

Blackmore Farm, Melksham

Ground Investigation Report



Report for:

David Wilson Redrow South West

Reference:

P1418/CS-2957

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EXECUTIVE SUMMARY

Site Setting		
Site description and current land use	The site occupies an area of 31 hectares (ha) and is currently used for agricultural purposes. The site is generally level with an elevation of between 49 and 39 metres Above Ordnance Datum (mAOD) . Blackmore Farm is located in the north most section of site comprising several barns and sheds.	
Environmental setting	Geology	Superficial - Alluvium is mapped alongside the stream. Bedrock - Oxford Clay Formation.
	Hydrology and hydrogeology	Oxford Clay - Unproductive Strata. Alluvium - Secondary A aquifer. There are no licensed abstractions within 500m of the site. The site is not located within a Source Protection Zone. A stream runs from the along the southern section of the site. The site is in a low risk Flood Zone 1.
	Mining	Mining is not considered to affect the site.
	Radon	Low risk. Protection measures are not required.
	UXO	Low risk.
	Site history	The site has comprised predominantly open agricultural fields since the earliest available mapping (circa 1880), with a stream traversing from the south-eastern boundary towards the west. Historical features recorded within the site include an orchard adjacent to Blackmore Farm in the north, multiple ponds, small stables, and a plantation (Eight Acre Plantation) in the south-east. Limited changes occurred until the 1970s, when several ponds were infilled and the northern orchard was progressively redeveloped into barns and paddocks associated with Blackmore Farm, which expanded between 1988 and 2000. Minor boundary alterations and further pond infilling occurred up to 2018, although overall agricultural land use remained consistent. The surrounding area has historically comprised farmland and scattered residential dwellings. By 2018, significant residential development had occurred to the west, with a ring road and a solar farm established approximately 220m east of the site.
Areas of potential concern at desk study stage	On-site	Potential made ground associated with historical and current site development.
	Off-site	No significant features identified.
Phase 2 Ground Investigation		
Ground conditions	Made ground was not encountered in any of the exploratory hole locations during the investigation. However, made ground was previously encountered within the farm area. Topsoil, approximately 0.2 – 0.3m thick, was encountered across the site as sandy clay. The Oxford Clay Formation was recorded in all exploratory locations, which typically comprise firm to stiff clay. No on-site superficial deposits were encountered in proximity to the stream present in the southernmost section of site. No visible or olfactory evidence of significant contamination was encountered during the ground investigation. However, occasional asbestos cement fragments were previously noted in the made ground within the farm area.	
Groundwater	Groundwater was only encountered within TP128 at 2.80mbgl with minor ingress.	
Principal Findings and Conclusions		

Human health and plant growth	Topsoil and natural soils – Low risk posed by soil chemical concentrations. Made ground was encountered during the previous investigation in the area of the farmyard and is not considered suitable to remain at shallow depth within areas of soft landscaping.	
Controlled waters	Low risk due to the absence of a significant potential contaminant source.	
Gas protection	Low ground gas concentrations revealed during monitoring – No protection measures required against ground gas.	
Potable supply pipework	PE water supply pipework is likely to be required by the local water authority.	
Waste	The natural soils are classified as non-hazardous waste. Fragments of asbestos containing cement were encountered within the made ground local to the farmyard. Based upon the BRD investigation data, it may be possible to separate the hazardous asbestos containing material from the non-hazardous made ground and reduce the overall volume of hazardous waste. Further Waste Acceptance Criteria (WAC) testing may be required by the receiving site.	
Engineering design	Foundations	Traditional foundations placed at a minimum depth of 1.0mbgl within the firm to stiff clay may be designed for an allowable bearing capacity of 100kPa for acceptable settlement.
	Roads	Design CBR value of 2.5% subject to firm clay being encountered at formation level.
	Concrete	Recommended design mix for buried structures concrete is DS-4 AC-4s.
	Drainage	Soakaways are unlikely to offer a viable method of surface water drainage.
	Other	The cohesive soils have shown to be of high-volume change potential and as a result will be susceptible to the influence of trees.
Considerations and Recommendations for Further Work		
Considerations	Made ground is considered unsuitable to remain at shallow depths in areas of soft landscaping	
Recommendations for further work	Human health/ plant growth	A remedial strategy should be prepared once the proposed development has been finalised.

	General	• A Flood Risk Assessment will be required in support of redevelopment of the site. • Discussions should be held with local landfill/soil waste treatment facilities to agree material classification required for any soils to be disposed off-site as a result of proposed construction and demolition works. • A site-specific health and safety plan should be prepared to inform on risks posed from the previous site use and mitigations for ground workers developing the site e.g. requirements for appropriate PPE, hygiene practices, environmental monitoring and requirements for mitigation measures during construction works. • Remain vigilant for newly encountered made ground or visible and olfactory signs of contamination associated with made ground post demolition of the existing buildings. • Provide the relevant regulatory authorities with a copy of this report to confirm that they are in agreement with the report findings.
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1 INTRODUCTION

1.1 Contract Details

Following instruction from **David Wilson Redrow South West** (the 'client'), this report presents the results of a Supplementary Ground Investigation undertaken for a proposed residential development at **Blackmore Farm, Melksham** (the 'site').

1.2 Proposed Development

Information presented to T&P Regeneration Ltd (T&P) indicates that the proposed development is intended to comprise the construction of up to 500N° traditional two storey residential dwellings with associated areas of communal and private soft landscaping. The development also includes hard landscaped access, parking, proposed primary school, sports pitches and allotments. A development layout plan is included in Appendix A, although it is understood this may be subject to change following completion of master planning.

1.3 Previous Reports

Previous reports pertaining to the site are listed in Table 1.1. Pertinent information is summarised in this report where appropriate. However, reference should be made to these reports directly for further detail.

Table 1.1 Summary of Previous Reports

Date	Title	Reference	Author
August 2018	Phase 1 Geo-Environmental Desk Study	BRD3304-OR1-A	BRD Environmental Ltd (BRD)
June 2023	Preliminary Phase 2 Geo-Environmental Site Investigation	BRD3304-OR2-B	

1.4 Objectives

Following completion of previous ground investigation, the purpose of the assessment is to target newly included area within the development and increase the broad exploratory hole density. This report also considers the likely foundation options appropriate to the proposed development, along with requirements for any related ground improvement works and/or remediation considered necessary to mitigate potentially unacceptable risks resulting from current and/or or historical land uses.

1.5 Scope of Works

The scope of works to fulfil the purpose of the assessment has included the following:

- Review of third party reports;
- Development of a preliminary site conceptual model and environmental risk assessment based on previous desk study information;
- Intrusive ground investigation comprising trial pitting and in-situ CBRs

- Collection of soil samples for chemical and geotechnical laboratory analysis;
- Assessment of chemical and geotechnical test results;
- Refinement of conceptual site model and update to environmental risk assessment; and,
- Presentation of geotechnical information to assist with foundation design.

1.6 Report Limitations

The recommendations, interpretations and conclusions of this report are based on the historical and current site conditions reported by database and mapping sources as supplemented with information gathered during on-site visits. No responsibility can be accepted for the accuracy of third party information including reference data contained within site specific database reports. Due to the inherent variability of ground conditions between exploratory hole positions, these conditions can only be interpreted and are accurate only for the date of the investigation works.

2 SITE INFORMATION

2.1 Site Location

Site location information is summarised in Table 2.1. A Site Location Plan is presented within Appendix A.

Table 2.1 Site Location Information

Information	Description
Full postal address	Land at Blackmore Farm, Melksham, SN12 7QS
National Grid Reference (NGR)	392538, 164394

2.2 Site Description

A summary of pertinent site information is provided in Table 2.2 with reference to information gathered during the T&P and previous investigations.

It should be noted an amendment to the site boundary has occurred since the completion of the original desk study in 2018, with the current boundary covering a reduced area absent of a field to the north of Sandridge Common (A3102) and 4-5No fields along the eastern boundary. It is understood a proposed commercial development is intended in the southwest corner of site; however, this area is outside of the investigation and is not considered further.

Table 2.2 Summary of Site Information

Information	Description	
Site access	The site is accessed via Blackmore Farm located off the adjacent Sandridge Common (A3102), which runs parallel to the northern boundary.	
Site description including current site use and dimensions/ area (ha)	The site is an irregular parcel of land measuring approximately 580m north to south and 500m west to east, occupying roughly 31ha. The site comprises several separate agricultural fields with barns/ sheds associated with Blackmore Farm present in the northern area of site. The fields are currently used as pastoral land.	
Site elevation and topography	The site elevation ranges between 49 and 39 metres Above Ordnance Datum (mAOD). The site is generally slopes from the north-east to the south-west towards a stream within a shallow valley feature.	
Ground cover (%)	The site ground cover comprises: • Soft landscaping (grass/planting) - 90% • Hard landscaping (tarmacadam/concrete) - 5% • Buildings - 5%	
Site boundaries	North	Hedge lines approximately 1 - 2m in height bound the site in all directions.
	South	
	East	
	West	
Surrounding land uses	North	The site is bounded by residential development to the north beyond which the A3102 (Sandridge Common) runs east to west.

Information	Description	
	South	The site is bounded by agricultural land.
	East	The site is bounded by agricultural land beyond which is Eastern Way and residential developments.
	West	The site is bounded by agricultural land.
Other significant on-site features	- Pond present in the central eastern section of site. The following onsite features were recorded by BRD, however, are not considered pertinent to the scope of this report. Reference should be made to previous reports for further detail. - The previous investigation encountered asbestos containing materials including suspected asbestos cement roof sheets, asbestos cement wall sheets, and broken cement fragments observed across the farmyard area. Although not relevant to the current investigation, vigilance should be kept for the presence of asbestos containing material. - A large slurry pit present within the north-east corner of the yard area, noted to be leaking in places. - A pond present at the south-west corner of the farmyard area which is surrounded by bunds of unknown material. - Evidence of an infilled pond was observed near the northern site boundary where a depression is present. - A significant amount of stockpiled topsoil was present in the northern part of site. - Two off-site actively used above ground fuel storage tanks present within Blackmore Farm. No evidence of leaks or spillages were observed.	

2.3 Environmental Setting

Pertinent environmental information within the available third party report has been reviewed and is summarised in Table 2.3. The following information has been prepared with reference to the site boundary as defined within the original assessment completed by BRD in 2018.

No significant changes to the conclusions of the environmental setting are noted as a result of the amended site boundary.

Table 2.3 Summary of Site Setting from Desk Study Information

Information	Description
Site history	<u>On site</u> From the earliest maps in the late 1800s, the site comprised multiple open agricultural fields (approximately 20No.) divided by hedgerows and tree lines, with a stream running from the south-eastern boundary through to the west. Several features were recorded within the site including an orchard in the northern area adjacent to Blackmore Farm, 4No small ponds, 2No small stables, and a plantation (Eight Acre Plantation) in the south-eastern corner. The site remained largely unchanged until 1972 when two of the ponds were no longer recorded, with a third pond removed by 1975. By this time, drainage ditches had been established and the northern orchard replaced with barns and paddocks associated with Blackmore Farm, which expanded further southwards between 1988 and 2000. By 2018, limited field boundary alteration and infilling of ponds had occurred, with the overall agricultural land use remaining consistent.

Information	Description
	<u>Off site</u> In the late 1800s maps of the surrounding area comprised predominantly agricultural land, with residential dwellings and small farms recorded from the late 1800s. By the early 1900s, Brickyard Plantation including former brick pits and ponds were recorded approximately 250m east and infilled by 1901. A barn situated on the northwest corner of the northern parcel of site first appears by 1900 but is removed by 1936. Through the mid-20th century, farm expansion and localised development occurred, including a depot 250m west. Between 1970 – 1990 maps show further farm expansion and the establishment of a pumping station approximately 40m northwest. By 2018, there is significant residential development to the west including the ring road and a large solar panel farm developed approximately 220m east of the site.
Geology	The site is reported to be underlain by bedrock geology of the Oxford Clay Formation (clay and mudstone) deposited 157 to 166 million years ago during the Jurassic Period. Superficial Alluvium (clay, silt, sand, gravel) is mapped alongside the stream that runs along the southern boundary of site.
Mining and geotechnical hazards	Based upon the database report within the appendices of the Desk Study, the site is not located within a coal or non-coal mining area and the risk is considered by T&P to be low. Soft or compressible natural deposits such as Alluvium are potentially present on site. Fine soils with possibility for high volume change capacity are present on site. No other geotechnical hazards are recorded on site.
Hydrology and hydrogeology	The Oxford Clay Formation is classified as Unproductive Strata. The superficial Alluvium is classified as a Secondary A aquifer. The site is not reported to be within a Source Protection Zone (SPZ) and there are no surface water abstractions within 250m from the site. A stream is present along the southern section of the site and runs from east to west. In addition, a shallow pond is located in the central eastern section within the site.
Environmental designations	There are no sensitive environmental designations on or near the site.
Radon	The site is located in an area where <1% of homes surveyed are above the action level. As such, no radon protection measures will be required for new development.
Background soil geochemistry	The site is not located within an area of naturally elevated metalliferous elements.
Flood risk	The site is located in a Flood Risk Zone 1. However, due to the size of the site (>1ha), a Flood Risk Assessment is recommended to support redevelopment.
UXO	The site is located in a low UXO risk area.
Areas of Potential Concern	Potential made ground associated with historical and current site development.

2.4 Summary of Previous BRD Ground Investigation Report

2.4.1 Summary of Field Work

An intrusive ground investigation was undertaken by BRD Environmental Ltd between the 14th to 18th November 2022, with an additional phase focusing on the farmyard on 14th June 2023 and associated gas and groundwater monitoring. The proposed site boundary has been altered multiple times during the different phases of investigation, which is noted to vary from the present day feasibility layout.

Exploratory hole locations outside the current site boundary have not been considered within this phase of works, except where commentary or considerations are required. Reference should be made to the previous report for further detail.

2.4.2 *Ground Conditions*

Made ground was predominantly encountered within the farmyard area, which typically comprised hardstanding (concrete or gravel) underlain by gravel subbase and reworked 'organic' soils to a maximum depth of 1.10m. Within WS20 a black ash and clinker layer was observed between 0.25 to 0.50m. Suspected asbestos cement fragments were also observed in this made ground in TP27 but were not encountered elsewhere in the farmyard area.

Shallow made ground was also noted within WS06, WS09 and WS14 located outside of the farmyard area which comprised reworked natural soils with brick and charcoal fragments. This extended to maximum depths of 0.50mbgl representing locally reworked natural soil deposits.

In addition, hand dug pit HD01 was excavated in the soil bund surrounding the slurry pond, which comprised 0.50m of a reworked made ground topsoil containing a single suspected asbestos cement fragment.

The Oxford Clay Formation was encountered in all the exploratory points either beneath made ground or topsoil. It was typically found to be initially firm to stiff silty clay and broadly increased in consistency/ strength with depth. Selenite crystals, calcareous concretions, shell fragments and relict rootlets were commonly recorded.

2.4.3 *Groundwater*

During the ground investigation BRD note that in several positions surface water seepages were encountered at the interface of the base of the topsoil and the top of the Oxford Clay Formation due to the heavy persistent rain. Deeper groundwater seepages within the Oxford Clay Formation strata were also observed in TP07 at 2.40mbgl, TP16 at 2.00mbgl, TP20 at 1.80mbgl, TP22 at 1.10mbgl and WS22 at 3.65mbgl. Groundwater levels were also recorded during the monitoring visits. The levels recorded within the boreholes revealed variable results with several wells noted to have been flooded and likely to have been affected by surface water entering the wells.

Based upon the above and the broadly cohesive ground conditions beneath the site, groundwater is considered to be laterally discontinuous at shallow depth and unlikely to be a significant construction consideration. Groundwater entries into open excavations are considered likely to be slow and controllable with sump pumping or similar methods.

2.4.4 *Environmental Findings*

All soil concentrations were found below the adopted human health screening for residential use with home grown produce. The presence of asbestos was recorded within 2No cement fragments recovered from TP27 and HD01 located within the farm yard area. However, quantification analysis of the soils in both TP27 and HD01 have confirmed the asbestos fibre content to be <0.001, suggesting that the made ground matrix has not been impacted from these fragments.

The risk to controlled waters is considered to be low.

The risk posed by ground gas is considered to be low and mitigation measures are not required.

The infilled pond is regarded to have a low / moderate risk by BRD and due to the shallow nature of the made ground and lack of a suitable migration pathway the risk has not been considered further.

2.4.5 Engineering Design

A DS-3 AC-2s design mix concrete should be suitable for buried structures placed within the shallow natural soils. A CBR value of 3% is recommended for preliminary design purposes based upon site observations but is not supported by in-situ or laboratory tests. An allowable bearing capacity of 125kPa is recommended for traditional foundations within the natural deposits beneath the site. BRD undertook 23 No plasticity tests to assess the volume change potential of the underlying cohesive deposits. Of which 1 No sample was found to be of low Volume Change Potential (VCP), 19 No medium VCP, and 2 No high VCP with an average result of 35%, noted to be within the medium VCP range (20-40%).

Based on the completed infiltration tests, traditional soakaways are not considered suitable for the site. Groundwater control is unlikely to be required at the site, however during inclement weather pumping from sumps or bailing out may be required to deal with surface water ingress or seepages.

2.5 Uncertainties/Data Gaps

Following a review of the reports outlined in Section 2.4, the following uncertainties/considerations were identified in the T&P Desk Study, which this report is intended to address.

- Additional areas have been added to the development that have not been investigated.
- Phytotoxic and potable supply pipework risk assessments were not undertaken.
- CBR testing was not undertaken as part of the investigation to inform road design.
- A Remediation Strategy will likely be required to detail the removal of the localised asbestos and capping of soft landscaping within the farmyard where made ground was identified.
- The site is classified as medium volume change potential by BRD. However, warranty providers may consider raising the current classification to high volume change potential based upon the plasticity test results which would increase the minimum founding depth to 1.00m and require a reassessment of the influence of trees. A foundation zonal plan is recommended to assess the potential impact on nearby plots.

3 PRELIMINARY CONCEPTUAL SITE MODEL

3.1 Background

A risk assessment has been carried out under the governing terms set by Part 2A of the Environmental Protection Act 1990, statutory guidance entitled 'Contaminated Land Statutory Guidance (April 2012)' and in accordance with UK's risk assessment framework¹.

The conceptual site model for the site has been developed with consideration of national guidance² which provides a framework for risk estimation and evaluation of plausible source-pathway-receptor linkages identified in the context of a proposed residential development.

3.2 Potential Contamination Sources

Potential on- and off-site sources of contamination have been identified in consideration of the review of previous reports as summarised in Site Information Section 2 in the context of on- and off-site current/historical activities. Potential contaminant sources identified within a 250m radius of the site are detailed in Table 3.1.

Based upon the identified sources, the following potential contaminants have been identified:

- Metals.
- Hydrocarbons.
- Asbestos. However, it has been assumed that an asbestos survey will be carried out prior to demolition works, with any identified asbestos containing materials appropriately removed. As such, potential asbestos within the existing buildings has been discounted from further consideration and this report considers the potential presence of asbestos within underlying made ground only.

3.3 Potential Receptors

Identified receptors with regard to the current site setting and future proposed development are included in Table 3.1. The following receptors have been discounted from further consideration:

- Construction workers – it is considered that risks during the construction works will be managed appropriately to mitigate short term risks through measures such as use of Personal Protective Equipment (PPE), hygiene practices and other on-site controls as outlined in their Construction Phase Health and Safety Plan and method statements/risk assessments.
- Current site users – in the context of the proposed development for the site, future residents represent a more sensitive receptor than current site users, and as such, consideration of potential risks to future residents will be suitably protective of current site users. As such, current site users will not be considered separately.

¹ Land contamination risk management - <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>.

² Annex 4 - Guidance for the Safe Development of Housing on land Affected by Contamination R&D66. NHBC. 2008.

3.4 Preliminary Qualitative Risk Assessment

Table 3.1 highlights the source-pathway-receptor relationships or “contaminant linkages” that may potentially be active in consideration of both the site’s current use and proposed future use. Those contaminant linkages assessed as low or very low risk at this stage will not be considered further.

Table 3.1 Summary of Source-Pathway-Receptor Relationships

APC N°	Source	Pathway (s)	Receptor(s)	Consequence	Probability	Risk*	Comment
1	On-site Potential made ground associated with historical and existing site development – excluding the farmyard	Oral ingestion	Future residents and maintenance workers	Medium	Low likelihood	Moderate/Low	-
		Vegetable uptake	Future residents	Medium	Low likelihood	Moderate/Low	
		Dermal contact	Future residents and maintenance workers	Medium	Low likelihood	Moderate/Low	
		Dust migration/inhalation	Future residents, maintenance workers and off-site residents/workers	Medium	Low likelihood	Moderate/Low	
		Uptake via root system	On-site flora	Medium	Low likelihood	Moderate/Low	Phytotoxic risk assessment not completed by BRD.
		Permeation into drinking water supplies	Future residents	Medium	Low likelihood	Moderate/Low	Potable water risk assessment not completed by BRD.
		Gas / vapour inhalation/explosion	Future residents and maintenance workers	Medium	Unlikely	Low	Based upon the existing site data and assessment, risks considered to be low. However, will be reviewed as part of this investigation to ensure conclusions are appropriate.
		Leaching/dissolution with vertical migration to groundwater	Groundwater	Medium	Unlikely	Low	With consideration of the previous investigation, the risks to controlled water are

APC Nº	Source	Pathway (s)	Receptor(s)	Consequence	Probability	Risk*	Comment
		Leaching/dissolution with vertical migration to groundwater, and lateral migration in groundwater	Surface water	Medium	Unlikely	Low	considered low. However, will be reviewed as part of this investigation to ensure conclusions are appropriate.
		Overland flow	Surface water	Medium	Unlikely	Low	
		Migration via existing service trenches	Groundwater/ surface water	Medium	Unlikely	Low	
		Leaching/dissolution with vertical migration to groundwater, lateral migration in groundwater and subsequent volatilisation	Future residents, maintenance workers and off-site residents/workers	Medium	Unlikely	Low	

**Where multiple receptors exist the risk classification is based on most sensitive receptor for conservatism.*

3.5 Summary of Geohazards

Based on information presented within Section 2.3 and the anticipated geology beneath the site, the following geohazards have been identified which require further consideration:

- Potential for shrink-swell behaviour of alluvial clays and residual weathered clays of the Oxford Clay Formation;
- Possible made ground of unknown composition which is unlikely to be a suitable founding stratum for new buildings/structures; and,
- Potential for excessive settlement of foundations and infrastructure where placed upon low strength, compressible ground (Alluvium).

4 SCOPE OF WORK

4.1 Summary of Fieldwork

An intrusive ground investigation was undertaken between 16th and 17th September 2025 and is summarised in Table 4.1.

Table 4.1 Summary of Exploratory Locations

Hole ID	Exploratory Location Type	Investigation Method	Depth (mbgl)		Comment
			Min	Max	
TP101 – TP130	Trial Pit	Wheeled JCB-3CX backhoe excavator	2.90	3.20	To gain greater coverage of site and target additional field parcels within the amended site boundary.
CBR101 – CBR110	In situ CBR Test	Vehicle mounted plunger (BS1377)	0.50	0.50	To assist with carriageway design.

All holes were logged in accordance with BS5930³.

An exploratory hole location plan is presented within Appendix A and the exploratory hole logs are presented as Appendix C.

4.2 Soil Sampling

Representative soil samples were collected for geotechnical and environmental analysis at appropriate intervals during the investigation, in line with the Supervising Engineer's instruction, and in general accordance with requirements of BS5930, BS18400 and other UK standards as relevant.

4.3 Geotechnical Laboratory Testing

The geotechnical testing deemed necessary to adequately characterise the site from a geotechnical perspective in the context of the proposed development is summarised in Table 4.2.

Samples from the investigation were forwarded to a UKAS accredited laboratory. Complete results are provided in Appendix D.

Table 4.2 Summary of Geotechnical Testing

Test	Notes	Quantity
Moisture content	-	15 soils
Atterberg limits	-	15 soils
Geochemical analysis BRE SD1 Suite	pH, sulphur, 2:1 water soluble sulphate, total sulphate	12 soils

³ BS 5930:2015+A1:2020. Code of Practice for Ground Investigations. 2020.

4.4 Chemical Laboratory Testing

The soil testing deemed necessary to adequately characterise the site from a contamination perspective in the context of the conceptual site model and proposed development is summarised in Table 4.3.

Samples from the investigation were forwarded to a UKAS and MCERTS accredited laboratory. Complete chemical results are provided in Appendix E.

Table 4.3 Summary of Chemical Testing

Test type	Quantity
Arsenic, Boron, Beryllium, Cadmium, Chromium, Lead, Mercury, Nickel, Copper, Zinc, Selenium, Vanadium, Phenols and US EPA 16 Polycyclic Aromatic Hydrocarbons.	14 soils
BS 3882:2015 Specification for Topsoil	3 soils

5 SUMMARY OF GROUND CONDITIONS

5.1 Encountered Strata

The geological sequence encountered during the ground investigation is summarised in Table 5.1 and described further in the following sub-sections. Ground conditions were found to differ from published geological information whereby no on-site superficial deposits were encountered in proximity to the stream present in the southernmost section of site. Exploratory logs are included in Appendix C.

Table 5.1 Summary of Ground Conditions

Stratum	Top depth range (mbgl)	Base depth range (mbgl)	Exploratory holes	Area of site	General description/ comments
Topsoil	0.00	0.20 – 0.30	All holes	General	Sandy CLAY.
Oxford Clay Formation	0.20 – 0.30	0.50 – 1.10	All holes	General	Firm to stiff orangish brown CLAY.
	0.50 – 1.10	2.90 – 3.20	All holes	General	Firm to stiff grey mottled orangish brown slightly sandy CLAY.

5.1.1 *Made ground*

Made ground was not encountered in any of the exploratory hole locations during the investigation.

5.1.2 *Topsoil*

Topsoil was encountered in all exploratory locations with a typical thickness ranging between 0.20 and 0.30m. In general, the topsoil was found to comprise dark brown sandy clay which, given the agricultural setting of the site, is likely to have been reworked through ploughing and crop cultivation.

5.1.3 *Bedrock Geology – Oxford Clay Formation*

Underlying the entire site, the Oxford Clay Formation was recorded in all exploratory locations. It was initially encountered as a firm to stiff orangish brown clay to a maximum depth of 1.00mbgl. The Oxford Clay Formation was then found to grade into a firm to stiff grey mottled orangish brown slightly sandy clay to termination depths between 2.90 – 3.20mbgl.

5.2 Evidence of Contamination

No significant visible or olfactory evidence of any contamination was noted during the ground investigation.

5.3 Below Ground Structures and Obstructions

No below ground structures or obstructions were encountered during the ground investigation.

5.4 Groundwater

Groundwater was only encountered within TP128 at 2.80mbgl with minor ingress. Recorded water levels after 20mins were noted to be stable.

6 HUMAN HEALTH AND PHYTOTOXIC RISK ASSESSMENT

6.1 Introduction

A human health generic quantitative risk assessment (GQRA) has been undertaken in accordance with the UK regulatory framework and current guidance on assessment of risks presented by land affected by contamination⁴.

When considering phytotoxic risks, contaminants selected are those listed within Annex 3 of 'Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D66: 2008 Volume 2' as being 'phytotoxic'.

Where available, assessment values have been chosen based on the criteria within (in priority order) SGV Documents, ICRCL 59/83 phytotoxic threshold levels, Dutch RIVM Serious Risk Concentrations (SRC) for ecological receptors (amended for a UK soil of 10% clay and 2% soil organic matter) and US EPA Soil Screening Levels for plants.

6.2 Determination of Averaging Areas/Zones

For the purposes of investigation and assessment a site can be divided into zones based on historical uses or proposed end use. These zones can be further divided into averaging areas, which can be used to assess different soil types or different potential exposure pathways etc. for the purposes of risk evaluation. Each averaging area can be considered independently for human health exposure assessment.

Based upon the proposed end use of the site and the findings of the ground investigation it is proposed that a single zone is appropriate for the site as follows:

- Site wide – topsoil/natural soils.

6.3 Human Health Screening Assessment

For each zone/averaging area, the analytical data has been evaluated directly against adopted screening levels⁵ for a 'residential with consumption of home-grown produce' end use. A copy of the screening assessment is included in Appendix E.

Where elevated concentrations of contaminants have been identified and the data set is considered suitable for statistical analysis, the 95th percentile Upper Confidence Limit (95th UCL) of the data set (and/or an indication on whether any of the values are considered to be outliers for each contaminant) has been calculated in accordance with national guidance⁶. A copy of the statistical analysis is provided within Appendix F.

⁴ Environmental Protection Act 1990.

Contaminated Land Statutory Guidance (April 2012).

Land contamination risk management - <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>.

⁵ The LQM/CIEH S4ULs for Human Health Risk Assessment. 2015.

SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. CL:AIRE. 2013.

⁶ Guidance on Comparing Soil Contamination Data with a Critical Concentration. CL:AIRE. 2021.

Table 6.1 summarises the results of the screening assessment for site wide topsoil/natural soils where soil exceedances against adopted screening levels have been identified.

Table 6.1 Summary of Human Health Soil Screening – Topsoil and Natural Soils

Determinant	Screening level (mg/kg) ¹	Screening level source	Min (mg/kg)	Max (mg/kg)	N° of exceedances	Calculated 95 th UCL (mg/kg)
Beryllium	1.7	S4UL	0.74	2.10	3 of 14	1.51

1. Category 4 Screening Level (C4SL) based on 1% Soil Organic Matter (SOM). SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Rev 2. CL:AIRE. 2014; Suitable 4 Use Level (S4UL) based on 1% SOM, where appropriate, as a conservative assessment. (The LQM/CIEH S4ULs for Human Health Risk Assessment (Land Quality Management, 2005). 'Residential with homegrown produce' end use.

In the absence of made ground and any visual signs of suspected asbestos containing materials being recorded, no asbestos analysis was undertaken.

The distribution of elevated soil concentrations is summarised within Table 6.2. Those determinants identified as Contaminants of Potential Concern (COPC) are discussed further in Section 6.5. All other contaminant concentrations were found to be either below the adopted screening levels or otherwise professionally judged to be below levels of concern.

Table 6.2 Summary of Elevated Soil Concentrations

Exploratory location	Location	Depth (mbgl)	Stratum	Contaminant of potential concern (COPC)	Soil Concentration (mg/kg)
TP102	North	0.4 – 0.5	Oxford Clay	Beryllium	2.10
TP106	Northwest	0.3 – 0.4	Oxford Clay	Beryllium	2.10
TP119	South	0.3 – 0.4	Oxford Clay	Beryllium	2

Testing of beryllium was not undertaken as part of the previous assessment completed by BRD, as such historical chemical data has not been incorporated into the statistical assessment or discussion within this report.

6.4 Phytotoxic Screening Assessment

A summary of soil concentrations compared with adopted phytotoxic screening levels is provided in Table 6.3 and Table 6.4. A copy of the screening assessment is included in Appendix E.

Where elevated concentrations of contaminants have been revealed and the data set is considered suitable for statistical analysis, the 95th percentile and Upper Confidence Limit (UCL) of the data set (and/or an indication on whether any of the values are considered to be outliers for each contaminant) has been calculated in accordance with national guidance⁷. A copy of the statistical analysis undertaken is included within Appendix F.

⁷ Guidance on Comparing Soil Contamination Data with a Critical Concentration. CL:AIRE. 2021.

Table 6.3 Summary of Phytotoxic Soil Screening

Determinant	Adopted screening level (mg/kg)	Min (mg/kg)	Max (mg/kg)	N° of exceedances	Calculated 95 th UCL (mg/kg)
Water Soluble Boron	3	1.7	3.8	5 of 14	3.1
Nickel	70	17	86	1 of 14	47

Concentrations of boron and nickel exceeded the adopted phytotoxic screening values in 5N° and 1N° of the 14N° samples respectively, tested from natural ground. The distribution of elevated phytotoxic concentrations is presented within Table 6.4 and the significance of these concentrations is discussed below.

Table 6.4 Summary of Elevated Soil Concentrations

Exploratory location	Location	Depth (mbgl)	Stratum	Contaminant of potential concern (COPC)	Soil Concentration (mg/kg)
TP102	North	0.4 – 0.5	Natural Ground	Nickel	86
TP104	Northeast	0.1 – 0.2		Water Soluble Boron	3.6
TP107	Central	0.1 – 0.2			3.6
TP114	Central	0.1 – 0.2			3.7
TP118	South	0.2 – 0.3			3.6
TP129	Southeast	0.1 – 0.2			3.8

6.5 Discussion

6.5.1 Topsoil/Natural Soils - Human Health Risk Assessment

The GQRA identified 3N° beryllium exceedances when compared to '*Residential with consumption of home-grown produce*' within the natural soils across the site. In the absence of evidence indicating significant contamination, these exceedances are considered to reflect naturally elevated concentrations attributable to the underlying geology. Therefore, statistical analysis of the topsoil and natural soils dataset for beryllium was undertaken.

The statistical analysis determined that the datasets are normally distributed and contained no outliers. As such, all data points were retained and no locations were identified as requiring separate assessment. For beryllium, the calculated 95th percentile upper confidence limit (UCL) was 1.51mg/kg below the respective adopted screening criteria of 1.70mg/kg.

On this basis, while isolated exceedances were recorded within the natural soil, it is considered that future site users are statistically unlikely to be exposed to concentrations exceeding the adopted screening criteria. These soils are therefore not considered to present a significant human health risk and the topsoil/natural soils are considered suitable for reuse within the proposed development, within either a private residential or allotment end use.

All other tested contaminants in the topsoil and natural soils were found to be below the adopted screening levels or otherwise below levels of concern.

6.5.2 *Topsoil/Natural Soils - Phytotoxic Risk Assessment*

A total of 5N° elevated water soluble boron soil concentrations were identified in the topsoil/natural soils encountered across the site. The calculated 95th UCL of 3.12mg/kg for water soluble boron only marginally exceeds the screening level of 3.00mg/kg. It should be noted phytotoxic screening criteria are very conservative, with many based on agricultural yields rather than general/decorative planting. Furthermore, no evidence of significant vegetation die-back or distress was noted during the investigation.

In addition, a single elevated nickel soil concentration was recorded above the adopted screening level in the assessed dataset. However, the calculated 95th% UCL of 47mg/kg is noted to be below the screening level of 70mg/kg. As such, no further consideration of nickel in soils is required.

As such, due to the statistical assessments and marginal nature of the exceedances, the soils on site are considered to pose a low risk to existing and future flora. However, it is recommended that the advice of the project landscaping consultants is sought to confirm this.

6.5.3 *Made ground – BRD Investigation*

Although made ground was not encountered during this investigation, it was noted within the farmyard during the BRD investigation. No significant elevated concentrations above the adopted assessment criteria were noted. However, occasional asbestos cement fragments were found within TP27 and HD01 and the general physical characteristics render the made ground unsuitable to remain at shallow depth within areas of soft landscaping.

6.6 Development Implications

Made ground in the vicinity of the farmyard is unsuitable to remain beneath areas of soft landscaping, provision of a suitable thickness of capping soils may be required. The cover thickness is anticipated to be up to 600mm in private gardens and 300mm in common areas of soft landscaping.

A Remediation Strategy should be produced to detail the final requirements as necessary once the development layout and landscaping plans are finalised.

7 CONTROLLED WATERS RISK ASSESSMENT

7.1 Risk Evaluation

Controlled waters were identified to have a low risk of contamination in Section 3. In the subsequent ground investigation, findings did not deviate significantly from the Preliminary Conceptual Site Model, as such it is considered the site has an overall low risk classification.

For further detail the previous reports should be referred to.

8 GAS/VAPOUR RISK ASSESSMENT

8.1 Risk Evaluation

Ground gas/vapour was identified as low risk in Section 3. In the subsequent ground investigation, findings did not deviate significantly from the Preliminary Conceptual Site Model, as such it is considered the site has an overall low risk classification.

For further detail the previous reports should be referred to.

9 POTABLE SUPPLY PIPEWORK RISK ASSESSMENT

Water industry guidance⁸ states that only organic contaminants pose a potential risk to plastic pipe materials. The UKWIR report provides threshold values for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern.

The previous site investigation completed by BRD did not include a potable water supply assessment, as such the relevant results from the previous report have been included in the following as part of a combined assessment. The results are summarised in Table 9.1 with exceedances highlighted in **bold**.

Table 9.1 Summary of Soil Screening Against UKWIR Criteria

Determinant	Pipe material Generic Assessment Criteria (mg/kg)		Min (mg/kg)	Max (mg/kg)
	PE	PVC		
Extended VOC suite ²	0.5	0.125	< 0.05	0.33
BTEX + MTBE	0.1	0.03	< 0.01	0.014
SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C ₅ -C ₁₀)	2	1.4	< 0.1	< 0.1
Phenols	2	0.4	< 1.00	1.10
Cresols and chlorinated phenols ³	2	0.04	< 0.1	< 0.15
Mineral oil C ₁₁ -C ₂₀	10	Suitable	< 2	< 10
Mineral oil C ₂₁ - C ₄₀	500	Suitable	< 10	< 10
Corrosive (conductivity, redox and pH) ¹	Suitable	Suitable	-	-

1. Determinant not tested.

2. Based upon recorded BaP concentrations.

3. Total Monohydric Phenols - Limit of Detection (LOD) is 5.0mg/kg. All speciated phenols are below LOD of 1.0mg/kg.

Given no visual or olfactory evidence of hydrocarbon or solvent based contamination was encountered on-site during the ground investigation, and the greenfield history of the site, most of the determinants of concern in relation to water supply pipework were not tested.

Based upon the above assessment PE water supply pipework is considered suitable throughout the development. It is advised that statutory water provider is consulted to confirm that no specialist potable pipework is required.

⁸ Guidance for the selection of water supply pipes to be used in brownfield sites (UK Water Industry Research Limited (UKWIR) - Ref: 10/WM/03/21) - 2010

10 REFINED CONCEPTUAL SITE MODEL

10.1 Overview

Following completion of the ground investigation, collection and interrogation of site data with consideration of the outcome of generic quantitative risk assessment discussed in preceding sections of this report, the conceptual site model has been revised.

10.2 Sources

Further to completion of ground investigation, potential made ground identified within the preliminary conceptual model as an APC was found to be absent from the investigation area. However, due to previous investigations undertaken by BRD recording made ground within the farmyard area, the APC has been revised to:

- Potential made ground associated with historical and existing site development – within the farmyard area.

No further potential sources of impact were identified during the subsequent ground investigation works.

10.3 Risk Evaluation

Those SPRs identified within Section 3 as presenting a moderate/low or moderate risk have been further interrogated in accordance with UK national guidance and regulatory framework⁹ following completion of ground investigation and risk assessment. Table 10.1 presents the revised SPRs with associated classification of risk as appropriate following re-evaluation of risks.

⁹ Annex 4 - Guidance for the Safe Development of Housing on land Affected by Contamination R&D66: 2008.
Land contamination risk management - <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>.

Table 10.1 Revised Source-Pathway-Receptor Relationships

APC Nº	Source	Pathway (s)	Receptor(s)	Consequence	Probability	Risk*	Comment
1	On-site Potential made ground associated with historical and existing site development – within the farmyard	Oral ingestion	Future residents and maintenance workers	Medium	Low likelihood	Moderate/Low	Chemical analysis of the made ground did not record any exceedances against the adopted screening criteria. However, within TP27 and HD01 asbestos fragments were noted.
		Vegetable uptake	Future residents	Medium	Low likelihood	Moderate/Low	
		Dermal contact	Future residents and maintenance workers	Medium	Low likelihood	Moderate/Low	
		Dust migration/inhalation	Future residents, maintenance workers and off-site residents/workers	Medium	Low likelihood	Moderate/Low	
		Uptake via root system	On-site flora	Medium	Low likelihood	Moderate/Low	Phytotoxic risk assessment not completed by BRD. Made ground considered physically unsuitable for soft landscaped areas.
		Permeation into drinking water supplies	Future residents	Medium	Low likelihood	Moderate/Low	PE pipework considered suitable for the remaining site however, depending on whether made ground is to remain on site confirmatory testing may be required.
		Gas / vapour inhalation/explosion	Future residents and maintenance workers	Medium	Unlikely	Low	Low gas generation risk.

APC Nº	Source	Pathway (s)	Receptor(s)	Consequence	Probability	Risk*	Comment
		Leaching/dissolution with vertical migration to groundwater	Groundwater	Medium	Unlikely	Low	The risks to controlled water are considered low. However, groundworkers should remain vigilant for any signs of contamination during demolition of buildings.
		Leaching/dissolution with vertical migration to groundwater, and lateral migration in groundwater	Surface water	Medium	Unlikely	Low	
		Overland flow	Surface water	Medium	Unlikely	Low	
		Migration via existing service trenches	Groundwater/ surface water	Medium	Unlikely	Low	
		Leaching/dissolution with vertical migration to groundwater, lateral migration in groundwater and subsequent volatilisation	Future residents, maintenance workers and off-site residents/workers	Medium	Unlikely	Low	

**Where multiple receptors exist the risk classification is based on most sensitive receptor for conservatism.*

11 TOPSOIL ASSESSMENT

11.1 Introduction

On-site topsoil has been assessed for suitability for re-use within the proposed development. During the ground investigation 3N° topsoil samples were recovered from TP101, TP112 as well as a combination of material from TP125 and TP127 which were submitted for laboratory analysis. This assessment aims to characterise the on-site topsoil in accordance with BS3882¹⁰ and determine its suitability for reuse in landscaping and planting areas. While BS3882 topsoil testing is unlikely to be a mandatory requirement for local authority and/or warranty provider approvals, it offers insight into the soil characteristics. Specifically, this analysis helps predict the performance of new planting within the topsoil to determine its compliance with any project-specific landscaping specifications.

Soil results have been compared against relevant standards in BS3882, as summarised in Table 11.1, the results of which are discussed below. Where relevant, results have been considered in the context of the development proposals and landscaping plan (if available).

11.2 Discussion

A combined topsoil sample from TP125 and TP127 was found within the screening levels for a multipurpose topsoil. The topsoil samples tested from TP101 and TP112 were also found to broadly conform to the multipurpose topsoil criteria. However, the extractable phosphate concentrations were found to be marginally below screening levels and may require enrichment prior to reuse.

It is advised that landscaping contractors are issued these results to confirm their agreement on the above and to ensure the future planting regime is suitable for this soil type.

Based on the above, if reuse of the existing topsoil is considered for the proposed development and once the volume of topsoil for planned reuse is known, it is recommended that additional testing is carried out across the site at a greater density to further identify any areas of unsuitable or potentially reusable material.

It is recommended that topsoil across the site that is required to be stripped and stored prior to its reuse is handled and prepared in an appropriate manner to ensure the physical and chemical parameters are not detrimentally affected. The operation should follow a detailed topsoil stripping plan showing soil units to be stripped, haul routes and phasing of movements.

¹⁰ BS3882:2015. *Specification for Topsoil*.

Table 11.1 Summary of Topsoil Characteristics

Parameter	Multipurpose topsoil	Specific purpose					TP101 0.2m	TP112 0.1 – 0.2m	TP125 & 127 0.1 – 0.2m
		Acidic	Calcareous	Low fertility	Low fertility acidic	Low fertility calcareous			
Mass loss on ignition % Clay 5% to 20% Clay 20% to 35%	3 - 20 5 - 20	3 - 30 5 - 30	3 - 20 5 - 20	2 - 20 2 - 20	2 - 30 2 - 30	2 - 20 2 - 20	19.0	9.3	15.0
Soil pH (measured in water)	5.5 - 8.5	3.5 - 5.5	7.5 - 9.0	3.5 - 9.0	3.5 - 5.5	7.5 - 9.0	6.30	7.20	6.20
Carbonate % m/m	-	-	>1	-	-	>1	5.30	5.20	5.20
Plant nutrient content									
Nitrogen % m/m	>0.15	>0.15	>0.15	-	-	-	0.81	0.35	0.65
Extractable phosphate mg/l	16 - 140	16 - 140	16 - 140	<20	<20	<20	13	10	20
Extractable potassium mg/l	121 - 1500	121 - 1500	121 - 1500	-	-	-	135	257	295
Extractable magnesium mg/l	51 - 600	51 - 600	51 - 600	-	-	-	170	440	320
Carbon:Nitrogen ratio	<20:1	<20:1	<20:1	<35:1	<35:1	<35:1	13.77	15.45	13.93
Electrical conductivity μS·cm ⁻¹	<3300	-	-	-	-	-	1970	1980	1980
Maximum coarse fragment content %m/m									
>2mm	30	30	30	30	30	30	1.7	0.5	2.3
>20mm	10	10	10	10	10	10	0	0	0
>50mm	0	0	0	0	0	0	0	0	0
	Multipurpose and specific purpose topsoil								
Potentially phytotoxic elements	Soil pH < 6.0		Soil pH 6.0 to 7.0		Soil pH > 7.0				
Zn (Nitric acid extractable)	<200		<200		<300		71	111	96
Cu (Nitric acid extractable)	<100		<135		<200		14	12	23
Ni (Nitric acid extractable)	<60		<75		<110		13	24	19
Visible contaminants % m/m									
>2mm	<0.5						0	0	0
...of which plastics	<0.25						0	0	0
...sharps	Zero in 1kg air dried soil						0	0	0
Soil Texture % m/m									
Clay Content %							8.1	25.1	8.2
Silt Content %							27.3	30.5	27.5
Sand Content %							8.1	44.4	64.3

Parameter	Multipurpose topsoil	Specific purpose					TP101 0.2m	TP112 0.1 – 0.2m	TP125 & 127 0.1 – 0.2m
		Acidic	Calcareous	Low fertility	Low fertility acidic	Low fertility calcareous			
Textural Classification (Figure 1 BS3882:2015)							Sandy loam	Clay loam	Sandy loam

12 PRELIMINARY WASTE ASSESSMENT

12.1 Waste Hierarchy

In line with the requirements of the Waste Framework Directive, the principles of the “waste hierarchy” should be applied to management options for on-site generated wastes, giving priority to the prevention of waste in the first instance, before considering re-use, recycling, recovery and lastly disposal. Principal considerations are set out in subsequent sections, although it is recommended that advice of a geo-environmental/waste specialist is sought at an early stage in the development process to ensure opportunities for minimisation of waste volumes are maximised.

12.2 On-site Re-Use of Materials

It may be possible to demonstrate through application of the CL:AIRE Definition of Waste Code of Practice (DoW CoP) that site won excavated soils are not classified as waste, and in doing so, permit this material to be re-used as part of proposed site redevelopment works. The DoW CoP may also apply to source segregated material arising from demolition activities. In determining the suitability of this approach, early consideration should be given to being able to demonstrate a specific planning requirement for the re-use of the excavated material. It is noted this approach cannot be applied retrospectively.

It should be noted that on-site re-use of “uncontaminated soil or other naturally occurring material” excavated as part of construction works for the purposes of construction is excluded from waste regulation.

Alternative mechanisms for on-site re-use of soils or aggregate may also be appropriate, on a site specific basis, depending on the volume/nature of the materials, and their intended use, such as:

- Waste exemptions under the Environmental Permitting (England and Wales) Regulations 2010, which are operations which are exempt from requiring permits, providing certain conditions are met. This typically applies to small volumes of non-hazardous soils although may also apply to other material types.
- Environmental permit under the Environmental Permitting (England and Wales) Regulations 2010 (standard or bespoke depending on the material and the activity).
- WRAP Aggregates Quality protocol¹¹ for the production and use of aggregates from inert waste, providing certain criteria are met.

12.3 Waste Disposal to Landfill

When waste is intended for disposal at a suitably licensed landfill site it is necessary for the waste producer (i.e. the developer or consultant on their behalf) to have completed a basic waste characterisation assessment, including:

- Description of the waste;
- List of Waste (LoW) code or codes if mixed waste;

¹¹ *Aggregates from inert waste. End of waste criteria for the production of aggregates from inert waste. WRAP.*

- Determine the chemical composition to identify if waste has hazardous properties or Persistent Organic Pollutants (POPs) are present;
- Determination of hazardous properties;
- Waste Acceptance Criteria (WAC) testing (if required) to determine landfill acceptance.

Relevant information on the above can be found in WM3¹² and is discussed further in the context of ground investigation findings in subsequent sections.

It should be noted that alternative off-site disposal routes may be available, such as recycling/treatment facilities and that in these instances, waste classification would not be appropriate. Instead, it will be necessary to confirm with the destination facility that the material complies with their permit criteria. Further testing in addition to the available ground investigation data may be required by them.

12.3.1 *Waste Classification*

A preliminary waste classification exercise has been undertaken with reference to available ground investigation data. Hazardous properties of the soils have been assessed using the HazWaste program. A copy of the HazWaste report is included in Appendix G.

All results have been assessed as non-hazardous.

12.3.2 *Landfill Waste Acceptance*

If a waste classification assessment determines that disposal to landfill is the appropriate option for the waste then WAC testing must be undertaken for wastes destined for inert, stable non-reactive hazardous or hazardous classes of landfill. WAC testing may not be required if the material falls into the list of waste material identified in The Landfill Directive assumed to fulfil the criteria for inert waste, as detailed in Article 2(e) of the Landfill Directive. This includes soils and stone with an EWC code 17 05 04 but excludes topsoil, peat and soil from contaminated sites. Additionally if waste has been classified as non-hazardous and is going to be disposed of to a non-hazardous landfill rather than an inert non-hazardous landfill then WAC testing may not be required. In all cases consultation with the receiving facility to confirm testing and acceptance of waste classification prior to disposal is advised.

12.3.3 *Landfill Tax*

Unless specifically exempt landfill tax applies to disposal of material at a landfill that's covered by a permit under specific environmental legislation and at any unauthorised waste site. Currently this tax rate is set at £126.15/tonne (2025/2026).

There are some circumstances where material placed within a landfill cell is excepted from the charge to Landfill Tax, including use of material for creation of capping, drainage or otherwise meets conditions of other Landfill Tax exemptions e.g. dredgings, mining and quarrying materials.

¹² Guidance on the classification and assessment of waste - Technical Guidance WM3. Environment Agency 2015.

A lower rate of landfill tax set at £4.05/tonne does apply to less polluting material listed in the landfill tax (qualifying material) order 2011¹³, including naturally occurring rocks and soils, excluding topsoil (group 1) and ceramic or concrete (group 2).

12.4 Recommendations

- Asbestos fragments were recorded within TP27 and HD01, with subsequent quantification analysis recording <0.001%. As such, where impacted it would be prudent to treat this material as a hazardous mixed waste. If it can be shown that the asbestos can be separated from the surrounding soil matrix, it may be possible to consider this as two separate waste streams, the first being representing segregated hazardous asbestos and the second larger volume represented by the remaining separate made ground which would be classified based upon its residual chemical composition.
- Waste management options should be considered in line with the Waste Hierarchy, with priority placed on prevention, re-use, recycling and recovery in order to reduce off-site disposal volumes. Sorting and segregation of excavated soils/materials may also enable reduction in off-site disposal volumes.
- In the event that off-site disposal of surplus excavated soils to landfill is intended, chemical results should be supplied to the receiving facility to confirm they will be able to accept the material. Supplementary testing may be required by the receiving facility, including WAC testing, to confirm the preliminary waste characterisation assessment and to ensure WM3 requirements have been met.
- Should on-site made ground be intended for re-use within the proposed development, it may be possible to demonstrate this material is not waste through preparation of a Materials Management Plan (MMP) to fulfil the requirements of the CL:AIRE DoW CoP. It is recommended that soil re-use opportunities are considered in the context of the development earthworks strategy, cut/fill and remedial strategy (if appropriate) with input from a specialist geoenvironmental consultant. Where an MMP is implemented to support material reuse, it is essential that this be prepared prior to the excavation of on-site soils in order to demonstrate prior intent to reuse.

¹³ Landfill Tax (Qualifying Material) Order 2011 can be found at <http://www.legislation.gov.uk/ukSI/2011/1017/contents/made>

13 COMMENTS ON ENGINEERING DESIGN

13.1 General

Eurocode 7 (Section 2)¹⁴ advocates the use of geotechnical categorisation of the proposed structures to establish the design requirements. Information presented to T&P indicates that the proposed development is to comprise 500N° traditional two storey residential dwellings together with a primary school and associated areas of communal and private soft landscaping and hard landscaped access and parking. It has been assumed that the dwellings will be of masonry construction with line loads of between 50-70kN/m.

In consideration of the available information on the development proposals, for the purposes of this investigation the proposed structures have been classified as follows:

- Geotechnical category 1: Small and relatively simple buildings (houses) with strip or piled foundations, roads, pavements, car parks, retaining walls below 2m, small excavations for drainage works.

13.2 Summary of Geotechnical Parameters

Stratum thicknesses and geotechnical parameters for the strata encountered in the investigation are summarised in the following sections.

13.2.1 Made Ground

Limited geotechnical parameters for the made ground are described in Table 13.1.

Table 13.1 Summary of Geotechnical Parameters – Made Ground

Parameter	Units	Min	Max	Design	Comments
Top Depth	mbgl	GL	GL	GL	Summary of made ground encountered during previous site investigation.
Base Depth	mbgl	0.10	1.00	1.00	
Thickness	m	0.10	1.10	1.10	
pH	-	-	-	-	Parameters not tested in previous site investigation.
Water soluble sulphate (SO ₄ ²⁻)	mg/l	-	-	-	
Note: The variability of the Made Ground strata is such that derivation of geotechnical parameters is considered to be generally inappropriate and potentially misleading.					

13.2.2 Oxford Clay Formation

The design thicknesses and geotechnical parameters for use in the London Clay Formation are described in Table 13.2.

¹⁴ BS EN 1997 – Part 2. Geotechnical Design.

Table 13.2 Summary of Geotechnical Parameters – Oxford Clay Formation

Parameter	Units	Min	Max	Design	Comments
Top Depth	mbgl	0.20	0.30	0.25	-
Base Depth	mbgl	>2.90	>3.30	>3.30	Base not proven
Moisture Content	%	19	35	25	-
Liquid Limit	%	34	78	58	-
Plastic Limit	%	18	29	24	-
Plasticity Index	-	16	53	35	-
% passing 425µm sieve	%	99	100	N/A	-
Modified Plasticity Index	-	16	53	≥40	Based on current NHBC guidance, results are indicative of soils of a high volume change potential
Undrained shear Strength	kPa	47	125	80	Determined from hand shear vanes
pH	-	7.3	8.1	-	
Water soluble sulphate (SO ₄ ²⁻)	mg/l	96	2840	2750	Subsurface concrete design value: DS-4 AC-4s.
Acid soluble sulphate (SO ₄ ²⁻)	%	0.13	10.90	8.46	
Total Sulphur	%	0.052	3.66	2.72	
Total Potential Sulphate	%	0.16	10.98	8.16	
Oxidisable Sulphide	%	-	0.44	0.30	

13.3 Construction Considerations

13.3.1 Subsurface Concrete

Based on the pH values, water soluble sulphate and SD1 suite concentrations recorded by the chemical and geotechnical laboratory analysis, together with the calculated oxidisable sulphide¹⁵, a DS-5 AC-4s design mix concrete should be suitable for buried structures placed within the shallow soils when compared against the BRE¹⁶ assessment levels.

However, a limitation can be applied if the sulphate class based on total potential sulphate is initially found to be DS-5, but the sulphate class for water soluble sulphate is found to be DS-3 or less. Therefore, in this case the Design Sulphate Class for the Oxford Clay Formation can be limited to DS-4 AC-4s.

13.3.2 Floor Slabs

The results of the investigation indicate that the cohesive soils on-site are of high volume change potential. As such, proprietary suspended ground floor slabs should be designed with a minimum 300mm void based upon NHBC guidance.

¹⁶ BRE Special Digest 1:2005 – Third edition – Concrete in aggressive ground.

13.3.3 *Groundwater*

Groundwater was only encountered within TP128 at 2.80mbgl and noted with minor seepage. It is not considered to represent any continuous groundwater bodies. During the previous investigation BRD note that in several positions surface water seepages were encountered at the interface of the base of the topsoil and the top of the Oxford Clay Formation due to the heavy persistent rain. Deeper groundwater seepages within the Oxford Clay Formation strata were also observed by BRD in TP07 at 2.40mbgl, TP16 at 2.00mbgl, TP20 at 1.80mbgl, TP22 at 1.10mbgl and WS22 at 3.65mbgl.

Groundwater levels were also recorded by BRD during the monitoring visits. The levels recorded within the boreholes revealed variable results with several wells noted to have been flooded and likely to have been affected by surface water entering the wells. BRD determined specific groundwater control is unlikely to be required, however, pumping from sumps or bailing out may be required during periods of inclement weather.

It should be noted that groundwater levels are subject to seasonal variations and shallower depths than those encountered to date may be observed during the winter months. In such circumstances the advice of a specialist dewatering contractor should be sought if shallow groundwater proves problematic for excavations.

13.3.4 *Deep Excavations*

Although deposits were generally found to be stable during the intrusive ground investigation, personnel entry into any excavations should be avoided where possible. However, if entry into excavations is required, the excavation sides should be adequately shored and supported or battered back to a safe angle in accordance with appropriate temporary works design.

13.3.5 *Buried Utilities*

It is recommended that existing live services are accurately located by careful hand digging and liaison undertaken with the utility companies with regard to any required works in these areas. The services should be clearly marked and taken into account in the construction design process.

13.3.6 *Earthworks and Material Handling*

It is currently unknown whether earthworks are taking place for the proposed development. However, it is possible that the re-use of existing soils may be required as part of redevelopment proposals. Should earthworks be required, an earthworks specification is recommended to ensure the appropriate management and reuse of the existing soils. The earthworks specification should also set out required verification activities which will be necessary to satisfy the NHBC upon completion of earthworks.

13.3.7 *Road Construction*

In total 10N° vehicle mounted CBR tests (CBR101 – CBR110) were undertaken along the proposed roadways across the site. The results of the CBR tests are shown in Appendix D.

Spatially the ground conditions beneath site were found to be consistent and in situ vehicle mounted CBR test results recorded across the site range from 5.4% – 9.3%. Based on the test

results and with consideration of the variable shallow geology, a design CBR value of 2.5% is recommended subject to the cohesive soils of the Oxford Clay Formation being encountered at formation level.

It should be noted however that where revealed the clay soils are moisture sensitive and will be prone to deterioration to give lower CBR values if left exposed during periods of wet weather. In such circumstances the use of geotextile at the base of construction may be prudent to reduce the potential loss of granular sub-base if placed during periods of inclement weather.

Made ground was locally revealed in the farmyard area in the north of site during the previous BRD investigation up to 1.10mbgl, which would not be suitable to remain beneath adoptable roads due to its inherent variability. Where it is observed at formation it should be excavated and replaced with compacted granular fill.

Typical adoptable road construction thicknesses for a CBR of 2.5%, equivalent to a subgrade surface modulus of 31.5MPa, are given below based on current guidance¹⁷:

- Foundation Class 1 – 550mm capping.
- Foundation Class 2 – 450mm sub-base.
- Foundation Class 3 – 360mm sub-base.
- 240mm Foundation Class 2 sub-base with 420mm Foundation Class 1 capping.
- 310mm Foundation Class 3 sub-base with 410mm Foundation Class 1 capping.

13.4 Preliminary Foundation Recommendations

13.4.1 *Building Near Trees*

The cohesive soils found beneath the site have been found to be of high volume change potential. Based upon the volume change potential and in accordance with NHBC guidelines the minimum founding depth of traditional foundations would be 1.00mbgl. At this stage due to the high volume change potential provision should be made for the use of void formers where shallow strip foundations are to be placed at a depth greater than 1.50mbgl due to the influence of existing/former trees. The impact of any new planting associated with future potential development of the site should also take into account the volume change potential of the soils.

Due to the high volume change potential of the soils, foundations will be highly susceptible to the influence of trees. It is recommended the findings of this report are considered in conjunction with an arboricultural survey and the recommendations given by the NHBC regarding the over deepening of foundations in the vicinity of trees.

Given the presence of mature trees on the field boundaries, traditional foundations may not be viable for a number of adjacent plots and an alternative foundation solution such as piling may be required.

¹⁷ CD 225. *Design For New Pavement Foundations*. 2020.

13.4.2 Foundation Options

The proposed development is to comprise 500N° traditional two storey residential dwellings of masonry construction with assumed line loads of between 50-70kN/m.

The ground conditions across the site were largely consistent, with localised made ground only encountered underlying or in the vicinity of the farmyard to a maximum depth of 1.10mbgl. Underlying the made ground or directly below the topsoil, natural deposits comprising firm to stiff clay of the were encountered generally in all exploratory holes across the site. The clay was found to be particularly stiff in the shallow subsurface, however this is likely attributed to previous extents of persistent dry weather.

Engineer's observations and *in situ* testing within the Oxford Clay Formation indicate an undrained shear strength of between 47 and 125kPa. Therefore, a typical value of 75kPa has been used for preliminary design purposes.

Based on the above and taking into account the NHBC guidance it is considered that traditional shallow strip foundations up to a maximum width of 1.0m and placed at the minimum depth of 1.0mbgl within the firm to stiff clay may be designed for an allowable bearing capacity of 100kPa for acceptable settlement.

In accordance with NHBC guidance, foundations should extend a minimum of 100mm into the specified/required bearing strata.

A foundation zonal plan has been prepared and included in Appendix A. This shows the approximate depth of traditional shallow strip foundations across the site

13.5 Drainage

13.5.1 Summary of Infiltration Testing

Infiltration testing was undertaken as part of the BRD ground investigation within 4N° trial pits (TP101 – TP104). Testing revealed negligible to no infiltration rates, as such based upon the test results and site observations it is considered that traditional soakaways are unlikely to offer a viable solution for surface water discharge and recourse to alternative options, such as utilising the existing drainage network, is recommended.

14 CONSIDERATIONS AND RECOMMENDATIONS

14.1 Considerations

The following uncertainties/data gaps have been identified which may require further consideration:

- Made ground was identified as physically unsuitable to remain at shallow depths in areas of soft landscaping.
- Asbestos fragments were recorded within TP27 and HD01, with subsequent quantification analysis recording < 0.001%. As such, where impacted it would be prudent to treat this material as a hazardous mixed waste. If it can be shown that the asbestos can be separated from the surrounding soil matrix, it may be possible to consider this as two separate waste streams.

14.2 Recommendations for Further Work

14.2.1 Human Health

- A Remediation Strategy should be produced to detail the final remedial requirements as necessary once the development layout and landscaping plans are finalised.

14.2.2 General

- The site is located within a Flood Risk Zone 1 however, due to the size of the site (>1ha), a Flood Risk Assessment will be required to support future development
- Ground workers should remain vigilant for visible and olfactory signs of contamination following demolition of on-site buildings.
- Although no areas of made ground were encountered during the investigation vigilance should be employed by the groundworks contractor during works. In the event that significant made ground is encountered, advice from a specialist geoenvironmental consultancy should be sought.
- Discussions should be held with local landfill/soil waste treatment facilities to agree material classification required for any soils to be disposed off-site as a result of proposed construction and demolition works.
- A site-specific health and safety plan should be prepared to inform on risks posed from the previous site use and mitigations for ground workers developing the site e.g. requirements for appropriate PPE, hygiene practices, environmental monitoring and requirements for mitigation measures during construction works.
- A copy of this report should be provided to the relevant regulatory authorities to confirm that they are in agreement with the report findings.

Appendix A – Drawings

Issue: 2
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BARRATT MIX MASTER									
Site Name		Melksham							
Number of Units									
HouseType	Sq.ft	Sq.m	St.	Beds	No's	Total Sqft	Total Sqm		
BARRATT HOMES									
2B	Donford	624	58.0	2	2	19	11,856	1,101	
	Kenley	624	58.0	2	2	19	11,856	1,101	
3B	Maldstone	830	77.1	2	3	28	23,240	2,159	
	Ellerton	830	77.1	2	3	29	24,070	2,236	
	Moresby	854	79.3	2	3	7	5,978	555	
	Ennerdale	917	85.2	2	3	19	17,423	1,619	
	Bewdley	978	90.9	2	3	14	13,692	1,272	
	Norbury	1,107	102.8	2.5	3	18	19,926	1,851	
	Kingsley	1,085	100.8	2	4	6	6,510	605	
4B	Woodcote	1,217	113.1	2.5	4	12	14,604	1,357	
	Hedleth	1,249	117.9	2.5	4	6	7,614	707	
	Alfreton	1,483	137.8	2	4	4	5,932	551	
	Radeigh	1,317	122.4	2	4	8	10,536	979	
Sub Total (Open Market)						189	173,237	16,094	
AFFORDABLE HOUSING									
SOCIAL/AFFORDABLE RENTED									
F	Loughton	472	43.8	3	1	6	2832	263	
	IBF	655	60.9	3	1	6	3930	365	
	Horsea	721	67.0	3	2	6	4326	402	
	Type 58**	538	50.0	2	1	3	1614	150	
	Type 59	584	54.3	2	1	3	1752	163	
2B	Type 51	842	78.2	2	2	33	27786	2581	
	WH0528**	1130	105.0	2	2	12	13560	1260	
3B	Type 52	929	86.3	2	3	23	21967	1995	
	Type 55	957	88.9	2	3	12	11484	1067	
4B	Type 54	1103	102.5	2	4	2	2206	205	
5B	H04*	1342	124.7	2	5	4	2684	249	
Sub Total (Affordable)						108			
SHARED OWNERSHIP									
	Type 51	842	78.2	2	2	7	5894	548	
	Type 52	929	86.3	2	3	2	2787	259	
	Type 55	957	88.9	2	3	13	2871	267	
FIRST HOMES									
3B	Kenley	624	58.0	2	2	17	10,618	986	
	Maldstone	771	71.7	2	3	6	4,590	463	
	Moresby	856	79.3	2	3	6	5,416	517	
Sub Total (Affordable)					44%		148	124,097	11,529
BARRATT TOTAL						337	297,334	27,623	
NET DEV AREA COVERAGE							17.45	acre	
							17,029	sqft/acre	
REDROW									
3B	Letchworth	983	91.3	2	3	14	13,762	1,279	
	Warwick	1,075	99.9	2	3	9	9,675	899	
	Amberley	1,144	106.3	2	3	4	4,576	425	
	Stratford	1,211	112.5	2	4	11	13,321	1,238	
	Marlow	1,288	119.7	2.5	4	11	14,168	1,316	
	Oxford	1,316	122.3	2	4	13	17,108	1,589	
	Overton	1,410	131.0	2	4	7	9,870	917	
4B	Shaftesbury (toolkit)	1,423	132.2	2	4	8	11,384	1,058	
	Harrigate	1,553	144.3	2	4	10	15,530	1,443	
	Ledsham (toolkit)	1,841	171.0	2	4	4	7,364	684	
	Henley	1,768	164.3	2	5	10	17,680	1,643	
5B	Hampstead	1,842	171.1	2	5	10	18,420	1,711	
Sub Total (Open Market)						111	152,858	14,201	
AFFORDABLE HOUSING									
SOCIAL/AFFORDABLE RENTED									
F	Loughton	472	43.8	3	1	3	1416	132	
	Horsea	721	67.0	3	2	6	4326	402	
3B	Hadeigh	801	74.4	1	2	3	2403	223	
Sub Total (Affordable)					32%		52	39,805	3,475
REDROW TOTAL						163	192,663	17,676	
NET DEV AREA COVERAGE							12.27	acre	
							15,702	sqft/acre	

WORK IN PROGRESS

LAND AT BLACKMORE FARM, MELKSHAM – COMBINED TESTING LAYOUT

| PEGASUSGROUP.CO.UK | TEAM/DRAWN BY: STH/THA | APPROVED BY: STH | DATE: 17/09/2025 | SCALE: 1:1000@A0 | DRWG: P24-2928_DE_07_A_01 | CLIENT: BARRATT REDROW |



— Site Boundary

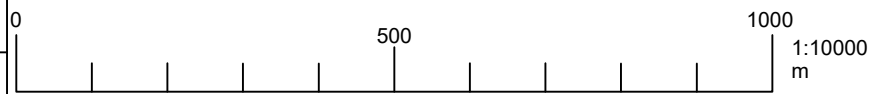


Base Map
Company: Bing Maps Autodesk Licence
DWG Title: -
DWG Number: -
Date: -

-	-	-	-	-
Drawn	Checked	Amendment	Date	Rev.
DWH South West				Client
Blackmore Farm, Melksham				Project
Site Location Plan				Title
Scale	Date	Drawn by	Check by	Rev.
1:10000@A4	21/09/25	DA	JH	-

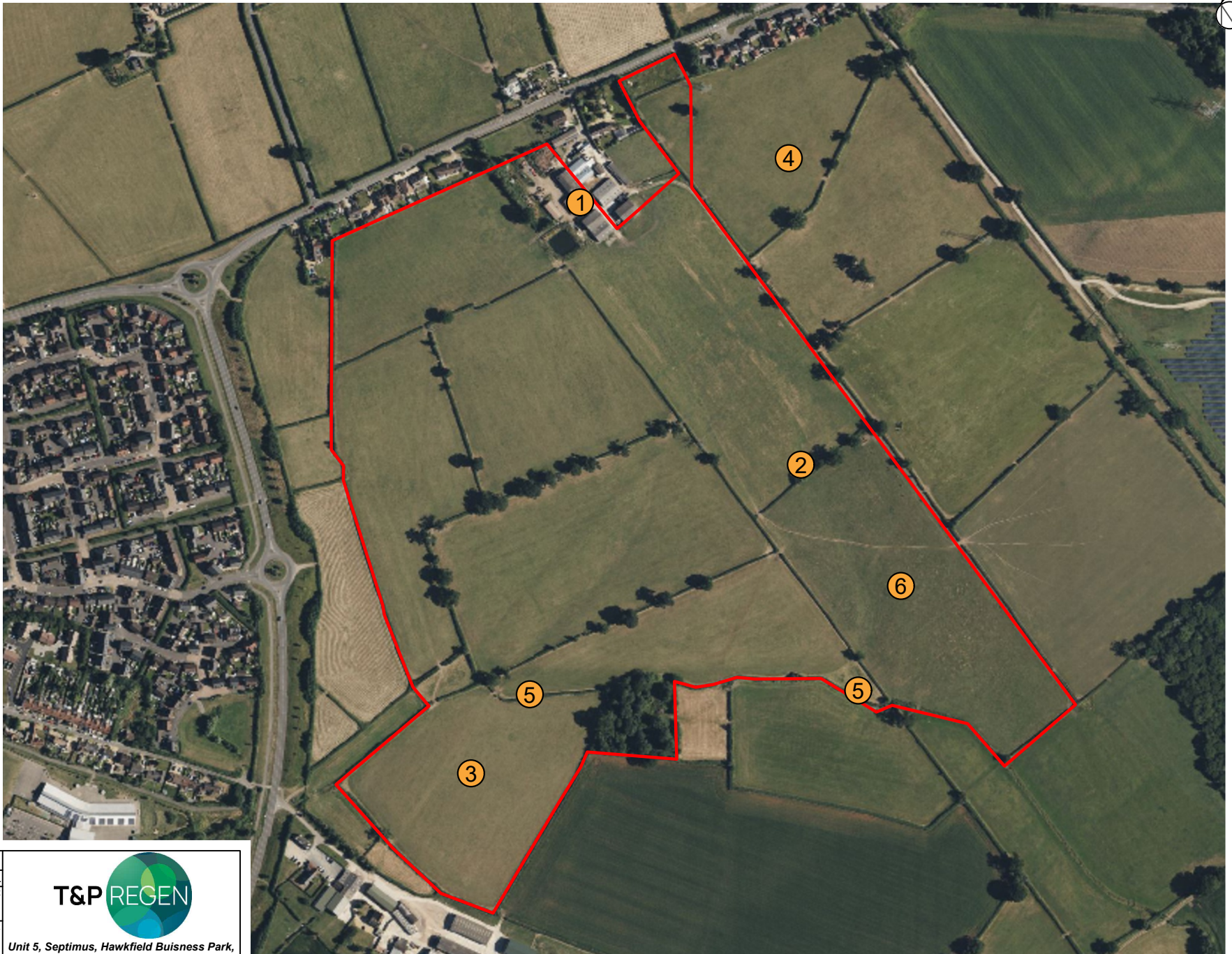
T&P
Regen
Unit 5, Septimus, Hawkfield Buisness Park,
Bristol, BS14 0BN
Tel: 0117 927 7756
Email: Info@TP-regen.co.uk

Drawing No. P1418-01-2957-001



— Site Boundary

- ① Asbestos containing material associated with the farmyard.
- ② Pond present containing minor levels of water.
- ③ Area for proposed commercial development, advised to leave outside of this investigation.
- ④ Area previously investigated by BRD, now outside of the amended site boundary.
- ⑤ Stream present in the southernmost section of site.
- ⑥ Field added to the investigation area.



Base Map

Company: - Bing Maps Autodesk Licence
DWG Title: -
DWG Number: -
Date: -

Drawn	Checked	Amendment	Date	Rev.
Client				
DWH South West				
Project				
Blackmore Farm, Melksham				
Title				
Site Features Plan				
Scale	Date	Drawn by	Check by	Rev.
Sbar@A4	24/10/25	DA	JH	-



Unit 5, Septimus, Hawkfield Buisness Park,
Bristol, BS14 0BN
Tel: 0117 927 7756
Email: Info@TP-regen.co.uk

Drawing No.
CS-J-1418-2957-01-004

