

Ground Investigation Report

**Land at Knowle Hill
Allbrook
Eastleigh
Hampshire**

Client

Bargate Homes

J202334

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APPENDIX

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a ground investigation carried out by the Wilson Bailey Partnership on the instructions of Bargate Homes with respect to the proposed residential development of this site. The purpose of the investigation has been to investigate the ground conditions and assess the implications of the findings with regards to geotechnical design and land contamination.

DESK STUDY

The desk study research has indicated that whilst the site itself is a greenfield site, it adjoins a backfilled former brick clay extraction pit and a former builders merchant, the majority of which has been subsequently redeveloped for housing. The site is therefore not considered to present a potentially contaminative land use history, but may be located in a setting where potentially mobile contaminants could migrate onto the site from adjoining land with potentially contaminative site histories. No other indications of potential contaminated land issues of concern have been identified in the vicinity of the site.

GROUND CONDITIONS

The boreholes and trial pits formed as part of the ground investigation have identified predominantly clay soils of the London Clay in the northern part of the site, with near surface sand soils of the Whitecliff Sand Member encountered within the central part of the site. In the southern part of the site these soils have been found to be overlain by variable clayey gravel, clay and sand of the River Terrace Deposits.

Groundwater was generally not encountered during the ground investigation, although monitoring carried out in installed boreholes has indicated the presence of groundwater within the deeper boreholes in the River Terrace Deposits, together with variable pockets of groundwater within the predominantly clay soils, although these have been assessed as pockets of perched water rather than actual groundwater.

Laboratory soil contamination testing of selected soil samples has indicated the presence of apparently localised elevated concentrations of arsenic within the near surface soils in the southern part of the site, with the testing carried out within the northern part of the site not indicating the presence of raised or elevated concentrations of a wide range of routine potential chemicals of concern. Laboratory geotechnical testing has indicated the clay soils to be high plasticity.

A programme of soil gas monitoring has been carried out and has indicated raised concentrations of carbon dioxide considered to be associated with the adjoining backfilled former clay extraction pit.

GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

The near surface natural and undisturbed firm clay soils and generally medium dense sand and gravel soils are considered suitable to support the anticipated light to moderate foundation loads likely to be associated with traditional two storey houses and foundations may be designed based on an assumed net allowable bearing capacity of 100 kPa. Due to the presence of high plasticity clay soils, floor slabs should be designed to be suspended over a naturally ventilated void.

Foundations will need to be deepened in the vicinity of trees due to the plasticity of the clay soils.

Normal sulphate design precautions should be adopted for the specification of foundation concrete.

Based on preliminary testing, road pavements may be designed based on an assessed CBR of 2% within the clay soils at this stage. Further testing should be carried out once the road levels have been finalised. The proposed residential development of this site has also been designed to incorporate an element of cut and fill, such that some roads will be formed within fill materials that are yet to be placed. A suitable earthworks specification will need to be developed to ensure the suitability of site won placed fill materials to support proposed new road pavements.

Surface water management is to comprise a series of attenuation features together with an off-site discharge, such that infiltration based drainage does not form part of the development proposals.

GEOENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

The historical use of the site as open agricultural land is not considered to present a potentially contaminative land use, although the adjoining backfilled former clay extraction pit has been found to present a source of mobile carbon dioxide that has been found to affect this site. As with any agricultural land there is also always the potential for localised burial of materials and potential for localised ground contamination.

Desk study research indicates that whilst the site is located within a 1km grid square where there is a raised potential risk of radon, the site itself is not located within a radon affected area such that additional precautions with respect to radon are not required.

A requirement for soil gas protection to proposed buildings has been identified on the basis of raised concentrations of carbon dioxide having been recorded with detectable flow rates and the proximity of a viable source of potentially mobile soil gasses in the form of the adjoining backfilled former brickworks clay excavation pit. The gas risk assessment carried out in accordance with BS8485 indicates a Gas Characteristic Situation of CS3.

The Remediation Strategy and Validation Plan sets out the assessment and validation requirements for soil gas remediation that will need to be incorporated into the design of the proposed buildings by the project architect and installed by a specialist contractor.

A requirement for soil remediation has also been identified within the southern part of the site where raised concentrations of arsenic have been detected. Within the southern part of the site the near surface soils will need to be removed and disposed off site prior to the placement of a clean topsoil and subsoil capping layer over a geotextile marker layer unless formation level inspection and testing confirms the absence of contamination of concern.

The Remediation Strategy and Validation Plan sets out the assessment requirements of soil remediation and the validation requirements.

Over and above the remediation requirements outlined above, across the site in general a requirement for a routine geo-environmental watching brief has been identified. In the unlikely event that suspicious or contaminated soils are encountered during the ground works, the watching brief will ensure that any such soils that may be encountered by the ground worker during the course of the development may be investigated, assessed, and remediated as necessary under the supervision of Wilson Bailey Partnership and in conjunction with the Local Authority.

Across the northern part of the site, subject to appropriate segregation, handling and storage, the site won topsoil is anticipated to be chemically suitable for reuse, although further testing of the topsoil once it has been collected into stockpiles will be required. Additional physical topsoil testing may be prudent to check that topsoil will be physically suitable to promote the healthy growth and development of garden plants in due course.

Any stockpiling of topsoil should be carried out in accordance with the guidance provided by DEFRA and should be carried out in accordance with the principles of a Materials Management Plan with regards to the sustainable reuse of topsoil on its site of origin.

1.0 INTRODUCTION

Wilson Bailey Partnership has been commissioned by Bargate Homes to carry out a ground investigation of development land at Knowle Hill, Allbrook, Eastleigh, Hampshire.

1.1 Proposed Development

Consideration is currently being given to the development of the site through the construction of 49 residential dwellings, together with access roads, paths, landscaping, hard standing for car parking, driveways drainage infrastructure including a series of reed beds, attenuation basins and associated works. The development will include areas of private residential gardens associated with the new dwellings.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows.

- to check the history of the site with respect to previous uses of the site and surroundings;
- to determine the prevailing near surface ground conditions;
- to investigate and test for the presence of contamination;
- to carry out an appropriate risk assessment with regards to any contamination; and
- to provide advice and recommendations with respect to geotechnical design.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of readily available geological maps and publicly available information provided by the Environment Agency;
- a review of information provided by the Health Protection Agency with regards to radon;
- a review of Ordnance Survey (OS) maps sourced from the Groundsure database; and
- a walkover survey of the site.

The physical ground investigation has been carried out in a single main phase and comprised, in summary, the following activities:

- a series of 14 small diameter boreholes drilled to depths of up to 4.45 m below ground level in locations across the site;
- a series of 11 trial pits excavated by a tracked mechanical excavator and used for soakage testing;
- installation of combined soil gas and groundwater monitoring standpipes in 5 locations across the site to facilitate winter water level monitoring and soil gas monitoring;
- laboratory testing of selected soil samples for geotechnical properties;
- laboratory testing of selected soil samples for the presence of contamination; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

A further phase of soil sampling has been carried out following discussions with the Local Authority Pollution Control Specialist, which comprised the following;

- a series of 6 additional shallow hand dug trial pits located within the southern and western parts of the site; and
- laboratory testing of selected soil samples for the presence of contamination.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made based on the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made based on information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by the Wilson Bailey Partnership.

2.0 Desk Study

2.1 Site Description and Site Walkover

The site comprises a parcel of open agricultural land that was in use as horse grazing at the time of our works. The site is irregularly shaped and has maximum dimensions of 410m by 105m.

The curved eastern boundary to the site is formed by a post and rail fence, beyond which is a sloping embankment down to Allbrook Way.

The northern part of the western site boundary is formed by a further fence, beyond which is an area of dense woodland. The central part of the western boundary is formed by a mixed residential boundary with the house and gardens of Westfield House. The southern part of the western site boundary is formed by a mature hedgerow, beyond which is Knowle Hill which provided vehicular access to the site.

The site has an overall gentle slope downwards to the south with a change in level of approximately 12m along the length of the site.

No indications of potentially contaminative uses were identified as part of the site walkover survey of the site.

2.2 Desk Study Findings

The desk study research has identified that the site has not been previously developed.

The desk study research has indicated the presence of nearby potentially contaminative land uses as noted overleaf.

- Former Landfill Site
The former Allbrook Brickworks site is located 20 metres to the west and south of the site and was licensed between 1977 and 1981 for the importation and placement of Inert Wastes.
- Historical Fuel Tanks
As part of the operation of the former Brickworks which was subsequently reused as a builders merchant following closure of the brickworks, a number of underground fuel tanks are known to have been present. These tanks were however removed and the associated soils were investigated and validated as clean and suitable as part of the residential redevelopment of this site in 2014 by Wilson Bailey Partnership on behalf of Bargate Homes, who were the developer of that adjoining site at the time.

The Geological Survey map of the area indicates the southern part of the site to be underlain by superficial River Terrace Deposits, with the remainder of the site indicated to be underlain directly by the London Clay, with outcrops of the Whitecliff Sand Member of the London Clay and the underlying Wittering Formation indicated to be present locally.

The River Terrace Deposits are identified as a Secondary A Superficial Aquifer, with underlying London Clay classed as an unproductive strata with negligible permeability. The site is not shown to be located within any class of groundwater source protection zone.

Desk study research indicates that whilst the site is located within a 1km grid square where there is a raised potential risk of radon, the site itself is not shown to be located within a radon affected area however, such that additional precautions with respect to radon are not required.

2.3 Preliminary Conceptual Model & Risk Assessment based on Desk Study

The long-term historical use of the site as open agricultural land is not considered to be significantly contaminative, although as with any agricultural land there remains an albeit minimal risk of potential buried or localised contamination.

The presence of an adjoining area of backfilled former brickworks excavation presents a potential source of potentially mobile ground contamination, although the landfill permit for this adjoining site only permitted the placement of Inert Wastes. It is important to note however that the definition of Inert Wastes has changed over time, and at the time of placement between 1977 and 1981, materials such as topsoil and subsoil are likely to have been classified as Inert. These materials are now no longer considered to be Inert as a result of their organic content, which can give rise to the generation of methane and carbon dioxide when landfilled.

The anticipated ground conditions at the site are not considered to be particularly sensitive, with the clay soils of the London Clay anticipated to be essentially impermeable. The granular soils of the River Terrace Deposits underlying the southern part of the site are anticipated to be at least locally permeable.

The proposed residential development of this site will introduce potentially sensitive receptors that may be affected by any potential ground contamination and potentially onerous soil gas regimes.

3.0 EXPLORATORY WORK SAMPLING STRATEGY

In order to meet the objectives described in Section 1.2 and address the key findings of the desk study a series of 14 small diameter boreholes have been drilled within accessible locations across the site together with a series of 11 machine excavated trial pits.

The locations of the exploratory holes were selected to obtain a general coverage and allow investigation of the prevailing ground conditions in accessible locations within the constraints presented by the site.

A second phase of supplementary soil contamination sampling and testing has also been carried out following on from discussions with the Local Authority Pollution Control Specialist.

Representative samples of the soils encountered were taken to the laboratory for geotechnical testing and contamination analyses. The analytical suite of soil contamination testing was selected to identify concentrations of a wide range of potential contaminants of concern for the purposes of general coverage. For this investigation the analytical suite included a range of metals, speciated total petroleum hydrocarbons (TPHCWG), speciated polycyclic aromatic hydrocarbons (PAH), and monohydric phenols together with routine analyses for pH and organic content. The contamination analyses were carried out at a MCERTs accredited laboratory and details of the MCERTs accreditation and test methods may be supplied on request.

The borehole and trial pit records and results of the insitu soil testing and laboratory analyses carried out as part of the initial and the supplementary phases of investigation are appended together with a site plan indicating the exploratory positions.

4.0 GROUND CONDITIONS

The investigation has broadly confirmed the expected ground conditions in that across the southern part of the site a variable clay, sand and gravel was encountered overlying clay soils of the London Clay, whilst across the remainder of the site London Clay was encountered from beneath the topsoil covering of the site. Within the central part of the site, silty sand soils of the Whitecliff Sand Member were encountered at the base of several of the exploratory holes.

4.1 Topsoil

Apparently natural and undisturbed topsoil was encountered in the exploratory positions located across the site to generally consistent depths of between 0.20 m and 0.30m, locally extending to 0.50 m below ground level in selected boreholes.

No visual or olfactory indications of ground contamination were noted within the topsoil encountered as part of the ground investigation.

Representative samples of the soils were recovered from selected exploratory positions and analysed for a range of contaminants and the results are summarised in Section 4.5. Whilst not every soil sample has been tested a suitable coverage of the site has been achieved.

4.2 **Made Ground**

In Borehole No 9, made ground comprising reworked topsoil with occasional brick fragments was encountered to 0.70 m below ground level. No visual or olfactory indications of ground contamination were noted within the made ground.

4.3 **River Terrace Deposits**

Where present within the southern parts of the site the River Terrace Deposits have been found to be highly variable comprising several interbedded layers of clayey gravel, clay with gravel, sand and gravel and sand.

No visual or olfactory indications of ground contamination were noted within these soils which were encountered to the full depth of investigation across much of the southern parts of the site.

4.4 **London Clay Formation**

Underlying the topsoil and the Head Deposits where proved, firm grey clay soils of the London Clay were encountered to the full depth of investigation in the majority of the exploratory positions. Laboratory geotechnical testing has confirmed these clay soils to be of High Plasticity, with indications of the effects of trees not being noted.

No visual or olfactory indications of ground contamination were noted within these soils.

4.5 **Whitecliff Sand Member**

Exploratory holes located within a central belt through the site encountered fine yellowish brown silty sand soils underlying the London Clay at depths of about 1.00m to 1.20 m below ground level. It is considered that these sand soils are indicative of the Whitecliff Sand Member, which is one of several locally significant interstitial layers of sand within the London Clay.

No visual or olfactory indications of ground contamination was noted within these soils.

4.6 **Soil Contamination**

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a “suitable for use” approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

The results of laboratory analyses carried out by an MCERTS accredited laboratory on five representative soil samples recovered from this site are enclosed. The testing suite has included testing for a wide range of metallic contaminants, speciated hydrocarbons, speciated poly-aromatic hydrocarbons and asbestos. The acceptability criteria used as part of the assessment of these results are presented below together with an assessment of the significance of the measured concentrations;

These acceptability criteria are widely accepted as providing a suitable initial screening value against which measured concentrations of potential contaminants can be assessed to determine the requirement for site specific quantitative risk assessment.

Determinant	Acceptability Criteria (residential with plant uptake) mg/kg	Number of exceedances (number of samples tested)	Location and value of exceedances
Asbestos	Trace concentration ($<0.001\%$)	None (of 12)	--
Arsenic (As)	32	Two (2 of 12)	BH 2 at 0.25m / 84 mg/kg BH4 at 0.25m / 76 mg/kg
Cadmium (Cd)	10	None (of 12)	--
Chromium (hex)	4.3	None (of 12)	--
Chromium (Cr)	3000	None (of 12)	--
Copper (Cu)	2330	None (of 12)	--
Lead (Pb)	200	None (of 12)	--
Mercury (Hg)	1.0	None (of 12)	--
Nickel (Ni)	130	None (of 12)	--
Selenium (Se)	350	None (of 12)	--
Zinc (Zn)	3750	None (of 12)	--
Benzo(a)pyrene	5.0	None (of 12)	--
Total Phenols (mono)	420	None (of 12)	--
Speciated Fuel Relation hydrocarbons (TPH)	Various species-specific values	None (of 12)	--

4.7 Groundwater

Groundwater was not encountered as part of the ground investigation at this site, although selected boreholes that extended to a greater depth encountered groundwater inflows at depths of 5.80 m and 7.80 m below ground level.

Water monitoring standpipes have been installed in several boreholes and a programme of water level monitoring has been carried out during the winter of 2023-2024 and 2024-2025, the records of which are appended. The results of this water monitoring programme have indicated variable and locally shallow depths of groundwater, although in view of the variability and the predominantly clay soils, these readings are assessed as being associated with a perched waters rather than actual groundwater.

4.8 Soil Gas

A programme of soil gas monitoring has been carried out that has included a period of low and falling atmospheric pressure, with the results of this monitoring appended.

This programme of monitoring has indicated the presence of adverse soil gas conditions, with elevated gas concentrations of Carbon Dioxide measured in a number of the boreholes together with detectable and variable gas flow rates. For the purposes of a gas risk assessment in accordance with BS8485, the worst case gas conditions are to be considered, which are a peak carbon dioxide reading of 14.8%, with many readings above 5%, together with a peak flow rate of 14.8l/hr.

5.0 GEOTECHNICAL ADVICE AND RECOMMENDATIONS

The firm clay soils of the London Clay should be suitable for supporting the anticipated lightly loaded spread foundations associated with traditional two storey houses. The superficial clay, sand and gravel of the River Terrace Deposits should also be suitable for the support of anticipated foundation loads, although the variability of these soils would require the use of mesh reinforcement.

As a result of the proposed cut and fill works that will be required achieve the proposed development levels, there is a risk that foundations to plots within the central part of the site may penetrate through the London Clay and locally be formed in the underlying silt and sand soils of the Whitecliff Sand Member. The Whitecliff Sand Member should also be suitable for supporting anticipated foundation loads, although foundations may locally require additional deepening to ensure that the foundations to any one plot are formed in the same founding strata if the sand soils are locally encountered.

5.1 Spread Foundations

Moderate width pad or strip foundations are anticipated to be viable for traditional housing up to two storeys constructed within this land parcel.

Foundations should bypass the topsoil and apparently localised made ground and may be designed to found within the firm clay and dense gravel of the River Terrace Deposits, the firm clay of the London Clay or the dense sand of the Whitecliff Sand Member at a minimum depth of 1.00 m below ground level and apply a net allowable bearing pressure of 100 kN/m², with a minimum width of 0.60m for external cavity walls.

In view of the variability of the sand and clay soils of the River Terrace Deposits, foundations bearing within these soils should be mesh reinforced to mitigate the risk of differential settlements. This is likely to affect foundations to Plot No 1.

As a result of the proposed cut and fill works, there is a potential that foundations to plots constructed within the south-central part of the site may extend into the silty sand soils of the Whitecliff Sand Member that have been encountered within this part of the site. Where encountered, foundations will need to be deepened in order that all parts of the foundation to any one plot are formed in a single soil type. This may affect Plot Nos 2 to 22.

This assumed net allowable bearing capacity value includes an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits. In the unlikely event that heavily or eccentrically loaded foundations are required, a check should however be made on the magnitude of settlement once the base sizes are known, as the design bearing pressure is settlement dependent.

Foundations will need to be deepened in the vicinity of existing, retained and proposed trees and National House Building Council (NHBC). Where trees are to be removed the required founding depth should be determined on the basis of the existing tree height if it is less than 50% of the mature height and on the basis of full mature height if the current height is more than 50% of the mature height. Where a tree is to be retained the final mature height should be adopted and due allowance should be made for future growth of trees. Where groups of trees are present, due allowance should be made for the group effects of trees.

Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation; in this respect it would be prudent to have foundation excavations inspected by a suitably experienced engineer. The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines.

The results of laboratory geotechnical testing indicate the clay soils to be High Plasticity.

Subject to the detailed design of the proposed layout, selected plots may be constructed in the vicinity of the various mature and semi-mature boundary trees, which include high water demand species such as oak. Where any such plots being constructed in the vicinity of trees are to be founded within clay soils, there is a potential risk that deepened foundation excavations could become problematic or potentially excessively deep. Further ground investigation may be prudent within any such areas to check whether a sufficient depth of granular soils may be encountered in foundation excavations to any affected plots, at which point further deepening may not be necessary. Further deepening below the upper levels of the Whitecliff Sand Member, if encountered, would not be required, as these soils are assessed as being non-plastic.

5.2 Excavations

Shallow excavations for services and foundations within the near surface soils may remain dry and stable during the traditionally drier summer months.

Within winter months, there is a potential that groundwater could be encountered in the foundation excavations and deeper drainage excavations to Plot Nos 1-23 in the sand and gravel layers encountered in these areas, with associated excavation instability to be anticipated.

Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

5.3 Ground Floor Slabs

In view of the presence of High Volume Change potential clay soils, and the localised presence of variable made ground within the western part of the site, it is anticipated that there will be a requirement for suspended ground floor slabs over a void in accordance with NHBC guidelines at this site.

In view of the raised concentration of Carbon Dioxide, detectable flow and the proximity of a viable source of potential soil gases in the form of the backfilled former brickworks clay excavation pit, it is considered that the ground floor slabs to proposed houses should be designed to incorporate a precautionary gas membrane.

5.4 Pavement Design

Preliminary CBR testing has been carried out by means of a TRL DCP probe which provides a profile of CBR values. The results of this testing are appended and indicate a design CBR value of 2% may be appropriate at this stage.

Further CBR testing will be required at the selected formation depth, depending upon finished levels, to confirm the design CBR value once the layout and levels of the proposed

development are known.

Due to the presence of clay soils, earthworks and road formations constructed within winter months may be challenging and the formation level may be expected to degrade rapidly if exposed to site traffic and inclement weather.

5.5 Buried Services

Precautions to ensure the protection of potentially sensitive underground services, such as drinking water pipes, are not likely to be required based on the results of soil contamination testing.

Statutory utility providers do however have a responsibility for ensuring the provision of wholesome water and may insist upon a protected plastic services. Detailed discussions with the utility company should be held as soon as possible in order to discuss the protection of buried potentially sensitive services.

5.6 Effect of Sulphates

The results of chemical analyses indicate low concentrations of soluble sulphate, corresponding to Class DS-1 AC-1s of Table 2 of BRE Special Digest 1: SD1 Part. The guidelines contained in the above digest should be followed in the design of foundation concrete.

5.7 Surface Water Drainage

Whilst soakage testing has been carried out to determine the suitability of the sand soils of the Whitecliff Sand Member and the River Terrace Deposits for the use of soakaways, this testing has indicated significantly variable results, with the remainder of the site underlain by impermeable clay soils of the London Clay.

The use of on site infiltration based drainage has therefore been considered and discounted as an alternative to the approved discharge of attenuated surface waters through a new discharge into the River Itchen to the southeast of the site.

In view of the presence of clay soils across most of the site, careful consideration should be given to the incorporation of garden drainage as part of the design and construction of proposed areas of private domestic garden. With an impermeable subsoil, together with impermeable construction elements such as patios and pathways and the foundations to walls and foundations, there is a significant risk of waterlogging to gardens.

6.0 CONTAMINATED LAND ADVICE AND RECOMMENDATIONS

6.1 Updated Conceptual Model

The preliminary conceptual model that was established for this site on the basis of the desk study research indicated a potential for soil contamination and a potentially onerous soil gas regime.

Following on from the completion of the ground investigation work including the supplementary phase of soil contamination sampling and testing, the site conceptual model has been updated to reflect the findings of these supplementary works.

On the basis of the soil contamination testing it is considered that whilst site wide ground contamination is not present at this site, apparently localised elevated concentrations of arsenic have been identified within the southern part of the site with concentrations that are in excess of the acceptability criterion for Residential with Plant Uptake and Public Open Space (Residential) end uses.

Based upon the findings of the soil gas monitoring, a potentially onerous soil gas regime has also been confirmed.

6.2 Contamination Risk Assessment

The history and current use of the site as open agricultural land is not considered to present a contaminated land use, although the results of the soil contamination testing have indicated the apparently localised presence of elevated concentrations of arsenic within two soil samples recovered from the southern part of the site

One of the requirements of the Environment Act (1995) is that local authorities carry out inspections of their area with a view to identifying sites that may be contaminated. When assessing whether a site is contaminated the local authority will attempt to establish the presence of a 'pollution linkage'.

A pollution linkage requires there to be a source of contamination, a sensitive receptor that can be adversely affected by the contamination and a pathway via which contamination can reach the target.

The proposed development of the site will introduce new sensitive receptors in the form of end users and construction workers, together with the formation of new pathways through the creation of areas of private domestic gardens.

With regards to specific considerations, the risk to the following potentially sensitive receptors has been considered;

Human Health (end users)

Potential risks posed to human health have been considered and the results of soil contamination testing indicate that there is no substantial requirement for ground remediation.

A requirement for soil gas protection from the elevated concentrations of Carbon Dioxide that have been measured has been identified. In view of the presence of an assessed viable source of potentially mobile soil gases in the form of the nearby backfilled form clay extraction pit, it is considered that the gas risk should be assessed using the approach set out in BS8485. This approach adopts a combination of the worst case measured gas concentration (14.8% v/v) and the worst case measured flow rate (14.8l/hr) which together indicate a Gas Screening Value of 2.2, which equates to a Characteristic Situation CS3 classification for the site.

A requirement for soil remediation has also been identified within the southern part of the site in order to mitigate the potential impact of elevated concentrations of arsenic that have been detected within two samples recovered from this southern part of the site.

As with any development site there is also an albeit limited potential for localised ground contamination that should be managed as part of an overall site contaminated land watching brief.

Human Health (site workers and future maintenance workers)

Precautions with regards to site workers and future maintenance workers are not anticipated over and above normal safe working practices such as restricted eating and drinking, regular hand washing and the provision and use of routine PPE.

Property (existing or proposed) including buildings, crops, livestock, pets, woodland and service lines and pipes

The risk to these potential receptors has been considered and in view of the absence of contamination, a significant risk warranting further action has not been identified. The requirement for protected services such as drinking water has been considered and should be discussed in detail with the statutory utility provider for potable water.

Adjoining land

The risk to this potential receptor has been considered and in view of the absence of ground contamination, a significant risk warranting further action has not been identified.

Groundwaters and surface waters

The risk to these potential receptors has been considered and in view of the absence of potentially mobile ground contamination, or a hydraulically continuous groundwater regime, a significant risk warranting further action has not been identified.

6.3 Potential Reuse of Site Won Topsoil

Chemical testing carried out as part of this ground investigation indicates that the topsoil present across the northern part of the site may be chemically suitable for reuse, whilst topsoil and made ground locally identified in the southern part of the site should be removed and stockpiled separately pending off site disposal or further testing and analysis..

Additional testing has been carried out to confirm the textural classification of the site won topsoil as part of a soil resource assessment. The testing carried out on a single recovered representative topsoil sample indicates that it complies with a Low Fertility Classification and may be expected provide a suitable growing medium for plants with minimal addition and amelioration.

6.4 Waste Disposal and Materials Management

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip. Under the European Waste Directive landfills are classified as accepting Inert, Non-hazardous or Hazardous wastes in accordance with Waste Acceptance Criteria (WAC) which, for Non-hazardous and Inert wastes are based upon the results of CEN method bulk leaching tests or percolation tests. Based upon the results of the analyses carried out and the technical guidance provided by the Environment Agency¹ it is considered likely that arisings of natural clay from construction works on this site are likely to be generally classified as Inert waste, providing that these soils can be effectively segregated.

Surplus topsoil at this site is not likely to be classified as Inert of waste disposal purposes due to the presence of vegetation, rootlets, and a moderate organic content. Providing they can be appropriately segregated and stockpiled; it is anticipated that the site won topsoil should be suitable for reuse within proposed new areas of private domestic gardens.

¹ Environment Agency 2003. *Hazardous Waste: Interpretation of the definition and classification of hazardous waste*. Technical Guidance WM2

In the unlikely event that during the ground works soils are found to be stained or have any hydrocarbon odour, they should be stockpiled separately from other soils in order that they may be tested to determine a revised waste classification, as these soils may potentially require classification as Hazardous waste. Any such segregation, stockpiling or on-site treatment to reduce or later the likely waste classification will need to be carried out in accordance with a Materials Management Plan that will need to be approved by the Environment Agency prior to commencement of work.

In any case, all waste classifications should be confirmed by the receiving landfill once the soils to be discarded have been identified. To finalise an Inert waste classification, it will probably be necessary to carry out further analyses including WAC CEN method bulk leaching tests. Such tests should be carried out upon representative samples from the waste stream once the extent of the materials to be discarded has been established. The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material and the scope of any additional testing that may be required.

7.0 REQUIREMENT FOR REMEDIATION

On the basis of the desk study and ground investigation works presented within this report a requirement for site wide soil remediation has not been identified, although remedial actions are considered necessary as part of the proposed residential development.

7.1 Contaminated Land Watching Brief

The development should be carried out in accordance with the requirements of a routine geo-environmental watching brief, whereby should any contaminated or suspicious soils be encountered by the ground works contractor as part of the proposed site works, they should be immediately brought to the attention of Wilson Bailey Partnership in order that they may be appropriately tested, investigated and assessed by Wilson Bailey Partnership in consultation with the Regulatory Authorities, before agreeing the scope of any remedial actions as necessary.

7.2 Soil Gas Protection to Proposed New Dwellings

A requirement for soil gas protection commensurate with Characteristic Situation 3 has been identified.

The detailed assessment of the gas risk and the requirement for remediation is detailed in the Remediation Strategy and Validation plan that should be read in conjunction with this report.

Initial discussion have been held with a specialist gas protection membrane supplier, installer and verification contractor and a copy of summary correspondence is included in the appendix to this report.

The appointed contractor shall be responsible for the installation and verification of the gas membrane works and a verification report will be provided upon completion of the installation works by the contractor in accordance with the Validation Plan

7.2 Soil Remediation

A requirement for soil remediation has been identified within the southern part of the site.

The detailed requirements for soil remediation are set out within the Remediation Strategy and Validation Plan, which should be read in conjunction with this report.

Further soil remediation, over and above a requirement for a routine geo-environmental watching brief is not considered necessary within the remainder of the site

8.0 FURTHER WORK

A further phase of geotechnical focused ground investigation is currently underway in order to provide a refined foundation assessment and to provide design information to support the design of piled foundations that are locally required in the vicinity of boundary trees. These works will be carried out in accordance with the contaminated land watching brief and reported separately.

APPENDIX

Borehole Records

Trial Pit Records

Soakage Test Results

Gas Monitoring Records

Soil Geotechnical Laboratory Analyses

Groundwater and Soil Gas Monitoring Records

Soil Chemical Analyses

Desk Study Search Records

Historical Mapping Records

Site Plans

Gas Protection Summary from Specialist