from walls. Formations should be adequately proof rolled and any excessively soft materials excavated and replaced with a suitable, well graded granular fill. The depth of any fill should be limited to a maximum of 600mm unless placed to an engineering specification designed to limit internal settlement of the fill materials to a tolerance to be advised by the designer.

8.3 Groundwater

Groundwater was not encountered within the boreholes during the short period of the intrusive works. It is noted that water levels within the exploratory holes may not have equilibrated with the groundwater table at the time the observations were made and that the ground investigation works were conducted during a dry summer period and that higher groundwater levels may prevail during wetter seasons.

It is expected that pumping from sumps would be sufficient to control groundwater ingress from surface water run-off or seepages from perched water above the groundwater table as well as groundwater in excavations extending a shallow depth beneath the groundwater table.

8.4 Stability of Excavations

All made ground and coarse grained soils exposed in excavations should be assumed to be unstable, even in the short term. Whilst the fine-grained natural soils may remain stable for a short period of time if not subjected to surcharge loads (such as may be imposed by existing foundations, traffic or storage of materials), the stability of these deposits if left unsupported should be assumed to have the potential to deteriorate. Where stable excavations are required, excavations should either be suitably supported or, where space permits, side slopes could be battered back to a safe angle of repose.

All excavations requiring human entry must be shored or battered as necessary to conform to current best practice, as accepted by the Health and Safety Executive (HSE)⁷. Current legislation requires that where personnel access is required into any excavation a competent person must inspect excavation supports or battering of slopes at the start of the working shift and at other specified times. No work should take place until the excavation is safe. Excavations should also be inspected after any event that may have affected their stability, such as a significant weather event, changes in surcharge loadings imposed by temporary storage of materials or changes in site traffic plans or alteration of support systems. Inspections should be formally recorded and any faults that are found should be corrected immediately.

Particular attention must be paid to ensuring the stability of nearby structures, services and neighbouring sites.

⁷ Relevant guidance is given on the HSE website, www.hse.gov.uk

8.5 Aggressivity to Concrete

The aggressivity of the soils to concrete has been assessed in accordance with guidance published by the BRE⁸. The results of the chemical laboratory testing together with a summary of the characteristic values is included in Appendix F.

In consideration of the soils encountered beneath the site it is considered that 'natural ground conditions' may be assumed for the purpose of assessing the aggressivity of the chemical environment for concrete classification (ACEC class). Given the localised occurrence of groundwater seepages, 'mobile groundwater' conditions should be assumed.

The soils present beneath the site may be expected to contain sulphides which if exposed to air and water, and potentially bacterial action, may oxidise and convert into sulphates. The sulphides are significantly more likely to oxidise in ground that has been significantly disturbed, for example by cutting and filling as part of earthworks or by excavation and backfilling. Ground that is not disturbed beyond the cut face (e.g. piling operations or excavation without backfill) would not generally be considered by the guidance as being disturbed ground. Where disturbed ground is likely to result from construction activities a Design Sulfate Class based on the total potential sulphate should be adopted.

The following table summarises the characteristic values indicated from the chemical analysis of the soils present beneath the site.

Table 15. Assessment of the Chemical Analysis of the Soil

	Characteristic Value	Design Sulfate Class	ACEC Classification
pH	7.6	-	-
Water Soluble Sulphate (mg/l as SO ₄) *	200	DS-1	AC-1
Total Potential Sulphate (TPS % SO ₄)	No Oxidisable Sulphides	N/A	N/A

Notes: * Characteristic value rounded to nearest 100.

In accordance with the guidance, a DS-1 Design Sulfate Class and an AC-1 ACEC classification should be assumed for the design of concrete in contact with the ground.

8.6 Pavement Design

Current guidance⁹ suggests that pavement design should be based on the design subgrade surface modulus, determined as being equal to the lower of the short-term subgrade modulus and the long-term subgrade modulus. The subgrade surface modulus can be related to California bearing ratio using the formula, $E = 17.6(\text{CBR})^{0.64}$, where E is the subgrade modulus expressed in MPa.

Cone penetrometer tests were undertaken to establish the California bearing ratio (CBR) of the in situ soils at the time of the investigation. The range of values determined is presented on the test result records

⁸ BRE Special Digest 1:2005 Concrete in Aggressive Ground.

⁹ Highways England Design Manual for Roads and Bridges CD 225 Rev1; Design for new pavement foundations.

within Appendix D, and the table and graphs contained within Appendix F. A summary of the in situ test data is presented below. It is noted that in situ CBR values are, in part, dependent on the moisture content of the tested soils and are consequently subject to seasonal variation.

Table 16. In Situ CBR Values (At Time of Ground Investigation Works)

	CBR (%)	Modulus of Subgrade Reaction E (MPa)
Minimum	1.4	22.0
Average	14.0	88.7
Maximum	114.7	366.0
10%ile	4.0	42.6
20%ile	5.3	50.9
50%ile (Median)	10.1	77.1

Equilibrium CBR values can be derived from knowledge of soil classification data (plasticity index for soils exhibiting cohesion (clay type) and particle size distribution for granular soils) and pavement thickness. Historical guidance¹⁰ suggests the following design equilibrium CBR values would be applicable to the Weald Clay Formation for the construction of pavement. The subgrade moduli calculated from these design equilibrium CBR values can be reasonably considered to be representative of long-term subgrade modulus using the formula given above.

Table 17. Long-term CBR Values

Stratum		Design Equilibrium CBR Value (%)		†Modulus of Subgrade Reaction E (MPa)
		Thin Road* Pavement	Thick Road* Pavement	
Fine grained Weald Clay Formation	Minimum	2.5	3.0	31.2
	Average	2.9	3.8	34.9
	Maximum	3.3	4.3	37.8

* Thin pavement being 300mm sub-base, thick pavement being 1200mm sub-base. †Modulus based on average of all calculated moduli based on CBR values for thin sub-base.

Designers will need to select an appropriate design equilibrium CBR value / modulus of subgrade reaction taking account of proposed pavement thickness, expected winter groundwater conditions, the standard to which pavement is to be designed and any local authority or other regulatory/warrantor requirements together with construction conditions likely to prevail at the time of construction.

The subgrade may be assumed not to be susceptible to frost heave.

¹⁰ Highways England Design Manual for Roads and Bridges Interim Advice Note 73/09 Rev1; now withdrawn.

8.7 Stormwater Infiltration Systems

In-situ infiltration testing¹¹ was undertaken in boreholes WS03 and WS10. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

The infiltration rates derived from the tests are summarised in the following table.

Table 18. Calculated Infiltration Rates

Exploratory Hole	Top of Response Zone (m bgl)	Bottom of Response Zone (m bgl)	Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
WS03	2.00	3.00	Weald Clay Formation	2.25×10^{-7}	2.5
WS10 Test 1	1.00	2.00	Weald Clay Formation	2.96×10^{-5}	1.0
				1.41×10^{-5}	0.7
WS10 Test 2	1.00	2.00	Weald Clay Formation	3.91×10^{-5}	1.0
				9.06×10^{-6}	0.6
WS10 Test 3	1.00	2.00	Weald Clay Formation	2.54×10^{-5}	1.1
				1.10×10^{-5}	0.8

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system. It is noted that the results from borehole WS10 are significantly better than those for borehole WS03, which would be considered more typical of the clays of the Weald Clay Formation. It is likely that the higher results achieved in borehole WS10 are linked to the more granular deposits that were encountered at this location, possibly representative of a horizon of rock deposits, and are unlikely to be representative of the soils generally encountered at the site.

To comply with building regulations¹², point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

The infiltration testing conducted in the boreholes is intended to provide calculated soil infiltration rates to assist in the preliminary design of infiltration systems at the site. In light of the varying results between the two boreholes, further testing across the site would be recommended ahead of undertaking designs if a soakaway drainage system is to be considered at the site.

It is also noted that Regulators/Local Authorities may require further testing to be undertaken at a later stage in accordance with the BRE365 guidance. This guidance states the testing should be carried out at the locations and depths of the proposed soakaways, which will not be known until preliminary drainage design has been undertaken.

¹¹ Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

¹² The Building Regulations 2010; Part H; Drainage and Waste Disposal

Monitoring of groundwater levels during the worst annual case (winter period) is often a requirement of Local Authorities and the BRE365 guidance suggests this should be undertaken prior to finalising design of infiltration systems.

9. QUANTITATIVE CONTAMINATION ASSESSMENT

9.1 Assessment Strategy

The design of the ground investigation considered the potential contaminant sources identified by the preliminary ground contamination risk assessment. The investigation strategy employed to assess the potential sources is summarised in the following table.

Table 19. Investigation Works Carried Out

Contaminant source	Exploratory Positions
Historical light industrial use of the large buildings, including potentially for vehicle or plant maintenance.	WS05-WS08 Sampling of soils and testing for contaminants of concern.
Made ground in the southern part of the site from historical demolition and construction of driveways and hard standing.	WS04 – WS10 Sampling of made ground soils and testing for contaminants of concern
Existing car repair garage and historical filling station to the south-east of the site.	WS09 and WS10 Testing of deeper samples to assess potential for migration from off-site source
Potentially elevated background concentrations of heavy metals	Sampling of shallow soils from across the site and testing for concentrations of heavy metals.

In addition to the above targeted investigation works, samples of the shallow soils from the northern part of the site (WS01 – WS04) were tested for a range of commonly occurring contaminants.

9.2 Analysis of Contamination Test Results

9.2.1 Method of Assessment

For the assessment of risk to end users, comparison of the results of the laboratory testing has been made against published soil screening values (SSV) comprising the 'Suitable For Use Levels' (S4UL)¹³ or, in lieu of an S4UL being developed for lead, the Category 4 Screening Level (C4SL)¹⁴.

In view of the development proposal, the SSV utilised in this assessment are those calculated for the generic "Residential with homegrown produce" land use.

9.2.2 Heavy Metals & Polycyclic Aromatic Hydrocarbon (PAH) Compounds

The following table summarises the SSV for heavy metals and PAH compounds, along with the maximum and minimum concentrations recorded.

¹³ Nathanail, C.P. et al., The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015, Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3071.

¹⁴ SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.

Table 20. Summary of Test Results – Heavy Metals and PAH Compounds

Contaminant	SSV (mg/kg)	No. of Samples	Minimum Concentration (mg/kg)	Maximum concentration (mg/kg)	Limit of Detection (mg/kg)	No of exceedances
Arsenic	37	9	<LOD	14	< 2	0
Water Soluble Boron	290	9	<LOD	<LOD	< 1	0
Cadmium	11	9	<LOD	0.4	< 0.2	0
Chromium	910	9	<LOD	40	< 2	0
Hexavalent Chromium	6	9	<LOD	<LOD	< 2	0
Copper	2400	9	7	32	< 4	0
Lead	200	9	9	62	< 3	0
Mercury	40	9	<LOD	<LOD	< 1	0
Nickel	180	9	<LOD	32	< 3	0
Selenium	250	9	<LOD	<LOD	< 3	0
Zinc	3700	9	8	91	< 3	0
Naphthalene	2.3	9	<LOD	<LOD	< 0.1	0
Acenaphthylene	170	9	<LOD	<LOD	< 0.1	0
Acenaphthene	210	9	<LOD	<LOD	< 0.1	0
Fluorene	170	9	<LOD	0.33	< 0.1	0
Phenanthrene	95	9	<LOD	0.39	< 0.1	0
Anthracene	2400	9	<LOD	<LOD	< 0.1	0
Fluoranthene	280	9	<LOD	1.38	< 0.1	0
Pyrene	620	9	<LOD	1.26	< 0.1	0
Benz(a)anthracene	7.2	9	<LOD	0.64	< 0.1	0
Chrysene	15	9	<LOD	0.98	< 0.1	0
Benzo(b)fluoranthene	2.6	9	<LOD	0.87	< 0.1	0
Benzo(k)fluoranthene	77	9	<LOD	0.41	< 0.1	0
Benzo(a)pyrene	2.2	9	<LOD	0.84	< 0.1	0
Indeno(123-cd)pyrene	27	9	<LOD	0.59	< 0.1	0
Dibenz(ah)anthracene	0.24	9	<LOD	0.13	< 0.1	0
Benzo(ghi)perylene	320	9	<LOD	0.47	< 0.1	0

None of the samples of the shallow soil (made ground and topsoil) tested recorded concentrations of individual heavy metals or PAH compounds above their respective SSV. The concentrations of heavy metals and PAH compounds present within the shallow soils are not considered to pose an unacceptable risk to end users of the site.

9.2.3 Asbestos

No suspected asbestos materials were noted within any of the exploratory holes undertaken at the site. None of the samples screened recorded the presence of any asbestos materials.

There is not considered to be an unacceptable risk to end users from asbestos materials within soils. Due to the heterogeneity of made ground, there will always remain the potential for localised asbestos materials to be encountered during construction works, though the likelihood of this is considered to be very low. All workers at the site should be made aware of what actions to take in the event that suspected asbestos materials are identified at any time during the development works.

As previously discussed, an asbestos survey of existing structures and infrastructure¹⁵ was beyond the brief of this report. Should asbestos be identified within buildings or infrastructure, with particular reference to the features identified in Section 2, any such materials must be managed in accordance with current legislation and guidance to ensure this does not represent an ongoing risk to end users and, specifically, to ensure that asbestos materials are not introduced into the underlying soils.

9.2.4 Petroleum Hydrocarbons. BTEX compounds and Volatile Organic Compounds (VOC)

The following tables list the SSV for petroleum hydrocarbon equivalent carbon weight fractions and BTEX compounds calculated for 1% organic content.

Table 21. SSV for petroleum hydrocarbon equivalent carbon weight fractions

Petroleum Hydrocarbon Fraction	SSV (mg/kg)	Petroleum Hydrocarbon Fraction	SSV (mg/kg)
Aliphatic EC 5-6	42	Aromatic EC 5-7	70
Aliphatic EC >6-8	100	Aromatic EC >7-8	130
Aliphatic EC >8-10	27	Aromatic EC >8-10	34
Aliphatic EC >10-12	130	Aromatic EC >10-12	74
Aliphatic EC >12-16	1100	Aromatic EC >12-16	140
Aliphatic EC >16-35	65000	Aromatic EC >16-21	260
Aliphatic EC >35-44	65000	Aromatic EC >21-35	1100
		Aromatic EC >35-44	1100

Table 22. SSV for BTEX Compounds

Compound	SSV (mg/kg)	Compound	SSV (mg/kg)
Benzene	0.087	Ethylbenzene	47
Toluene	130	p-Xylene ¹	56

Table Notes: ¹ Xylene has three structural isomers, the SSV presented is for p-Xylene, which has the most conservative SSV.

¹⁵ As defined under Section 5(a) of the Control of Asbestos Regulations, 2012.

Whilst full speciation of the concentrations of petroleum hydrocarbons by aromatic and aliphatic fractions was not undertaken, the results of the testing undertaken can still be compared with the more stringent of the screening values for the respective equivalent carbon weight fraction and, where the concentration recorded is found to be lower, it can be reasonably concluded that no significant risk is present.

For the exploratory holes in the more northern part of the site (WS01-WS04) where no potential source of petroleum hydrocarbons was identified, shallow samples were tested for concentrations of petroleum hydrocarbons in the >C8-C40 fractions. Very low concentrations of petroleum hydrocarbons were recorded in these samples, all of which were significantly below the more conservative SSV for each equivalent carbon weight fractions.

In the southern part of the site, shallow and deeper samples were tested for concentrations of petroleum hydrocarbons in the >C6-C40 fractions, with selected samples tested for BTEX compounds as part of the VOC suite.

Only two of the shallow samples, WS07 at 0.20-0.25m and WS10 at 0.20m, recorded any detectable concentrations of petroleum hydrocarbons. The remaining 16 samples of soils tested, including the deeper samples from WS07 and WS10 (where shallow petroleum hydrocarbons were recorded) did not record any detectable concentrations of petroleum hydrocarbons.

The detectable concentrations were all significantly lower than the more conservative SSV for each equivalent carbon weight fraction.

Some of the samples tested recorded concentrations of ethylbenzene or m,p-xylene marginally above the limit of detection of the test (ranging between 0.002mg/kg and 0.005mg/kg). All detectable concentrations were significantly lower than their respective SSV.

With the exception of those BTEX compounds discussed above, none of the samples tested recorded any detectable concentrations of other VOC.

Comparison of the test results for petroleum hydrocarbons for samples taken from >0.75m depth, the depth at which water supply pipework are likely to be laid, has been undertaken with the threshold value for PE water supply pipework¹⁶. The concentrations from these samples do not exceed the threshold value.

There is not considered to be an unacceptable risk to end users from petroleum hydrocarbon, BTEX or VOC contamination at the site. It is however recommended that, following the demolition of the buildings, inspection of the formation level for any visual or olfactory evidence of petroleum hydrocarbon contamination is undertaken. Particular attention should be paid to the area of the suspected vehicle inspection pits.

No evidence of off-site migration from the garage or petrol filling station was evident from the samples tested.

It is strongly recommended that designers consult with the local water supply company to determine the specific water supply pipe material required to be used, or whether they require further laboratory testing and assessment specific to proposed routes of services.

¹⁶ Set out within Table 3.1 of the Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UK Water Industry Research, 2010.

9.3 Quantitative Contamination Risk Assessment

9.3.1 Contamination Sources Identified

No sources of contamination have been identified by the quantitative assessment.

9.3.2 Quantitative Conceptual Model

The quantitative conceptual model for the proposed development is presented in Appendix G.

In the absence of any complete pollutant linkages being identified, no remedial measures or further contamination risk assessment works are considered to be necessary, although as discussed above, inspection of the formation levels should be undertaken following demolition of the existing buildings.

9.4 Risks to Other Potential Receptors

All construction workers must undertake their own risk assessment, based upon the works to be carried out and the proposed method by which this will be achieved, in accordance with current health and safety legislation. Their assessment should take into account all available information about the site, including that present within this report.

Appropriate working procedures and PPE should be adopted to ensure the health and safety of the site operatives. Instruction should be given in the recognition of potentially hazardous materials. All site personnel should be appropriately briefed on the discovery strategy, presented below, and what actions they must take in the event that further evidence of contamination is identified or suspected.

9.5 Regulatory and Warrantor Approval

This report should be submitted to the local authority in support of a planning application for the site. The conclusions drawn in this report should be considered as provisional until such time as the report has been accepted and the relevant conditions have been discharged. The report should also be provided to any other relevant regulator and/or warrantor.

9.6 Discovery Strategy

If, during the course of the site clearance and development works, any materials not previously identified by the investigation that are suspected of being 'contaminants' are encountered, then the following procedure should apply:

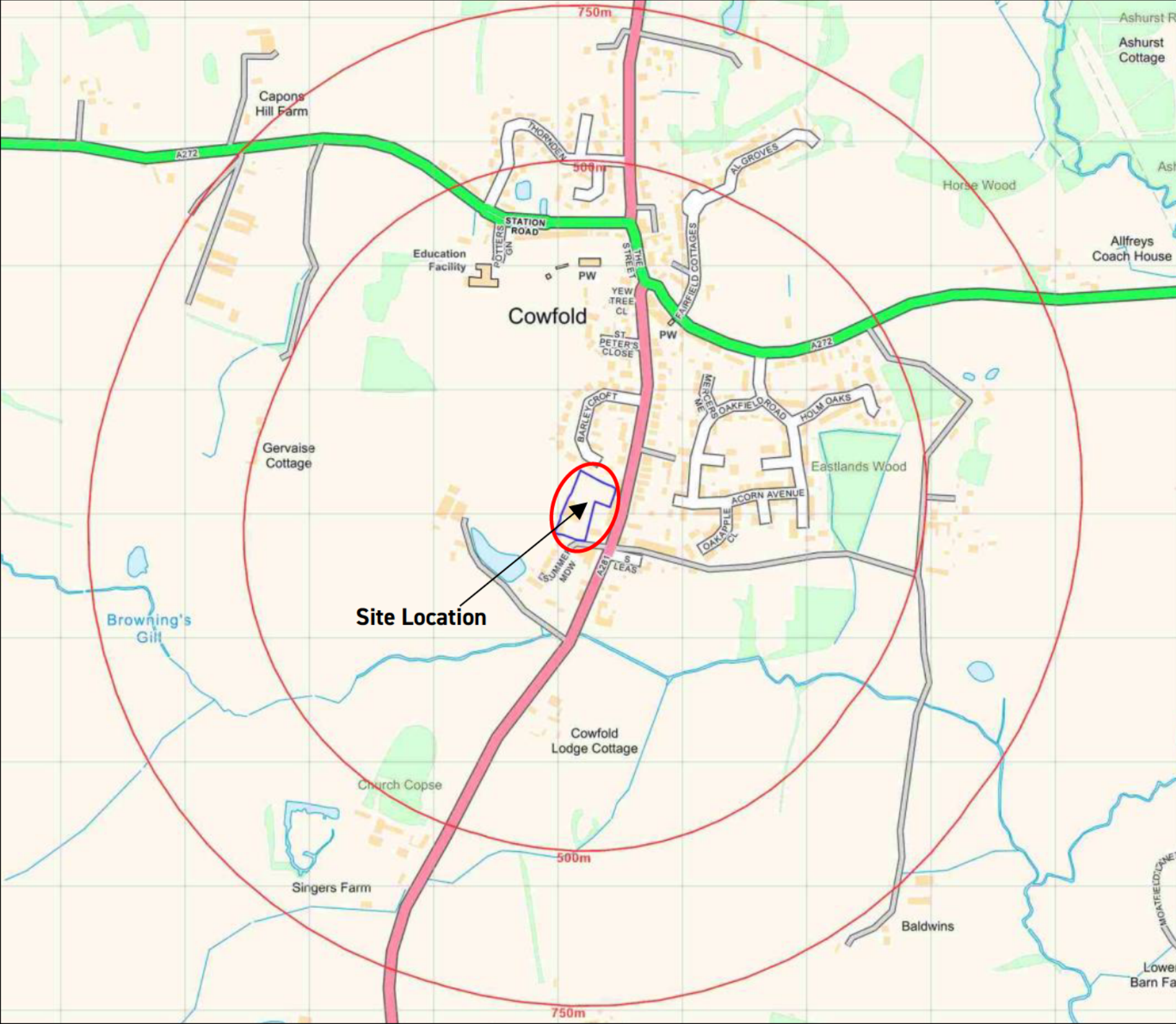
- All works in that area should cease and the site manager should be informed.
- Advice should be sought from suitably qualified and experienced personnel as to whether any further site inspection, sampling, testing and/or assessment is deemed necessary.
- If required, the conclusions of any assessment and any proposed remedial works (if required) should be agreed by the local authority.
- If necessary, full details of any remedial works should be included in a verification report for the site.

Suspected 'contamination' may take the following form, though it is noted that this list is not exhaustive and site operatives should ask if they are at all unsure of any findings:

- Soil or water looks oily and/or has an oily odour
- Soil or water has a solvent type of odour
- Significant quantities of man-made materials within fill such as paint cans, car parts, glass fragments
- Suspected asbestos containing materials (insulating boards, cement, loose fibres etc.)
- Significant volumes of clinker like or ashy material
- Sand bags, and/or subsurface concrete structures
- Animal carcasses or evidence of animal burial pits

FIGURES

- Figure 1 Site Location Plan
- Figure 2 Site Plan



Head Office

Unit 3
The Old Grain Store
Ditchling Common Business Park
Ditchling
East Sussex
BN6 8SG
contact@ashdownsi.co.uk

Site

Watermead
Henfield Road
Cowfold
West Sussex

Project Ref

P17246

Figure No

1

Drawing Title

Site Location Plan

Scale

Not To Scale



Head Office
Unit 3 The Old Grain Store Ditchling Common Business Park Ditchling East Sussex BN6 8SG contact@ashdownsi.co.uk
Site
Watermead Henfield Road Cowfold West Sussex
Project Ref
P17246
Figure No
2
Drawing Title
Site Plan
Scale
Not To Scale

APPENDIX A

Preliminary Feasibility Layout