

Land South of Green Lane and East of Bacons Lane, Pinchbeck, Lincolnshire, PE11 3XS

Supplementary Phase 2 Geo-environmental Site Investigation Report

Report on behalf of:
R. Bratley (Quadring) Ltd.

August 2023

FINAL REPORT

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CONTENTS

1.0 INTRODUCTION 7
2.0 SUMMARY OF PREVIOUS WORKS 11
3.0 GROUND INVESTIGATION 19
4.0 CHEMICAL (CONTAMINATION ANALYSIS) LABORATORY TESTING 29
5.0 CONTAMINATION RISK ASSESSMENT CRITERIA 30
6.0 CONTAMINATION ANALYSIS TESTING RESULTS AND RISK ASSESSMENT 32
7.0 REVISED RISK ASSESSMENT 35
8.0 Further RECOMMENDATIONS/PRELIMINARY REMEDIATION STRATEGY 43
9.0 GROUND GAS MONITORING 45
10.0 REFERENCES 47

APPENDICES

Appendix A DRAWINGS
Appendix B LOCAL AUTHORITY (SHDC) CORRESPONDENCE
Appendix C PHOTOGRAPHS
Appendix D EXPLORATORY HOLE LOGS
Appendix E GAS/GROUNDWATER MONITORING CERTIFICATES
Appendix F GRANGE GEOCONSULTING LTD METHODOLOGY
Appendix G CHEMICAL ANALYSIS RESULTS

EXECUTIVE SUMMARY

Purpose of This Report	Supplementary Phase 2 Interpretative Ground Investigation
Client	Report on behalf of R Bratley (Quadring) Ltd.
Site	Land South of Green and East of Bacon's Lane, Pinchbeck, Lincolnshire
Site Location	The site is situated in a predominantly rural area of Lincolnshire, approximately 1km north of the village of Pinchbeck and 4km north of Spalding Town Centre. The approximate National Grid Reference for the site is 523590, 327010 and the postcode is PE11 3XS.
Current Land Use & Description	At the time of the investigation, the site comprised three individual agricultural field units, possessing a total area of approximately four hectares. The site did not appear to be under cultivation during the investigation, however evidence of a previous harvest was noted within the southernmost of the fields. The substrate across the entirety of the site during the fieldwork phase of the investigation consisted of bare earth, shrubs, grass, and low vegetation. No existing developments or areas of hardstanding were noted on-site at this time.
Proposed Development	The proposed development scheme comprises the erection of sixty-three residential dwellings with gardens, garages and parking provision, and areas of amenity space including a play area and soft landscaping. Access to the development will be from Surfleet Road.
Ground Investigation Overview	The fieldwork phase of the supplementary ground investigation was undertaken between the 26th and 27th April 2023 and involved the advancement of twelve window sample boreholes (WS101 to WS112 inclusive) to depths of between 2.0m and 3.0m bgl. Several of these excavations were positioned so as to target areas where contamination was previously identified in an Phase 2 Site Investigation undertaken in 2019. In addition, eight standpipes, installed during the 2019 investigation, were reinstated during the current phase of works. The investigation works were carried in order to enable the logging of the soils encountered, to facilitate in-situ testing, to collect soil samples for chemical (contamination) analysis, and to install groundwater/ground gas monitoring standpipes. On completion of the fieldwork, a programme of groundwater and ground gas monitoring was undertaken, comprising 6 visits over an approximate 6 week period.
Findings of the Ground Investigation	<u>Ground Conditions</u> Topsoil/Reworked Natural strata were encountered at the surface in five of the twelve supplementary boreholes, and recorded to a depth of between 0.3m and 0.5m bgl. The excavations in which this material was identified (WS101, WS106, WS107, WS110, and WS108) were positioned toward the eastern and western peripheries of the site. Made Ground was encountered at the surface in seven of the excavations undertaken as part of the supplementary site investigation. The thickness of the Made Ground varied between 0.4m and 1.2m. The Made Ground encountered could be broadly categorised into; material consistent with the fill identified during the previous investigation (i.e. Landfill Material), which was recorded in WS103, WS111, and WS112, and 'general Made Ground' containing brick and concrete (i.e. Non Landfill Made Ground), proven in WS102, WS104, WS105, and WS109. The distinction between the two types appeared less distinct than was previously recorded. A complex interbedded and alternating sequence of predominantly cohesive and granular strata consistent with Tidal Flat Deposits was encountered below the Made Ground and/or Topsoil in each of the excavations, and recorded to the base of each excavation (between 2.0m and 3.0m bgl. In general, granular materials, described as loose to medium dense locally slightly clayey, slightly silty to silty fine grained SAND, predominated. <u>Groundwater</u> Groundwater strikes were encountered during the fieldwork phase of the investigation in each of the twelve additional investigation locations undertaken. In each borehole, groundwater strikes were encountered at an approximate depth of 2.0m bgl. A programme of groundwater monitoring was undertaken between the 16th May 2023 and 27th June 2023. During this programme, water levels within the newly installed, and reinstated standpipes were measured over an approximate six week period. Each of the

	newly installed standpipes were dry during the monitoring programme. Water levels in the remaining locations varied between 1.01m and 2.09m bgl. Based on the levels recorded, a slight groundwater gradient appears to be present from west to east, and from the northern and southern peripheries of the site toward the centre of the site. A surface water drain runs approximately east to west through the centre of the site.
Contamination Testing	Five samples were taken from Topsoil/Reworked Natural materials, six from Made Ground, and one sample was taken from the Tidal Flat Deposits to enable laboratory chemical analysis. In addition, seven groundwater samples were taken from viable, previously installed standpipes. The analysis results were screened against Grange GeoConsulting Ltd GAC screening values for a residential with plant uptake land use scenario (soil samples), and freshwater EQS (water sample), and/or UKDWS to carry out an assessment of potential risks to human health and controlled water receptors associated with contamination.
Contamination Results	**<u>Soil Contamination</u>** Lead was recorded in a single soil sample analysed during the supplementary site investigation at a concentration exceeding the generally accepted Generic Acceptance Criterion appropriate to a residential with plant uptake end use scenario (200mg/kg). The sample was taken from WS103 at a depth of 0.8m bgl. WS103 was positioned close to TP16, corroborating a potentially substantial contamination hot-spot in this location. Two lead hotspots, centred on WS11, and WS103/TP16 have been proven at the site (inclusive of results obtained during previous phases of investigation). During the supplementary investigation, two samples, taken from Made Ground in WS104 at a depth of 0.3m to 0.6m bgl, and WS109 between 0.1m and 0.3m bgl recorded the presence of loose fibres of chrysotile (WS104 and WS109) and amosite (WS109) asbestos. Based on the findings (inclusive of findings from previous investigations), three discrete hotspots of asbestos contamination have been identified at the site, situated toward the northern periphery, adjacent the former residential property (TP16 and WS104), and toward the centre of the site (WS109). Asbestos cement sheet fragments were identified in two locations (TP19 and TP1) during the previous site investigation works undertaken in 2019 Excavations undertaken during the supplementary investigation adjacent the impacted locations did not identify asbestos cement sheet fragments. It is therefore anticipated that two small areas of the site have been affected by this contamination. **<u>Groundwater Contamination</u>** Groundwater analysis undertaken during the supplementary investigation has identified a number of contaminants exceeding relevant GACs, including iron, manganese, copper, nitrate/nitrite, and ammoniacal nitrogen. The manganese and copper contamination appeared sitewide, and in the absence of a significant on site soil source, was considered likely to be a characteristic of regional geochemistry. The elevated ammoniacal nitrogen concentrations did not appear to correlate closely with the location of the former 'landfill', suggesting an alternative, potentially off-site source. The nitrate/nitrate contamination was localised, and did not appear representative of widespread on-site use of nitrogen based fertilisers. None of the groundwater contaminants recorded were considered to represent a significant risk to human health receptors. It was considered unlikely that groundwater remediation would be effective in reducing risks to controlled waters, given the regional/widespread nature of the identified contaminants.
Recommended Remediation Measures/Further works	A risk assessment was subsequently carried out in order to examine and evaluate plausible contaminant linkages. Based on the findings of the intrusive investigation it was considered that following redevelopment, a Moderate risk of harm to human health receptors would remain as a result of contamination present within soils at the site. The risk to controlled waters resulting from contamination at the site following redevelopment was considered Moderate. Based on the findings of the updated CSM/Risk Assessment, it is considered that remediation works will be required in order to address the plausible contamination linkages identified, and residual risks to the proposed development/ end users. The objective of these works will be to ensure that the site is suitable for the proposed development. Details of the recommended

	remedial works will be presented within a formal Remediation Strategy document, which will subsequently be produced for the site. The remedial works could involve the following measures, presented as a Preliminary Remediation Strategy: • Localised removal and off site disposal of localised hotspots of Made Ground containing lead contamination, and asbestos fibres could be carried out in order to remove the principle sources of soil contamination considered to represent a risk to identified human health and controlled water receptors. Where possible, excavated materials should be loaded directly onto a sheeted/enclosed transport vehicle. If this is not possible, temporary stockpiles should be placed on an impermeable membrane, and protected from the effects of weathering. A bund should be created to prevent runoff. • On removal of the contamination hotspots, soils at the base and along the sides of the resulting excavation should be sampled and tested for the contaminants of concern. Where contamination remains, the excavations should be extended unto the soil source has been removed, and sample results complying with appropriate assessment criteria have been received. • An examination of the existing substrate ('litter pick') for the presence of asbestos containing materials (i.e. cement sheet fragments) should be undertaken by a suitably licenced contractor in the two sections of the site where ACM fragments were recorded in 2019. Given the sensitive nature of the proposed development, it is recommended that these works also extend across the remainder of the site, subject to other methods of validation. • Given the previous uses of the site, and the sporadic and discontinuous nature of the contamination identified, it is recommended that a clean cover system (topsoil /subsoil) with a thickness of 450mm is placed within each of the residential gardens. It is recommended that a brightly coloured geotextile membrane be placed in garden areas prior to the implementation of the overlying clean cover system, to deter excavation by future site users into the original substrate. • A watching brief should be maintained for contamination throughout the duration of the proposed development. In the event that any unforeseen gross or widespread contamination is encountered on site, an appropriately qualified contaminated land specialist should be contacted immediately. • Any unexpected contamination encountered during the development should be subject to appropriate management. • Specialist contractors should be employed as necessary to advise on the management of unexpected contamination. • Re-use and/or disposal of site won materials/arisings should be undertaken in accordance with current waste management guidance/regulations. Where re-use is proposed, it may be necessary to obtain an Environmental Permit, or to produce a Material Management Plan (MMP) in accordance with the CL:aire Definition of Waste Code of Practice (DoWCoP). • The local water supplier should be contacted for further details regarding the use of protected potable water pipework at the site. The results provided as part of this report may be sufficient to confirm this requirement, however it may be necessary to undertake supplemental testing depending on the requirements of the utility provider. • A Verification Report should be produced on completion of the remediation, detailing works undertaken, presenting the results of validation testing, and providing waste consignment/disposal notes as appropriate.

This Executive Summary forms part of Grange GeoConsulting Ltd report number R21082/R04 (Issue 1) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

It is currently proposed by the Client, R Bratley (Quadring) Ltd. to undertake residential redevelopment of an agricultural facility located off Green Lane, Pinchbeck, Lincolnshire, hereafter referred to as the Site.

The site is situated in a predominantly rural area of Lincolnshire, approximately 1km north of the village of Pinchbeck and 4km north of Spalding Town Centre. The approximate National Grid Reference for the site is 523590, 327010 and the postcode is PE11 3XS. A Site Location Plan (Drawing R18012-DWG1) is presented in Appendix A.

At the time of the investigation, the site comprised three individual agricultural field units, possessing a total area of approximately four hectares. The site has historically been divided into two distinct areas; Area 1, encompassing the north-eastern, eastern, and central areas of the site, and the remainder of the site, known as Area 2, which occupied the western and south-western areas of the site. It is understood that whilst proposed development works may be undertaken in phases, the current planning application addresses the site as a single unit. A plan showing the existing layout of the site (Drawing R18012-DWG2) is included in Appendix A. An additional phasing plan has been produced by Studio11 Architecture Ltd. (Drawing Ref #581.CPP.03), which is included in Appendix A.

The site did not appear to be under cultivation during the investigation, however evidence of a previous harvest was noted within the southernmost of the fields. The substrate across the entirety of the site during the fieldwork phase of the investigation consisted of bare earth, shrubs, grass, and low vegetation. No existing developments or areas of hardstanding were noted on-site at the time of writing.

The southern site boundary is marked by a drainage ditch. Beyond this lie residential houses facing Milestone Lane and associated gardens. Open countryside is present to the north and west. Surfleet Road (the B1356) provides access onto the site and marks the eastern site boundary, the area beyond which is agricultural in character. The western site boundary is defined by Bacon´s Lane and an associated drainage ditch. Green Lane is present along the north-western site boundary. Residential properties are present beyond the site to the south and south-east. Open drainage channels run between the site and these residential areas. Each of the drainage ditches surrounding the site appear ephemeral.

The proposed development scheme comprises the erection of sixty-three residential dwellings with gardens, garages and parking provision, and areas of amenity space including a play area and soft landscaping. Access to the development will be from Surfleet Road. A Proposed Development Plan for the current scheme (‘Site Layout Plan-As Proposed’ Produced by Oglesby & Limb Ltd. in January 2019- Drawing Ref A1273-10 Rev E) is presented in Appendix A. Permission reference H14-0259-23 dated 28 June 2023 has now been implemented by virtue of part of the access (part of Phase 1 shown on approved *Plan #581.CPP.03*). Planning conditions have been revised in approval H14-0259-23 to prevent any further development beyond Phase 1 until the ground investigation strategy is agreed.

Grange GeoConsulting Limited was commissioned by the Client to undertake a supplementary Site Investigation in order to address geo-environmental issues previously identified at the site, and to enable the proposed development. Additional detail regarding the investigation history of the site is presented in Section 2.0.

The current report summarises the findings of a Supplementary Phase 2 Geoenvironmental Site Investigation undertaken at the site in April 2023, by Grange GeoConsulting Ltd. The report was intended to form part of a formal submission to secure compliance with Condition 4 of planning application H14-0137-19. This has now been overtaken by events and a revised planning application was approved by the Local Authority, South Holland District Council on the 28 June 2023 (ref H14-0259-23). This revised permission enabled works (part construction of site access) to proceed as Phase 1 of development. Planning conditions have been revised in the new approval H14-0259-23 to prevent any further development beyond Phase 1 until the current ground investigation strategy is agreed. However, the permission has now been implemented with engineering works to create part of the access into the site form Surfleet Road

1.2 Objectives and Scope

The principal objective of the supplementary Site Investigation was the further examination of known and potential contamination issues previously identified in a Phase 1 Desk Study and Phase 2 Site Investigation Report, produced by Grange Geoconsulting on behalf of R Bratley (Quadring) Ltd. in July 2019 (Report Ref R18012/002). This report should be read in conjunction with this document.

A conceptual site model (CSM), which was developed as part of the Phase 1 Desk Study, and subsequently refined following the findings of intrusive investigation works, will be further revised during the current phase of work, and used to support a Revised Risk Assessment, identifying potential environmental or ground-related risks associated with the proposed redevelopment, and enable remediation requirements to be established. The current document will update and supersede the findings of previous investigations.

A Remediation Strategy was previously produced for the site by Grange Geoconsulting in June 2022 (Report Ref R22022/R03), based on the findings of the previous investigation phase. The release of the current report will render this document obsolete. A revised Remediation Strategy will be provided, based on the updated risk assessment provided in this document.

The supplementary ground investigation detailed in the current report was designed on the basis of previous investigation works (detailed in Grange Geoconsulting ‘Phase 1 Desk Study and Phase 2 Ground Investigation Report’ (July 2019)), and subsequent discussions with South Holland District Council (See Section 3.0).

The aims of the investigation were to determine the underlying ground and groundwater conditions, including the depth of the groundwater table, and to assess the environmental quality of the soils and their potential to adversely impact proposed building foundations, human health, and the wider environment. Specific focus was given to areas where contamination was previously identified, and with respect to ground gas monitoring, which was deemed by SHDC to have previously been insufficient to fully characterise risk, based on historic use of the site.

The scope of works, as outlined in the Grange GeoConsulting Ltd proposals submitted to South Holland District Council on the 24th February 2023 are summarised below.

Supplementary Phase 2 Ground Investigation

- The excavation of 12No. additional boreholes using Dynamic (window) Sample techniques to enable the logging of soils encountered, and the collection of soil and groundwater samples for subsequent laboratory testing. As well as providing general coverage of the site, a subset of these excavations were to be undertaken in areas where previous investigation works have identified plausible contamination risks issues (See section 3.1).
- Laboratory chemical (contamination testing of soils. A representative soil sample will be taken from each of the new excavations and scheduled for testing at an accredited laboratory, in accordance with current guidance.
- The installation of ground gas monitoring positions in each of the new locations, with response zones tailored to the shallow water table previously encountered at the site (as agreed with SHDC- See Section 3.0).
- The reinstatement of nine (9No.) of the standpipes installed during the previous phase of intrusive works, which initial due diligence indicated would likely be viable, creating a cohort of 21No. monitoring locations.
- A programme of Ground Gas monitoring appropriate to residential end use (6No. visits over a period of six weeks) in accordance with the guidance of CIRIA C665 and BS8576:2013. The ground gas programme would include screening using a Photo-ionisation Detector.
- The collection of water samples from each of the newly installed standpipes to enable subsequent laboratory chemical testing.
- Collation of the findings within an Interpretative Report (this document).

A copy of correspondence approving the supplementary investigation scope is included in Appendix B.

1.3 Limitations

This report is based upon information obtained from third party sources, together with observations and data obtained during the recent ground investigation. The third-party data has been accepted at face value and has not been independently verified. Grange GeoConsulting Ltd can therefore give no warranty, representation, or assurance as to the accuracy or completeness of such information.

The spacing of the excavations/in-situ testing, and the sampling and analysis undertaken during the investigation is considered to have provided a reasonable level of certainty concerning the ground conditions. However, it is important to recognise that contamination can be both widespread and relatively localised, depending upon its source and nature. No investigation, however comprehensive, can be expected to determine the nature and extent of all contamination that could be present, and there will always be an element of uncertainty. The potential for currently undetected contamination to be present must therefore be considered not only in the risk assessment presented within this report, but also in

consideration of future development activities, i.e. health and safety planning and risk management.

This report has been prepared for the sole internal use and reliance of the Client, R Bratley (Quadring) Ltd, and shall not be relied upon by other parties without the express written authority of Grange GeoConsulting Ltd. If an unauthorised third party comes into possession of this report, they then rely on it at their own risk.

2.0 SUMMARY OF PREVIOUS WORKS

2.1 Grange Geoconsulting 'Phase 1 Desk Study and Phase 2 Ground Investigation Report' (July 2019)

Grange Geoconsulting Ltd. were appointed to undertake a Phase 1 Desk Study and Phase 2 Geoenvironmental Site Investigation at the site in November 2018. The fieldwork phase of the investigation took place between 21st and 24th January 2019. The following section summarises the findings and recommendations set out in subsequent reporting, published in July 2019. This report should be consulted in conjunction with the current phase of works.

2.2 Phase 1 Desk Study

2.2.1 Site History

Detailed maps and aerial photographs of the site and surrounding area dated 1887 to 2019 (at scales of 1:2,500, 1:10,000 and 1:10,560) were reviewed. The findings are summarised below.

The site was predominantly occupied by undeveloped agricultural land during the 1880s. A residential building was present toward the north of the site. Drainage ditches were at this time shown adjacent the perimeter of the site, and across the site itself, separating the internal field boundaries. By 1904, what appeared to be two small pits/excavations were shown across the western section of the site, however the purpose of this feature was not established. By 1969, the pits were referred to on available mapping as 'refuse tips', and had increased significantly in size. An Ordnance Survey map dated 1982, showed the former residential property across the north of the site to have been demolished. The refuse tip(s) toward the west of the site were no longer shown at this time. A 1999 aerial photograph of the site showed the site to be open, cultivated agricultural land. The location and extent of the former 'refuse tip' could not be distinguished.

The area surrounding the site has been predominantly agricultural and residential in character since the 1880s. No significantly contaminative activities were noted in the vicinity of the site.

2.2.2 Geology

The British Geological Survey (BGS) indicate the site to be underlain by Superficial Tidal Flat deposits, comprising silty Clay with layers of Sand, Gravel, and Peat. The bedrock at the site, according to the BGS, comprises strata from the Oxford Clay Formation, a grey, silicate-rich, slightly silty Mudstone, with Limestone nodules.

The site is in a low probability radon area (with less than 1% of the homes are estimated to be at or above the Action Level). No radon protection measures were considered necessary in the construction of new dwellings or extensions on site.

2.2.3 Hydrogeology, Hydrology and Flood Risk

The superficial and consolidated geological units underlying the site have been classified by the Environment Agency as Unproductive. The site was not recorded to be within a Groundwater Source Protection Zone and no groundwater or surface water abstractions were identified within 400m. No discharge consents were recorded within 225m of the site.

The closest surface water features were recorded to be the open drainage channels, situated on and at the periphery of the site. These channels were considered to potentially be hydraulically connected to the principle local watercourse, the River Glen, located approximately 205m west of the site.

The site was not recorded to be within an area at risk of flooding by rivers or seas and was not protected by flood defences. The site and the immediate area were not listed as having the potential for groundwater flooding to take place.

2.2.4 Waste Management and Hazardous Substances

One historical landfill site was recorded by Envirocheck within 250m of the site. This landfill was noted to be on-site, referencing the ‘refuse tip’ shown across the western/south-western section of the site on historical mapping. According to the Envirocheck entry, first waste input into the landfill took place in 1967. Information on the last input into the landfill is not specified. The deposited waste is recorded to have been ‘commercial’ in origin. This facility was also listed as a BGS recorded landfill site.

2.2.5 Contemporary Trade Entries

The closest trade directory entry recorded with respect to the site was a vehicle repair garage (‘GM Motors’), positioned by Envirocheck approximately 85m south of the site, off Milestone Lane. According to Envirocheck, this enterprise (currently inactive) was superseded by an additional garage (‘Motortech’). Available mapping, aerial photography, and internet records show Motortech to be at a greater distance (175m) from the site than was recorded by Envirocheck, suggesting positional error with respect to this activity.

No further active entries are listed within 900m of the site.

Inactive entries recorded within 500m of the site included; a used car dealership located 204m south, distribution services 212m south, a horticultural equipment, manufacturer and distributor located 248m south-east, a carpet, curtain and upholstery cleaning business situated 357m south-west, an electrical engineering facility 387m south-west, a ceramic manufacturer and supplier located 399m south-west, and a pottery manufacturer and suppliers 427m to the south-west.

The closest fuel station was identified approximately 176m south. This facility was understood to be obsolete.

2.2.6 Sensitive Land Use

The site is located within the River Glen (surface water) Nitrate Vulnerable Zone as classified by the Environment Agency.

No further sensitive land uses are listed within 2km of the site.

2.2.7 Local Authority Searches

The Local Authority, South Holland District Council was contacted by Grange GeoConsulting Limited to try and obtain further information about the site, particularly relating to the historical landfill recorded within the south-western area of the site. SHDC provided anecdotal evidence that ´the site has been subject to historic landfilling operations, including waste from the past use as a (plant) nursery as well as construction waste, but not domestic waste´.

The Local Authority also indicated that a member of the public had reported the possible presence of 'hydrocarbon contamination' at the site. Further details, however, were considered confidential by SHDC, and no details relating to the credibility of this information or the location of concern on site has been provided.

The Local Authority confirmed that the site was not currently classified as Contaminated Land under Part 2a of the EPA 1990.

2.3 Phase 2 Site Investigation

An intrusive ground investigation was undertaken at the site between the 21st and 24th January 2019. This investigation included the excavation of twelve (12No.) dynamic (window) sample boreholes and twenty-one (21No.) trial pits, advanced to a maximum depth of 5m below ground level (bgl). This was carried out to enable the logging of the soils encountered, to facilitate in-situ testing and to collect soil samples for chemical (contamination) and geotechnical testing. Nine (9No.) of the boreholes were Groundwater and ground gas monitoring standpipes were installed in nine (9No.) of the boreholes excavated. Ground gas monitoring was undertaken for a period of six weeks following the ground investigation in accordance with current guidance.

A drawing showing the location of excavations undertaken as part of the previous site investigation (Drawing R18012-DWG3) is included in Appendix A.

2.3.1 Ground Conditions Encountered

The ground conditions encountered during the 2019 Ground Investigation were in general accordance with the published geological literature. Superficial Tidal Flat Deposits were encountered at the site, overlain by significant and variable thicknesses of Made Ground, inclusive of re-worked Topsoil, re-worked natural materials and landfill / fill materials. Consolidated bedrock from the Oxford Clay Formation not encountered during the ground investigation. A brief summary of the various material subtypes encountered during the works is provided below. Additional detail is presented in Grange Geoconsulting 'Phase 1 Desk Study and Phase 2 Ground Investigation Report (July 2019).

Re-worked Topsoil

Materials consistent with reworked former topsoil were encountered in six of the excavations undertaken during the investigation, predominantly located toward the eastern periphery of the site.

In WS12, re-worked Topsoil was present at ground level and was described as dark grey mottled black, clayey, slightly sandy, slightly gravelly Silt. The re-worked Topsoil was less than 0.1m in thickness in this location. In TP15, TP17, TP18, TP20 and TP21, a re-worked Topsoil, described as brown friable sandy, slightly gravelly Silt was present at ground level. The gravel component comprised rare, rounded quartz. These materials exhibited a thickness of between 0.4m and 0.6m.

No visual or olfactory evidence of contamination was noted within the Re-worked Topsoil.

Made Ground and Re-worked Natural

Made Ground and re-worked natural materials, that did not appear to comprise landfill/fill, were recorded in 10No. excavations undertaken during the previous investigation (WS3, WS5, WS6, WS7, WS8, WS10, WS11, TP11, TP13 and TP19). These excavations were situated across the central and west of the site, including two locations within the anticipated location of the former landfill.

Two of the exploratory holes in which the 'non-landfill' Made Ground was identified were situated adjacent the former residential property. Made Ground in this area (exhibited in WS11 and TP19) was recorded to be between 1.0m and 1.2m in thickness, and comprised silty, gravelly Sand, containing possible asbestos cement sheeting, brick, glass, and Sandstone. The Made Ground in TP19 also contained metal artefacts (springs), bricks and brick rubble, breezeblocks, asphalt, occasional plastic, ceramic pipe fragments, timber, concrete and plyboard sheeting. These materials appeared to be building rubble associated with the former demolition works in this area of the site.

In WS3 and WS5, located toward the south-west of the site, the Made Ground, recorded to between 0.8m and 0.9m bgl comprised re-worked natural material, containing rare timber and brick fragments. In WS6, WS7 and WS8 situated toward the west/north-west of the site, re-worked strata containing limestone and brick fragments were recorded to a depth of approximately 0.5m bgl.

Based on the findings, it was considered possible that a process of land-raising had taken place across the west of the site.

Made Ground was observed in WS10 and TP11 to a depth of 0.7m bgl, comprising reworked natural strata containing occasional anthropogenic inclusions (glass fragments between 0.35m and 0.7m bgl, brick gravels and boulders of concrete)

In TP13, Made Ground was present to 1.7m bgl. Organic materials described as black Silt were encountered between 1.2m and 1.7m bgl. Abundant tree branches and organic material were present and appeared to have been buried. This was considered potentially indicative of an infilled former channel. The material in this location exhibited a strong organic odour, was

very wet and partially decayed, though no evidence of landfill material, or contamination was noted. The material overlying the Silt, recorded between ground level and 1.2m bgl appeared to comprise re-worked natural strata, similar to other excavations undertaken in the area.

Made Ground (Fill)

Landfill / infill materials were encountered in fifteen (15No.) of the excavations undertaken during the previous investigation (WS1, WS2, WS4, TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP12 and TP14). These excavations were predominantly situated toward the south-west of the site, within the anticipated location of the former pit shown on historical maps, however the extent of the landfill appeared to extend slightly beyond this area to the north.

The nature of fill materials encountered was variable, and was typically encountered to a depth of between 0.5m and 2.1m bgl. The fill was not noted to contain significant quantities of organic/putrescible materials. The Made Ground was noted to comprise re-worked natural strata and include soft to firm, orange to brown, infrequently black, occasionally clayey sandy Silt, and silty Sand.

Where encountered, the fill material was generally described as clayey sandy locally gravelly Silt and silty Sand containing moulded plastic artefacts, coal (between 0.45m and 0.6m in WS1 only), plastic bags, crushed brick, ceramic pipework, pot fragments, plastic bags, nylon string, paper, plastic cups, propagator cups, polythene bags, metal container fragments, rubber bands, plant labels, plastic bottles, plastic packaging, plastic mesh, and rare timber. Fragments of possible asbestos cement sheeting were recorded in TP1 between 0.5m and 1.4m bgl.

In TP7, evidence of a fire was noted. Materials including charcoal, burnt paper and melted plastic were present within the Made Ground in this location between 0.2m and 0.95m bgl.

Whilst highly variable, the average depth of the fill materials within the ‘former landfill’ was approximately 1.0m bgl, locally increasing to a maximum of 2.1m bgl.

The artefacts encountered within the fill were consistent with waste from a former (plant) nursery, as was anticipated based on evidence collected during the Phase 1 Desk Study. The anthropogenic materials encountered were predominantly inert.

Tidal Flat Deposits

Strata consistent with superficial Tidal Flat deposits were recorded below the Re-worked Topsoil/Made Ground in each of the exploratory holes excavated as part of the previous investigation. Materials from this unit were typically described as grey, brown, or orangish brown, locally clayey, very silty SAND and/or sandy SILT. The material was noted to be frequently damp or wet within the exploratory holes.

The Tidal Flat Deposits were encountered at depths of between 0.1m bgl (WS12) and 1.7m bgl (WS1), and recorded to the full depth of each excavation. The maximum depth to which Tidal Flat deposits were proven during these works was 5.0m bgl (WS7).

2.3.2 Groundwater

Groundwater strikes were recorded in the majority of excavations undertaken during the investigation at depths of between 1.0m and 2.0m bgl. In general the shallowest groundwater strikes were identified in excavations situated toward the west and south of the site, however it is acknowledged that groundwater depth was variable throughout the site.

Subsequent post fieldwork groundwater monitoring visits, undertaken between 25th January and 28th February 2019, proved groundwater levels within installed standpipes to be between 0.76m and 1.37m bgl.

2.3.3 Chemical Analysis

Soils

Twenty-five soil samples were taken from the Made Ground (inclusive of fill materials). Five soil samples were taken from the underlying natural strata. The samples were scheduled for analysis at a UKAS accredited laboratory for a suite of testing which included; asbestos screening, metals/metalloids, pH, organic matter content, speciated Polynuclear Aromatic Hydrocarbons (PAHs), speciated Total Petroleum Hydrocarbons (TPHs) using CWG methodology, MTBE, BTEX, an SVOC suite, Polychlorinated Biphenyls (PCBs), and a pesticide/herbicide suite.

The results obtained were compared against Generic Assessment Criteria (GACs) appropriate to a Residential with Plant Uptake end use scenario, based on the proposed development. Additional detail regarding the criteria adopted is presented in the original report.

One of the soil samples tested, taken from TP16 at a depth of 0.8m bgl proved concentrations of asbestos in excess of qualitative (microscopy) laboratory limits of detection. The asbestos comprised loose fibres of Chrysotile and Amosite. The total asbestos content within the sample was recorded as 0.002%.

None of the soil samples subjected to analysis as part of the previous investigation proved individual PAH, TPH, BTEX or MTBE species at concentrations which exceeded relevant GACs appropriate to the proposed end use.

None of the samples analysed proved significantly elevated concentrations of pesticide or herbicide species.

Speciated PCB testing was carried out on six soil samples collected during the investigation. In each of the analysed samples all PCB congeners were recorded at concentrations below laboratory levels of detection.

Two soil samples, taken from WS11 between 0.3m to 0.5m bgl, and from TP16 at a depth of 0.8m bgl, recorded concentrations of lead which marginally exceeded the generally accepted GAC for residential use of 200mg/kg. The concentrations recorded were 210mg/kg, and 290mg/kg respectively.

Mercury concentrations exceeding laboratory levels of detection were recorded in samples obtained from TP9 at 1.7m bgl (0.8mg/kg), WS11 at 0.3m to 0.5m bgl (1.0mg/kg), TP7 at 0.5m bgl (0.9mg/kg), and 1.3m bgl (2.7mg/kg), and TP19 at 1.2m bgl (0.6mg/kg). The sample obtained from TP7 at 1.3m bgl proved mercury concentrations in excess of the GAC for the elemental form of the contaminant, based on proposed end use (1.2mg/kg). All recorded concentrations were well below the GAC for inorganic mercury compounds (40mg/kg). It is considered highly unlikely that the mercury concentrations identified during the investigation were in elemental form, due to the volatility of this species.

Groundwater

Two groundwater samples were collected during the previous investigation and sent within a 24hr period to a UKAS accredited laboratory for subsequent chemical analysis.

The samples were scheduled for a range of analysis, including; metal/metalloids, inorganic contaminants (including nitrate, nitrite, cyanides, sulphate, chloride, fluoride, ammonium ions and hardness), total phenols, and speciated Polynuclear Aromatic Hydrocarbons (PAHs).

The results were compared against GACs consisting of freshwater EQS, and UK Drinking Water Standards (UKDWS). Additional detail regarding the criteria adopted is presented in the original report.

No freshwater EQS exceedances were recorded in either of the groundwater samples taken. Concentrations of Nitrite (as NO_2) were elevated above UK DWS in one of the samples, obtained from WS7. The recorded concentration was 1600µg/l, exceeding the UK DWS of 500µg/l.

Both of the groundwater samples taken recorded elevated concentrations of Manganese (1800µg/l) which exceeded the freshwater EQS of 123µg/l, based on bioavailability.

Ammonium (as NH_4) concentrations were also elevated in each of the water samples analysed. No GACs have published with regard to this determinand.

Due to the unsuitability of the underlying geology for use as a potable aquifer, and since the development will be connected to the mains for provision of drinking water, the contaminant concentrations recorded were not considered to pose a significant human health risk. Since no on-site soil sources have been established with respect to the contaminants identified in the groundwater, it was considered possible that they were a characteristic of regional groundwater chemistry.

2.3.4 Ground Gas

A programme of ground gas monitoring was carried out during the previous investigation, comprising six (6No.) visits carried out over a period of six weeks between 25th January and 28th February 2019.

The monitoring results proved a maximum (peak) flow rate of 11.2l/hr, a maximum Carbon Dioxide concentration of 5.5% vol., and a maximum peak methane concentration of 0.3% vol.

The findings of the site investigation would suggest, in accordance with the guidance established in CIRIA Guidance document C665, a worst case GSV/Q_{hg} of 0.616 l/hr for the site, indicating that Characteristic Situation 2-'Low Risk' (CS2), or Amber 1 (NHBC Traffic Light System for low-rise housing with a ventilated underfloor void) would be an appropriate classification with regard to new developments.

These classifications would require the implementation of Ground Gas protection measures for future developments.

2.3.5 Risk Assessment and Further Works

Based on the findings of the Site Investigation, an initial risk assessment was undertaken which concluded that Human Health risks with respect to the proposed development were 'low to moderate', and that there were no significant risks to controlled waters from contamination identified at the site.

It was, however, acknowledged that further investigation may be necessary to fully characterise the contaminative and ground gas risk. Recommended works are summarised below:

- Further groundwater samples will need to be taken across the site to confirm the groundwater quality.
- Additional ground gas monitoring, the scope of which should be discussed with the Local Authority. The monitoring should include the use of a Photo Ionisation Detector (PID) to confirm the presence/absence of TPH (volatile fractions) and VOC vapours within boreholes.
- Groundwater levels should be measured as part of the monitoring programme.
- Further ground investigation may be required within the vicinity of TP13 to confirm the presence of the infilled channel in this area; and
- An invasive weeds survey will need to be undertaken on site by a specialist third party contractor to confirm the absence of invasive plants on site. This element is beyond the scope of the current investigation.

In lieu of the findings of any supplementary investigation works, a series of possible remediation options were presented as part of the previous report. Whilst the possible options presented in that document have been considered, the conclusions and any preliminary remediation options presented this report, (which includes a revised CSM and risk assessment) supersedes any previous recommendations.

3.0 GROUND INVESTIGATION

3.1 Investigation Rationale

The ground investigation rationale summarised in

Table 3.1 has been based on the findings of the previous reporting (outlined in Section 2.0 of this report). The proposed methodology and scope of the works was submitted to SHDC for review and approval prior to commencement of works. A copy of the correspondence agreeing with the approach is presented in Appendix B. Photographs taken during the ground investigation are presented in Appendix C.

Table 3.1: Investigation Rationale

Exploratory Holes	Purpose
Excavation of Additional Window sample boreholes (WS101 to WS112 inclusive) excavated to between 2.0m and 3.0m below ground level (bgl)	• Enable logging of the soils encountered and assess shallow ground conditions at the site. • Allow the collection of soil samples for chemical (contamination) testing • Enable the installation of groundwater/ground gas monitoring boreholes in all excavations. WS105 was positioned adjacent the previous borehole (WS11) in which slightly elevated lead concentrations were identified in one sample (taken from a depth of 0.3m to 0.5m bgl). The objective of this excavation was to confirm and delineate the presence of this contaminant, and to provide general coverage of the site. WS104 was excavated adjacent the previous excavation (TP19) in which asbestos cement sheeting was previously identified. The objective of this excavation was to further examine this area for the presence of asbestos fibres, and to provide general coverage of the site. WS103 was excavated adjacent the previous excavation (TP16) in which asbestos fibres and elevated lead concentrations were identified in single soil sample (taken from a depth of 0.8m bgl). The objective of this excavation was to further examine this area for the presence of these determinands, and to provide general coverage of the site. WS102 was positioned adjacent the previous excavation (TP13) in which a possible former, buried channel was identified in previous investigations. The objective of this excavation was to further examine this feature, and to provide general coverage of the site. WS112 was excavated adjacent the previous excavation (TP1) in which asbestos cement sheeting was previously identified (Made Ground between 0.5m and 1.4m bgl). The objective of this excavation was to further examine this area for the presence of asbestos, and to provide general coverage of the site. All additional excavations were positioned to provide general coverage of the site and to further delineate the boundary of former fill operations. Due to the presence of shallow groundwater, identified during previous investigation works at depths of between 0.76m and 1.37m bgl, standpipes installed during this phase of works, predominantly to be used for ground gas monitoring, were installed with shallow response zones (typically between 0.5m and 1.0m bgl). This approach was discussed and

Exploratory Holes	Purpose
	agreed with the local authority to mitigate the effects of the extremely shallow water table.
Reinstatement/recommission of previously installed standpipes (WS1, WS2, WS3, WS4, WS5, WS7, WS8, WS10, WS12)	• Enable the inclusion of previous monitoring wells within the cohort of investigation locations examined during the current ground gas monitoring programme.

It should be noted that in the process of reinstating the former gas monitoring standpipes, the well installed in WS2 was proven to be damaged beyond use. This location was therefore excluded from the monitoring programme.

3.2 Site Works

The fieldwork phase of the supplementary ground investigation was undertaken between the 26th and 27th April 2023.

The approximate positions of the additional window sample boreholes were surveyed using a tape measure, and GPS receiver, with distances measured from landmarks present on site. The locations are shown in the Site Investigation Plan (Drawing R18012-DWG4) provided in Appendix A. The works undertaken are summarised in Table 3.2. The borehole logs, including details of the ground conditions encountered, water strikes, any visual or olfactory evidence of contamination, monitoring installations and in-situ testing are presented in Appendix D.

Table 3.2: Summary of Site Works

Exploratory Holes	Depth (m bgl)	In-situ testing	Observations
WS101	3m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at 1.0m and 2.0m bgl. Low to moderate SPT at 3m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS102	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at 1.0m and 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS103	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at 1.0m and 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.

Exploratory Holes	Depth (m bgl)	In-situ testing	Observations
WS104	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS105	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS106	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS107	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS108	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at 1.0m and 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS109	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. Made Ground containing rare ash was recorded between 0.0m (ground level) and 0.5m bgl. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS110	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low to moderate SPT at 1.0m bgl. Low SPT at 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS111	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at 1.0m and 2.0m bgl. No SPT refusals obtained.	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.
WS112	2.0m bgl	SPTs undertaken at 1m intervals throughout the excavation. Low SPTs at	A groundwater strike was recorded at a depth of approximately 2.0m bgl. No visual or olfactory evidence of contamination was

Exploratory Holes	Depth (m bgl)	In-situ testing	Observations
		1.0m and 2.0m bgl. No SPT refusals obtained.	noted. Gas/groundwater monitoring standpipe installed to 1.0m bgl. Response zone was between 0.5m and 1.0m bgl.

3.3 Ground Conditions

The ground conditions proven during the ground investigation were in general accordance with published geological literature, and the findings of the previous investigation. The ground conditions are presented in full in the logs in Appendix D and summarised in Table 3.3.

Table 3.3: Strata Encountered

Stratum Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Topsoil/Reworked Natural	GL	0.3-0.4	0.3-0.4
Made Ground	GL	0.4m to 1.2m bgl	0.4m to 1.2m
Tidal Flat Deposits	0.3m to 1.2m bgl	2.0m to 3.0m bgl (Base not proven)	0.8m to 2.6m (Thickness unproven)

3.3.1 Topsoil/Reworked Natural

Topsoil was encountered at the surface in five of the twelve supplementary boreholes, and recorded to a depth of between 0.3m and 0.5m bgl. The excavations in which this material was identified (WS101, WS106, WS107, WS110, and WS108) were positioned toward the eastern and western peripheries of the site. The composition of the materials encountered was reasonably consistent. It is considered possible that these strata are synonymous with materials previously referred to as 'Reworked Natural', however this could not be confirmed due to the absence of anthropogenic materials.

In general, two principal subtypes of Topsoil/Reworked Natural material were identified during the works. A summary of these types is presented below.

- Brown clayey sandy Silt. This was the predominant Topsoil/Reworked Natural subtype encountered, and was recorded in WS101, WS106, WS107, and WS110 to depths of between 0.3m and 0.4m bgl.
- Dark brown sandy silty Clay. This cohesive deposit was encountered in a single location (WS108), situated close to the south-eastern boundary of the site, and was recorded to a depth of 0.3m bgl.

Where encountered, these materials were underlain by natural Tidal Flat Deposits.

3.3.2 Made Ground

Made Ground was encountered at the surface in seven of the excavations undertaken as part of the site investigation (WS102, WS103, WS104, WS105, WS109, WS111, and WS112). The thickness of the Made Ground varied between 0.4m and 1.2m.

The Made Ground encountered could be broadly categorised into; material consistent with the fill identified during the previous investigation (i.e. Landfill Material), and 'general Made Ground' containing brick and concrete (i.e. Non Landfill Made Ground), however the distinction between the two types appeared less distinct that previously recorded. Anthropogenic materials appeared to be less prevalent in the supplementary locations, although it should be

noted that the investigation methodology adopted during the current works (Window Sample Boreholes) provided a more discrete representation of the ground conditions than previous Trial Pitting will have done. This would not, however, have a significant impact on the representativeness of soil samples taken.

The general Made Ground (non-landfill) encountered comprised one of the following two subtypes:

- Dark brown locally mottled brown locally slightly silty slightly sandy, slightly gravelly to gravelly Clay. The gravel component of this material was described as fine to coarse, angular to subrounded of brick, flint, sandstone, concrete, and locally rare ash (WS109 only). This subtype was encountered in WS102 between 0.0m and 0.5m bgl, in WS104 between 0.0m and 0.6m bgl, and in WS109 between 0.0m and 0.4m bgl. These excavations were situated across the northern and north-eastern sections of the site.

- Brown silty Clay containing rare gravel of brick. This sub-type was encountered in WS105 (north-eastern periphery of the site) between 0.0m and 0.4m bgl.

The materials potentially consistent with 'Landfill' material- i.e. containing anthropogenic artefacts (plastic) were generally described as Brown silty, locally slightly sandy, slightly gravelly Clay. The gravel was fine to coarse, angular to subrounded of brick, limestone, concrete, and rare to occasional plastic artefacts. These materials were proven in WS103, WS111 and WS112, and recorded to depths of between 1.0m and 1.2m bgl.

The locations of those excavations where 'fill' material was encountered were in general as expected (across the south-western section of the site), based on the findings of the previous investigation, however WS103 and WS110 were notable outliers WS103, positioned toward the northern site boundary, recorded Made Ground from the possible 'landfill' subtype, whilst no made ground was encountered in WS110, which previous works would have suggested was within the former 'landfill' area.

On this basis it is considered possible that the extent to which 'landfill' materials were deposited may have been less disciplined than previously anticipated, and that associated fill may be discontinuous and localised, particularly toward the north of the site. It is still considered likely that the bulk of the fill was deposited across the south-western corner of the site, however a formal boundary/head-wall could not be delineated, and this location should be considered a guide, rather than a rule. It is considered unlikely, based on the findings of both investigations undertaken, that 'landfill' material extends onto the central, eastern, or north-eastern sections of the site, which were characterised by more generic Made Ground, or reworked natural materials respectively.

No putrescible materials were identified within material tentatively designated 'landfill'.

3.3.3 Tidal Flat Deposits

A complex interbedded and alternating sequence of predominantly cohesive and granular strata consistent with Tidal Flat Deposits was encountered below the Made Ground and/or Topsoil in each of the excavations. In general the materials encountered comprised one of the following subtypes:

- Firm brown, grey and orange brown silty, locally slightly sandy CLAY. This material was recorded in WS101 between 0.4m and 0.8m bgl, in WS104 between 0.6m and 1.0m bgl, and in WS110 between 1.0m and 1.2m bgl. In WS110 these deposits were recorded to contain abundant shell fragments.

- Dark grey/black PEAT. This organic deposit was proven in WS101 between 0.8m and 1.2m bgl, in WS111 between 1.0m and 1.4m bgl, and in WS112 between 1.0m and 1.4m bgl.

- Loose to medium dense grey, yellow brown, orange brown, brown, or light brown locally slightly clayey, slightly silty to silty fine grained SAND. This was the predominant subtype encountered across the site, and was identified in WS101 (1.2m to 3.0m bgl), WS102 (0.5m to 0.9m and 1.2m to 2.0m bgl), WS103 (1.2m to 2.0m bgl), WS104 (1.0m to 2.0m), WS105 (0.8m to 2.0m bgl), WS106 (0.3m to 2.0m bgl), WS107 (0.8m to 2.0m bgl), WS108 (0.3m to 2.0m bgl), WS109 (0.4m to 1.0m bgl), WS110 (0.3m to 0.8m and 1.2m to 2.0m bgl), WS111 (1.4m to 2.0m bgl) and WS112 (1.4m to 2.0m bgl). Where encountered, these deposits were typically recorded toward the base of the profile.

- Stiff dark brown/brown organic locally silty CLAY. Proven in WS102 between and 1.2m bgl, and in WS110 between 0.8m and 1.0m bgl.

- Grey/brown, yellow brown, brown or orange brown locally slightly clayey sandy to very sandy SILT. This subtype was encountered in WS105 between 0.4m and 0.8m bgl, and in WS107 between 0.3m and 0.8m bgl.

- Loose to medium dense grey/brown fine grained SAND. Recorded in a single location (WS109) between 1.0m and 2.0m bgl.

Whilst broad patterns could be identified vertically within the sequencing of horizons in this unit, no obvious lateral patterns of distribution were observed.

WS102, excavated adjacent TP13, a trial pit undertaken during the previous phase of site investigation did not identify the presence of particularly organic materials to any substantial depth. The presence of a former channel in this location could therefore not be corroborated. Similarly, the presence of PEAT in WS101, WS111 and WS112 appeared to differ from the previous excavations undertaken in/adjacent these locations (TP11, TP7, and TP1). This would suggest that organic deposits are unlikely to form contiguous distribution patterns (linear or otherwise), and are more likely to comprise localised pockets or lenses of organic material, present within the Tidal Flat Deposits.

3.4 Borehole/Trial Pit Stability

No evidence of instability was noted during the advancement of boreholes during the excavation.

3.5 Visual and Olfactory Evidence of Contamination

Within one excavation undertaken during the current phase of works (WS109), Made Ground containing rare ash was encountered between 0.0m (Ground Level) and 0.4m bgl.

No visual or olfactory evidence of contamination was encountered in any of the excavations progressed during the investigation.

3.6 Groundwater Strikes

Groundwater strikes were encountered during the fieldwork phase of the investigation in each of the twelve additional investigation locations undertaken. In each borehole, groundwater strikes were encountered at an approximate depth of 2.0m bgl. Additional observations are provided on the borehole logs presented as Appendix D.

A programme of groundwater monitoring was undertaken between the 16th May 2023 and 27th June 2023. Water levels recorded within the standpipes installed during this monitoring programme, as well as viable reinstated wells from the 2019 investigation are summarised in Table 3.4. Copies of the monitoring certificates are included in Appendix E.

Table 3.4: Groundwater Monitoring Results (16th May to 27th June 2023)

Borehole/Standpipe Location	Groundwater Level (mBGL)
WS101	Dry
WS102	Dry
WS103	Dry
WS104	Dry
WS105	Dry
WS106	Dry
WS107	Dry
WS108	Dry
WS109	Dry
WS110	Dry
WS111	Dry
WS112	Dry
WS1	1.25m to 1.59m bgl
WS3	1.24m to 1.61m bgl
WS4	1.10m to 1.50m bgl
WS5	1.05m to 2.01m bgl
WS7	1.01m to 1.59m bgl
WS8	1.63m to 2.09m bgl
WS10	1.34m to 1.69m bgl
WS12	1.27m to 1.96m bgl

Each of the newly installed wells were dry throughout the monitoring period. This was expected, since the response zones in these locations were designed predominantly to enable ground gas monitoring, and were set within the unsaturated zone of the soils underlying the site.

Groundwater levels within the reinstated boreholes excavated in 2019 varied significantly throughout the monitoring period, however were generally shallow (within 1.5m of the existing ground surface).

Based on the levels recorded, a slight groundwater gradient appears to be present from west to east, and from the northern and southern peripheries of the site toward the centre of the site. A surface water drain runs approximately east to west through the centre of the site.

3.7 In-situ Testing

3.7.1 Standard Penetration Tests

Standard Penetrations Tests (SPTs) were undertaken during the advancement of the Window Sample boreholes on-site. The SPT (N values) results are presented in Table 3.5.

Table 3.5: SPT Results (N values)

Excavation locations	Depth SPT undertaken (m)	SPT (N value) recorded
WS101	1m bgl (TF)	9
	2m bgl (TF)	6
	3m bgl (TF)	11
WS102	1m bgl (TF)	16
	2m bgl (TF)	4
WS103	1m bgl (MG)	7
	2m bgl (TF)	4
WS104	1m bgl (TF)	12
	2m bgl (TF)	8
WS105	1m bgl (TF)	13
	2m bgl (TF)	10
WS106	1m bgl (TF)	14
	2m bgl (TF)	7
WS107	1m bgl (TF)	12
	2m bgl (TF)	7
WS108	1m bgl (TF)	9
	2m bgl (TF)	4
WS109	1m bgl (TF)	13
	2m bgl (TF)	4
WS110	1m bgl (TF)	16
	2m bgl (TF)	9
WS111	1m bgl (TF)	0 (self weight)
	2m bgl (TF)	8
WS112	1m bgl (TF)	6
	2m bgl (TF)	3
Key to materials in which SPTs were carried out: MG- Made Ground, TF- Tidal Flat Deposits		

4.0 CHEMICAL (CONTAMINATION ANALYSIS) LABORATORY TESTING

4.1 Sampling Strategy

The following soil and groundwater samples were taken by Grange GeoConsulting Ltd between the 26th and 27th April 2023:

- 5 No. samples from the Topsoil/Reworked Natural materials;
- 6 No. samples from the Made Ground;
- 1 No. Sample from the Tidal Flat Deposits; and
- 7 No. groundwater samples taken on 6th June 2023 from reinstated boreholes, installed during the previous investigation (WS3, WS4, WS5, WS7, WS8, WS10 and WS12). Excavations installed during the current phase of works used response zones set within the unsaturated zone, with the principal objective of enabling ground gas monitoring.

Where samples were taken during the previous investigation and found to contain contaminant concentrations which were potentially considered a risk to the proposed development, samples were taken from corresponding boreholes excavated during the current investigation (those positioned so as to re-examine the impacted locations), at similar depths, and/or from materials representative of the original contaminated strata.

Samples were taken, stored, and transported in general accordance with the British Standard 10175: 2011 Code of Practice for Investigation of Potentially Contaminated sites, and transported by courier to I2 Analytical Services; a UKAS accredited laboratory

4.2 Laboratory Analyses Undertaken

A suite of analysis was undertaken on the soil samples obtained, which included the following determinands. This analysis suite was agreed with SHDC prior to implementation:

Soils

Arsenic (As), Cadmium (Cd), Hexavalent and Total Chromium (Cr III and VI), Copper (Cu), Lead (Pb), Inorganic Mercury (Hg), Manganese (Mn), Nickel (Ni), Selenium (Se), Vanadium (V), Zinc (Zn), Total Cyanide, pH, Organic Matter, Asbestos Screen, and Speciated Poly-Aromatic Hydrocarbons (PAH).

Groundwater

The groundwater samples were scheduled for the following analysis:

Water hardness ($mgCaCO^3/l$), Silver (Ag), Aluminium (Al), Antimony (Sb), Arsenic (As), Boron (B) (water soluble), Barium (Ba), Calcium (Ca), Cadmium (Cd), Hexavalent and Total Chromium (Cr II and VI), Copper (Cu), Iron (Fe), Mercury (Hg), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Sodium (Na), Nickel (Ni), Lead (Pb), Selenium (Se), Tin (Sn), Vanadium (V), Zinc (Zn), Free and Total Cyanide, pH, Sulphate, Total Phenols, Ammoniacal nitrogen, Fluoride, Chloride, Bromate, Nitrate, Nitrite and Speciated Poly-Aromatic Hydrocarbons (PAH).

5.0 CONTAMINATION RISK ASSESSMENT CRITERIA

A risk-based approach is used for the assessment of contamination. This requires identification of a contaminant source, a receptor, and a realistic pathway via which the contaminant may reach the receptor. The key receptors considered in this assessment are human health (future residential occupants, ground workers and off site human health receptors) and controlled waters (surface water features including on-site and adjacent drainage ditches/channels and the River Glen). Due to the aquifer status of the Tidal Flat deposits, as designated by the Environment Agency (unproductive unit), the underlying groundwater is not considered a sensitive receptor.

The Risk Assessment is a two-stage process. The first stage is to perform a Generic Quantitative Risk Assessment (GQRA) - the soil test results have been compared against the relevant Generic Assessment Criteria (GAC). In the absence of a complete regulatory set of screening values, derived using the CLEA Framework, Grange GeoConsulting Limited GAC screening values have been utilised and are based on the following:

- Category 4 Screening Levels (C4SLs) published by DEFRA;
- The 2014 Land Quality Management (LQM) / Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels for Human Health Risk Assessment (S4ULs); and
- Guidance values produced by the Environmental Industries Commission (EIC), the Association of Geotechnical and Geoenvironmental Specialists (AGS), and Contaminated Land: Application in Real Environments (CL:AIRE) in December 2009.

The second stage of the Risk Assessment process is Risk Evaluation, which comprises an authoritative review of the findings with other pertinent information in cases where GAC are exceeded, to consider if exceedance may be acceptable in the context of the site.

5.1 Human Health

This is a Tier 2 assessment, using GAC soil screening values, and involves generic human health risk assessment for the following CLEA scenario:

Residential with plant uptake (including the consumption of home-grown produce) which typically applies to houses or flats with gardens and / or areas of soft landscaping.

Given the presence of shared and individual garden areas as part of the proposed development, a ‘Residential with Plant Uptake’ scenario is considered the most conservative approach with respect to risk assessment in this case.

The chemical (contamination analysis) testing results have been screened against Grange GeoConsulting Ltd GAC screening values (provided in Appendix F) to carry out an assessment of potential risks associated with contamination at the site. Justification for the criteria adopted for this Risk Assessment is given in Appendix F. In the case where all the samples tested for a given substance were below the GAC, no further consideration is necessary for that substance.

The mean average Soil Organic Matter Content (SOM) has been calculated for the units from which soil samples were obtained and analysed. GACs for organic contaminants have been

based on a conservative SOM derived from the mean organic matter content recorded during laboratory analysis. Table 5.1 presents the average SOM content for each geological unit (by site), and the subsequent adopted soil organic matter content for GAC comparison.

Table 5.1: Soil Organic Matter Content for GAC Comparison

Stratum	Mean average of recorded SOM values (%)	Adopted GAC SOM (%)
Topsoil/Reworked Natural	2.18	1%
Made Ground	4.06	2.5%
Tidal Flat Deposits	12.0	6%

Copies of the Chemical Analysis certificates are presented in Appendix G.

5.2 Controlled Waters

The risks to groundwater and surface water from contaminants on site have been assessed against the Environment Agency (2006) Remedial Targets Methodology (RTM). Pollutants from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC), and as such are regulated under the Agency's 'limit' pollution objective.

Acceptable Water Quality Targets (WQT) are defined for protection of human health (based on UK Drinking Water Standards (DWS)), and for the protection of aquatic ecosystems (Environmental Quality Standards (EQS)).

For the purpose of controlled waters assessment, analysis results for groundwater samples have been compared against Environmental Quality Standards (EQS) for freshwater. Where EQS are not available, UK Drinking Water Standards (DWS) or World Health Organisation guidelines for drinking water were applied. Where a range of EQS values are provided, the concentration used for comparison purposes is generally dependent upon the water hardness of the area. Water hardness data obtained during the chemical analysis programme proved concentrations of $CaCO_3$ to be between 669mg/l and 976mg/l, indicating that groundwater underlying the site is (in accordance with the criteria of the UK Drinking Water Inspectorate) 'very hard'.

6.0 CONTAMINATION ANALYSIS TESTING RESULTS AND RISK ASSESSMENT

6.1 Analysis Results- Soils

6.1.1 Inorganic Contaminants (including Metals and Semi-Metals)

Lead was recorded in a single sample analysed during the supplementary site investigation at a concentration exceeding the generally accepted Generic Acceptance Criterion appropriate to a residential with plant uptake end use scenario (200mg/kg). The sample was taken from WS103 at a depth of 0.8m bgl. WS103 was positioned close to a previous trial pit (TP16), undertaken during the previous (2019) site investigation. A sample previously taken from the made ground TP16 also recorded an elevated concentration of lead. The supplementary investigation has therefore corroborated this contamination hot-spot.

None of the remaining samples, taken during the supplementary investigation, proved metal / semi-metal or other inorganic contaminants at concentrations which exceeded GACs for a residential (with plant uptake) end-use scenario.

Manganese concentrations recorded in soil samples taken from each of the units sampled (Topsoil/Reworked Natural, Made Ground, and Tidal Flat Deposits) were proven to be between 160mg/kg and 430mg/kg. No GAC has been published for this determinand. The recorded concentrations were consistent with regional topsoil concentrations published by the UK Soil Observatory (UKSO), a technology partnership funded by, and receiving data from multiple research organisations, including the BGS, and Natural Environmental Research Council (NERC). The UKSO indicate regional manganese concentrations in topsoil on and in the vicinity of the site to be 0.05% (equivalent to 500mg/kg). On this basis, soil manganese concentrations at the site are not considered to be elevated above those representative of regional geochemistry. In general, phytotoxicity at the concentrations, and pH levels recorded (acidic soils (pH<7) increase environmental mobility of manganese ions) is considered unlikely.

6.1.2 Polycyclic Aromatic Hydrocarbons (PAHs)

None of the samples tested proved individual PAH species at concentrations exceeding relevant GACs for a Residential with Plant Uptake end use scenario, taking into consideration the appropriate SOM content.

6.1.3 Asbestos

Qualitative laboratory analysis (microscopy) of two samples, taken from Made Ground in WS104 at a depth of 0.3m to 0.6m bgl, and WS109 between 0.1m and 0.3m bgl recorded the presence of loose fibres of chrysotile (WS104 and WS109) and amosite (WS109) asbestos.

The concentration of asbestos within each of the remaining samples analysed during the investigation was found to be below qualitative (microscopy) laboratory levels of detection (<0.001%), and was therefore recorded as ‘not detected’ in accordance with laboratory methodology.

The concentration of asbestos within each of the remaining samples analysed during the site investigation was found to be below qualitative (microscopy) laboratory levels of detection (<0.001%).

6.2 Groundwater Analysis Results

6.2.1 Inorganic Contaminants (including Metals and Metalloids)

Manganese was recorded in the six of the seven water samples obtained during the supplementary investigation at concentrations which exceeded Freshwater EQS (AA) and UKDWS. These samples were taken from WS3, WS4, WS5, WS7, WS8, and WS10. Given the absence of a significant soil source on site, it is considered likely that this contamination is characteristic of regional groundwater (including groundwater situated beyond the boundaries of the site). Associated remediation works are therefore considered unlikely to be effective in reducing risk to controlled water receptors. Based on the concentrations recorded, risk to human health receptors from this determinand is considered negligible, particularly given the modest concentrations recorded in soil samples taken from the unsaturated zone. The proposed development will not involve the abstraction of potable water from the underlying geology.

Concentrations of copper in the water samples obtained from each of the water samples obtained during the supplementary investigation were recorded to slightly exceed Freshwater EQS (AA), however were significantly below UK DWS. Human health risks associated with this contaminant are therefore considered negligible. The sitewide distribution of this contaminant, and lack of a significant identified soil source suggests that copper contamination within the groundwater may be a feature of regional geochemistry. Given the concentrations recorded, potential risks to controlled waters are considered low. Remediation works are unlikely to be effective in further reducing risk to aquatic receptors due to the regional distribution of the contaminant.

Iron was recorded at a concentration of 1.9mg/l in the water sample taken from WS5. This concentration slightly exceeded the Freshwater EQS (AA) of 1.0mg/l. Given the slight nature of this exceedance, the ubiquitous geological presence of iron as a determinand, and the lack of evidence for industrial use on or in the vicinity of the site, potential risk associated with this contamination, both with respect to controlled waters and human health, is considered negligible.

Nitrate and nitrite (as NO3 and NO2 respectively) concentrations were recorded in the water sample obtained from WS12 during the supplementary investigation in excess of UK DWS. The GACs for these determinands are 50mg/l, and 0.5mg/l respectively. Recorded concentrations were 61mg/l and 0.86mg/l. The distribution of this contaminant, and the slight nature of the exceedance is not considered consistent with the sitewide use of nitrogen based fertilisers.

Elevated ammoniacal nitrogen concentrations were recorded in WS5, WS7, and WS10. No GAC has been published for this determinand. The impacted water samples were collected from boreholes situated toward the southern, northern, and eastern peripheries of the site. None of the significantly impacted samples were taken from boreholes situated within the area formerly designated as a ‘landfill’.

None of the remaining metal/metalloid, or inorganic species analysed were recorded at concentrations in excess of the relevant assessment criteria, based on the appropriate water hardness data.

6.2.2 Polycyclic Aromatic Hydrocarbons (PAHs)

None of the individual PAH species analysed were recorded at concentrations which exceeded the UKDWS for total (collective) PAHs of 0.1µg/l in any of the water sample analysed. The concentrations of individual and total PAH species in each of the samples tested were below laboratory levels of detection.

7.0 REVISED RISK ASSESSMENT

7.1 Revised Ground Model

The preliminary conceptual site model initially developed during the Phase 1 Desk Study has been updated using the findings of the ground investigation.

Topsoil/Reworked Natural strata were encountered at the surface in five of the twelve supplementary boreholes, and recorded to a depth of between 0.3m and 0.5m bgl. The excavations in which this material was identified (WS101, WS106, WS107, WS110, and WS108) were positioned toward the eastern and western peripheries of the site.

Made Ground was encountered at the surface in seven of the excavations undertaken as part of the supplementary site investigation. The thickness of the Made Ground varied between 0.4m and 1.2m.

The Made Ground encountered could be broadly categorised into; material consistent with the fill identified during the previous investigation (i.e. Landfill Material), which was recorded in WS103, WS111, and WS112, and 'general Made Ground' containing brick and concrete (i.e. Non Landfill Made Ground), proven in WS102, WS104, WS105, and WS109. The distinction between the two types appeared less distinct than was previously recorded.

A complex interbedded and alternating sequence of predominantly cohesive and granular strata consistent with Tidal Flat Deposits was encountered below the Made Ground and/or Topsoil in each of the excavations, and recorded to the base of each excavation (between 2.0m and 3.0m bgl. In general, granular materials, described as loose to medium dense locally slightly clayey, slightly silty to silty fine grained SAND, predominated.

The potential presence of an infilled former channel in the vicinity of TP13 (excavated during the 2019 investigation) could not be corroborated. Based on the findings of the supplementary investigation, it is considered unlikely that organic deposits form contiguous distribution patterns (linear or otherwise), and are more likely to comprise localised pockets or lenses of organic material, present within the Tidal Flat Deposits.

The Environment Agency have designated the Tidal Flat deposits which underlie the site as an Unproductive unit. Whilst infiltration testing was not undertaken at the site, the characteristics of materials and groundwater encountered would suggest sparing permeability and transmissivity. The sensitivity of the site with respect to groundwater is therefore considered to be slightly higher than was originally anticipated during the previous phase of works. Groundwater is present at approximately 2.0m bgl, however this may vary seasonally, given the shallower levels recorded in 2019. The closest surface water receptors are a series of ephemeral ditches located on and in the vicinity of the site. It is assumed that these channels are hydraulically connected to the River Glen, situated approximately 205m west of the site.

Based on a combination of these factors, the overall sensitivity to identified controlled water receptors from contamination at the site is considered moderate. Surface water receptors are considered the principal risk drivers.

7.2 Revised Exposure Model/Conceptual Site Model

The plausible contaminant sources, pathways, and receptors previously identified in the 2019 Phase 1 Desk Study and Phase 2 Ground Investigation have been updated based on the findings of the Supplementary Phase 2 Ground Investigation.

7.2.1 Sources

The 2019 site investigation identified the presence of elevated concentrations of lead in WS11 and TP16, situated toward the northern periphery of the site, close to a former residential property (subsequently demolished).

Lead was recorded in a single sample analysed during the supplementary site investigation at a concentration exceeding the generally accepted Generic Acceptance Criterion appropriate to a residential with plant uptake end use scenario (200mg/kg). The sample was taken from WS103 at a depth of 0.8m bgl. WS103 was positioned close to TP16, corroborating a potentially substantial contamination hot-spot in this location. Two lead hotspots, centred on WS11, and WS103/TP16 have been proven.

One of the soil samples tested during the 2019 investigation, taken from TP16 at a depth of 0.8m bgl proved concentrations of asbestos in excess of qualitative (microscopy) laboratory limits of detection. The asbestos comprised loose fibres of Chrysotile and Amosite. The total asbestos content within the sample was recorded as 0.002%. During the supplementary investigation, a further two samples, taken from Made Ground in WS104 at a depth of 0.3m to 0.6m bgl, and WS109 between 0.1m and 0.3m bgl recorded the presence of loose fibres of chrysotile (WS104 and WS109) and amosite (WS109) asbestos. The sample taken from WS103, excavated adjacent the original hotspot of asbestos fibre contamination, was not found to contain asbestos contamination. Based on the findings, three discrete hotspots of asbestos contamination have been identified at the site, situated toward the northern periphery, adjacent the former residential property (TP16 and WS104), and toward the centre of the site (WS109).

In addition, asbestos cement sheet fragments were identified during the 2019 investigation in TP19 (adjacent the former residential property) and TP1 (located toward the western periphery of the site). Excavations undertaken during the supplementary investigation adjacent the impacted locations did not identify asbestos cement sheet fragments. It is therefore anticipated that two small areas of the site have been affected by this contamination.

Groundwater analysis undertaken during the supplementary investigation has identified a number of contaminants exceeding relevant GACs, including iron, manganese, copper, nitrate/nitrite, and ammoniacal nitrogen. The manganese and copper contamination appeared sitewide, and in the absence of a significant on site soil source, was considered likely to be a characteristic of regional geochemistry. The elevated ammoniacal nitrogen concentrations did not appear to correlate closely with the location of the former ‘landfill’, suggesting an alternative, potentially off-site source. The nitrate/nitrate contamination was localised, and did not appear representative of widespread on-site use of nitrogen based fertilisers. None of the groundwater contaminants recorded were considered to represent a significant risk to human health receptors. It was considered unlikely that groundwater remediation would be effective

in reducing risks to controlled waters, given the regional/widespread nature of the identified contaminants.

7.2.2 Receptors

Based on the findings of the various phases of investigation undertaken, potential receptors identified include the following:

- Proposed site end users (residential occupants, neighbours, and site visitors)
- Groundworkers (construction and future maintenance workers)
- Building materials (buried concrete and underground services)
- Controlled waters (Surface Water Receptors- channels located on and adjacent the site with assumed connectivity to the River Glen, located 205m west of the site)

The sensitivity and transmissivity characteristics of groundwater receptors are generally considered to be slightly higher than those anticipated during the previous Phase 1 Desk Study, or from published sources. Permeability/transmissivity of the underlying Tidal Flat Deposits is considered to be sparing, based on the nature of materials encountered.

7.2.3 Pathways

Following the various phases of investigation undertaken at the site, and based on the proposed residential development of the site, potential pathways include:

- Direct human contact (dermal contact)
- Inhalation (dust and vapours)
- Ingestion (homegrown produce)
- Direct contact of structures/utilities with aggressive ground conditions
- Leaching and on/off-site migration of contaminants via sparingly permeable soils

7.3 Summary of Potential Contaminant Linkages

A revised Conceptual Site Model (Table 7.2) has been produced which presents an updated list of plausible contaminant linkages based on information obtained during the site investigation, and an evaluation of these linkages in accordance with the guidance provided in Environment Agency (2020) Land Contamination Risk Management. (LCRM). Linkages have been assessed in general accordance with guidance provided in the CIRIA Report C552 (Rudland *et al* 2001) but with the addition of a 'no linkage' category as detailed in Table 7.1.

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to groundworkers (construction and future maintenance workers), consideration of occupational health and safety issues is beyond the scope of this report and needs to be considered separately in the Construction Phase Health and Safety Plan.

Table 7.1: Risk Assessment Process

	Consequence			
Probability	**Severe**	**Medium**	**Mild**	**Minor**
High Likelihood	Very high risk	High risk	Moderate risk	Low risk
Likely	High risk	Moderate risk	Low risk	Very low risk
Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
Unlikely	Low risk	Very low risk	Very low risk	Very low risk
No Linkage	No risk			

Table 7.2: Final Conceptual Model and Residual Risks Following Risk Evaluation

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk	Comments
On Site: Two (2No.) lead hotspots situated adjacent WS11 and WS103/TP16 Elevated lead concentrations identified within Made Ground in the impacted locations.	Direct dermal contact, Inhalation (dust and vapours), Ingestion, Direct contact of structures/ utilities with aggressive ground conditions. Leaching and off-site migration via sparingly permeable soils. Surface runoff to on/off site drainage channels.	Site end users (residential occupants, neighbours, and site visitors), Construction and maintenance workers, Building materials/ utilities, Surface water receptors (on/off site drainage channels)	Likely	Medium	**Moderate**	The 2019 site investigation identified the presence of elevated concentrations of lead in WS11 and TP16, situated toward the northern periphery of the site, close to a former residential property (subsequently demolished). Elevated lead concentrations were recorded in a single sample analysed during the supplementary site investigation, taken from WS103 at a depth of 0.8m bgl. WS103 was positioned close to TP16, corroborating a potentially substantial contamination hot-spot in this location. Two lead hotspots, centred on WS11, and WS103/TP16 have been proven. The proposed development involves the construction of residential properties with associated private gardens and access infrastructure. The presence of gardens will enable direct contact between future site occupants and any contamination present. The growth of home-grown produce for consumption is considered possible. Construction workers are likely to come into direct contact with any contamination present, however it is assumed that good working practices including the use of appropriate PPE, regular hand washing, and other hygiene techniques will be adopted which would reduce the likelihood of long-term exposure. The presence of potentially but sparingly transmissive soils underlying the site has been confirmed during the site investigation. Superficial deposits which underlie the site have been classified Unproductive by the Environment Agency. The presence of private gardens following development will enable infiltration and vertical movement of meteoric water. Surface water receptors have been identified on, and in the vicinity of the site (drainage ditches). These channels are assumed to be in hydraulic connectivity with the regional river network. Groundwater was found to be present at shallow depths beneath the site.

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk	Comments
On Site: Loose asbestos fibres (chrysotile and amosite) encountered in three (3No.) discrete hotspots located toward the north and centre of the site. Asbestos fibres identified within Made Ground in the impacted locations.	Direct dermal contact, Inhalation (dust and vapours), Ingestion, Direct contact of structures/ utilities with aggressive ground conditions. Leaching and off-site migration via sparingly permeable soils. Surface runoff to on/off site drainage channels.	Site end users (residential occupants, neighbours, and site visitors), Construction and maintenance workers, Building materials/ utilities, Surface water receptors (on/off site drainage channels)	Likely (Human Health Receptors) Unlikely (Controlled Waters)	Medium	**Moderate (Human Health Receptors)** **Very Low (Controlled Waters)**	One of the soil samples tested during the 2019 investigation, taken from TP16 at a depth of 0.8m bgl proved concentrations of asbestos in excess of qualitative (microscopy) laboratory limits of detection. The asbestos comprised loose fibres of Chrysotile and Amosite. During the supplementary investigation, a further two samples, taken from Made Ground in WS104 at a depth of 0.3m to 0.6m bgl, and WS109 between 0.1m and 0.3m bgl recorded the presence of loose fibres of chrysotile and amosite asbestos. Based on the findings, three discrete hotspots of asbestos contamination have been identified at the site, situated toward the northern periphery, adjacent the former residential property (TP16 and WS104), and toward the centre of the site (WS109). The contaminant of concern (asbestos) is not considered significantly mobile in the environment, due to its immiscibility with water. The proposed development involves the construction of residential properties with associated private gardens and access infrastructure. The presence of gardens will enable direct contact between future site occupants and any contamination present. The growth of home-grown produce for consumption is considered possible. Construction workers are likely to come into direct contact with any contamination present, however it is assumed that good working practices including the use of appropriate PPE/RPE, regular hand washing, and other hygiene techniques will be adopted which would reduce the likelihood of long-term exposure.

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk	Comments
On Site: Asbestos Cement Sheet fragments encountered in two (2No.) highly localised areas situated toward the northern, and western peripheries of the site. Asbestos cement sheet fragments identified at the surface, and within Made Ground in the impacted locations.	Direct dermal contact, Inhalation (dust and vapours), Ingestion, Direct contact of structures/ utilities with aggressive ground conditions. Leaching and off-site migration via sparingly permeable soils. Surface runoff to on/off site drainage channels.	Site end users (residential occupants, neighbours, and site visitors), Construction and maintenance workers, Building materials/ utilities, Surface water receptors (on/off site drainage channels)	Likely (Human Health Receptors) Unlikely (Controlled Waters)	Medium	**Moderate (Human Health Receptors)** **Very Low (Controlled Waters)**	Asbestos cement sheet fragments were identified during the 2019 investigation in TP19 (adjacent the former residential property) and TP1 (located toward the western periphery of the site). Excavations undertaken during the supplementary investigation adjacent the impacted locations did not identify asbestos cement sheet fragments. It is therefore anticipated that two small areas of the site have been affected by this contamination. The contaminant of concern (asbestos) is not considered significantly mobile in the environment, due to its immiscibility with water. The proposed development involves the construction of residential properties with associated private gardens and access infrastructure. The presence of gardens will enable direct contact between future site occupants and any contamination present. The growth of home-grown produce for consumption is considered possible. Construction workers are likely to come into direct contact with any contamination present, however it is assumed that good working practices including the use of appropriate PPE/RPE, regular hand washing, and other hygiene techniques will be adopted which would reduce the likelihood of long-term exposure.

7.4 Residual Risks

The supplementary Site Investigation and Revised CSM has further examined and evaluated those plausible contaminant linkages which were identified during previous phases of investigation, and considered to represent a potential risk with respect to the proposed development. In addition, any additional contamination sources, pathways, or receptors which were revealed during the intrusive ground investigation have been identified and evaluated.

Based on the magnitude of harm and the likelihood of a pollutant pathway being established, and the findings of the intrusive investigation it is considered that following redevelopment (in accordance with current proposals), a **Moderate** risk of harm to human health receptors will remain as a result of contamination present within soils at the site.

The risk to controlled waters resulting from contamination at the site following redevelopment was also considered **Moderate**.

8.0 FURTHER RECOMMENDATIONS/PRELIMINARY REMEDIATION STRATEGY

Based on the findings of the updated CSM/Risk Assessment, remediation works will be required in order to address the plausible contamination linkages identified, and residual risks to the proposed development/ end users. The objective of these works will be to ensure that the site is suitable for the proposed development.

Details of the recommended remedial works will be presented within a formal Remediation Strategy document, which will subsequently be produced for the site.

The remedial works could involve the following measures, presented as a Preliminary Remediation Strategy:

- Localised removal and off site disposal of localised hotspots of Made Ground containing lead contamination, and asbestos fibres could be carried out in order to remove the principle sources of soil contamination considered to represent a risk to identified human health and controlled water receptors. Works should be undertaken by a suitably licenced contractor, who should provide a safe system of work prior to commencement. Contaminated materials should be sent for off site disposal at a suitable disposal facility in accordance with current waste management, and control of asbestos (CAR) regulations. Where possible, excavated materials should be loaded directly onto a sheeted/enclosed transport vehicle. If this is not possible, temporary stockpiles should be placed on an impermeable membrane, and protected from the effects of weathering. A bund should be created to prevent runoff. Due to the presence of asbestos fibres, dust suppression measures may be necessary to prevent fibre release, subject to the procedures adopted by the licenced removal contractor. Waste consignment/disposal notes should be collected and retained for inclusion in subsequent Verification Reporting.

- On removal of the contamination hotspots, soils at the base and along the sides of the resulting excavation should be sampled and tested for the contaminants of concern. Where contamination remains, the excavations should be extended unto the soil source has been removed, and sample results complying with appropriate assessment criteria have been received. Completed excavations may be infilled with clean imported soils, which have been subjected to chemical analysis to prove suitability for use on site, given the nature of the proposed development.

- An examination of the existing substrate (‘litter pick’) for the presence of asbestos containing materials (i.e. cement sheet fragments) should be undertaken by a suitably licenced contractor in the two sections of the site where ACM fragments were recorded in 2019. Given the sensitive nature of the proposed development, it is recommended that these works also extend across the remainder of the site, subject to other methods of validation. Asbestos containing materials liberated during this process should be appropriately stored and disposed of in accordance with waste management, and control of asbestos (CAR) regulations. Appropriate PPE/RPE should be utilised during these works, and a safe system of works provided by the appointed contractor prior to commencement.

- Given the previous uses of the site, and the sporadic and discontinuous nature of the contamination identified, it is recommended that a clean cover system (topsoil /subsoil) with a thickness of 450mm is placed within each of the residential gardens. This will provide protection to human health receptors, and provide a suitable growth medium for vegetation. The soils used as part of this system should ideally be screened prior to importation, and should meet both the requirements of British Standard (BS 3882:2015) and GACs appropriate to a residential with plant growth end-use scenario. It is recommended that a brightly coloured geotextile membrane be placed in garden areas prior to the implementation of the overlying clean cover system, to deter excavation by future site users into the original substrate.

- A watching brief should be maintained for contamination throughout the duration of the proposed development. In the event that any unforeseen gross or widespread contamination is encountered on site, an appropriately qualified contaminated land specialist should be contacted immediately.

- Any unexpected contamination encountered during the development should be subject to appropriate management.

- Specialist contractors should be employed as necessary to advise on the management of unexpected contamination.

- Re-use and/or disposal of site won materials/arisings should be undertaken in accordance with current waste management guidance/regulations. Where re-use is proposed, it may be necessary to obtain an Environmental Permit, or to produce a Material Management Plan (MMP) in accordance with the CL:aire Definition of Waste Code of Practice (DoWCoP).

- The local water supplier should be contacted for further details regarding the use of protected potable water pipework at the site. The results provided as part of this report may be sufficient to confirm this requirement, however it may be necessary to undertake supplemental testing depending on the requirements of the utility provider.

- A Verification Report should be produced on completion of the remediation, detailing works undertaken, presenting the results of validation testing, and providing waste consignment/disposal notes as appropriate.

Providing the above recommendations are adopted, it is anticipated that, with respect to the contamination identified during the current and previous phases of investigation, the site will be suitable for it’s intended end use.

9.0 GROUND GAS MONITORING

A programme of ground gas monitoring was undertaken as part of the supplementary site investigation. The programme consisted of 6No. weekly visits, undertaken between 16th May and 27th June 2023 in order to characterise ground gas risks at the site. The monitoring programme included each of the standpipes installed during the supplementary investigation (WS101 to WS112 inclusive) as well as wells installed during the previous investigation undertaken in 2019 which were considered viable following reinstatement (WS1, WS3, WS4, WS5, WS7, WS8, WS10 and WS12).

The gas monitoring certificates are included in Appendix E, and the results are summarised in Table 9.1.

Table 9.1. Ground Gas Monitoring Results 16th May to 27th June 2023

Exploratory Hole	Max CH_4 Conc. (%vol)	Max CO_2 Conc. (%vol)	Min O_2 Conc. (% vol)	Max Flow Rate (l/hr)	Atmospheric Pressure (mb)
WS101	<0.1	11.1	10.6	0.2	1010 to 1032
WS102	<0.1	8.1	12.6	0.1	1010 to 1032
WS103	<0.1	7.1	14.3	0.2	1010 to 1032
WS104	<0.1	4.0	16.2	0.1	1010 to 1032
WS105	<0.1	2.3	18.6	0.2	1010 to 1032
WS106	<0.1	0.8	19.8	0.1	1010 to 1032
WS107	<0.1	0.7	19.7	0.1	1010 to 1032
WS108	<0.1	1.8	19.1	0.2	1010 to 1032
WS109	<0.1	2.6	17.7	0.2	1010 to 1032
WS110	<0.1	6.2	12.6	0.2	1010 to 1032
WS111	<0.1	2.3	18.4	0.3	1010 to 1032
WS112	<0.1	7.1	10.9	0.1	1010 to 1032
WS1	<0.1	9.9	7.9	0.2	1010 to 1032
WS3	<0.1	1.9	17.7	0.1	1010 to 1032
WS4	<0.1	7.8	11.7	0.2	1010 to 1032
WS5	<0.1	2.2	18.0	0.2	1010 to 1032
WS7	0.6	13.6	4.8	0.2	1010 to 1032
WS8	<0.1	2.5	16.7	0.2	1010 to 1032
WS10	<0.1	16.3	5.7	0.2	1010 to 1032
WS12	<0.1	5.7	15.7	0.1	1010 to 1032

Methane was recorded above limits of detection in a single borehole (WS7) during the monitoring programme. The maximum methane concentration recorded in this location (located toward the north-western corner of the site) was 0.6% vol. Carbon dioxide concentrations were moderately elevated in the majority of boreholes. The highest carbon dioxide concentration recorded was 16.3% vol.. The minimum oxygen concentration recorded during the ground gas monitoring programme was 4.8% vol. WS1, WS7 and WS10 consistently recorded O_2 concentrations below 10%

The maximum recorded gas flow rate was 0.3l/hr.

Based on the guidance in BS 8485:2015+A1:2019, a preliminary calculation of the hazardous gas flow rate (Q_{hg}) has been undertaken based on the maximum concentration of a hazardous gas observed on site. In this instance carbon dioxide was the risk driver. For the purpose of the calculation, the flow rate was taken as 0.3l/hr, which was the maximum recorded flow rate during the monitoring programme. The preliminary Q_{hg} estimate is provided below:

Q_{hg} = 0.3 x (16.3/100) = 0.049l/hr

The findings of the site investigation would suggest a worst case Q_{hg} of 0.049 l/hr for the site, which is indicative of Characteristic Situation 1-'Very Low Risk' (CS1). In accordance with the guidance established in CIRIA C665, where recorded carbon dioxide concentrations exceed 5%, an increase to Characteristic Situation 2-'Low Risk' (CS2) is considered appropriate classification with regard to new developments. For developments including low-rise housing with a ventilated underfloor void (referred to as Situation B in C665), the NHBC traffic light system is considered suitable. Using this system, the results of the ground gas monitoring programme are representative of an Amber 1/Amber 2 classification.

Details provided by the client about the proposed development suggest that the buildings would be of 'Type A' (as per Table 3 of the BS8485). On this basis (CS2 or Amber 1/Amber 2 designation, and building Type A) the gas protection score for the site would therefore be '3.5' in accordance with Table 4 of the guidance document.

According to BS8485:2015, this designation requires specific mitigation measures. The exact gas protection measures to be implemented will be subject to building design and approval, however should be in accordance with BS8485:2015, which requires the gas protection score (3.5) to be achieved through a combination of structural barriers, ventilation measures, and/or a gas resistant membrane. Each of the options available within these categories have been awarded a protection score (e.g. a passive sub floor dispersal layer with 'good' performance scores 2.5). A selection of measures should be adopted within the building design, with the sum of the techniques equalling the gas protection score.

Measurements were taken in each standpipe, and during each ground gas monitoring visit using a Photo-ionisation Detector (PID), which measures the presence of volatile organic compounds (VOCs). In general measurements in excess of 50ppm recorded during this monitoring are considered to be sufficiently elevated to warrant further investigation.

None of the PID measurements recorded during the ground gas monitoring programme exceeded 1.5ppm.

10.0 REFERENCES

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Appendix A DRAWINGS

Appendix B LOCAL AUTHORITY (SHDC) CORRESPONDENCE

Appendix C PHOTOGRAPHS

Appendix D EXPLORATORY HOLE LOGS

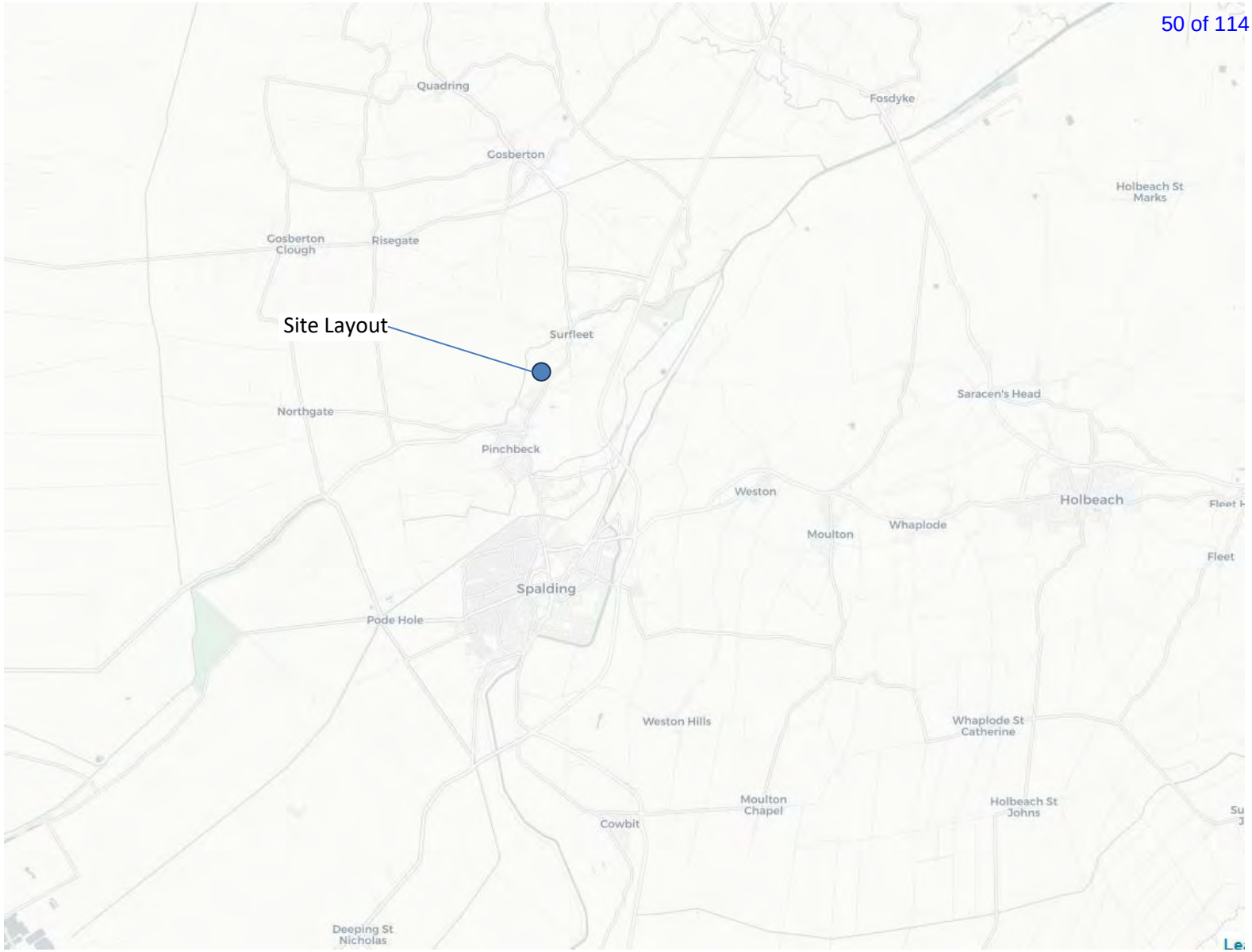
Appendix E GAS/GROUNDWATER MONITORING CERTIFICATES

Appendix F GRANGE GEOCONSULTING LTD METHODOLOGY

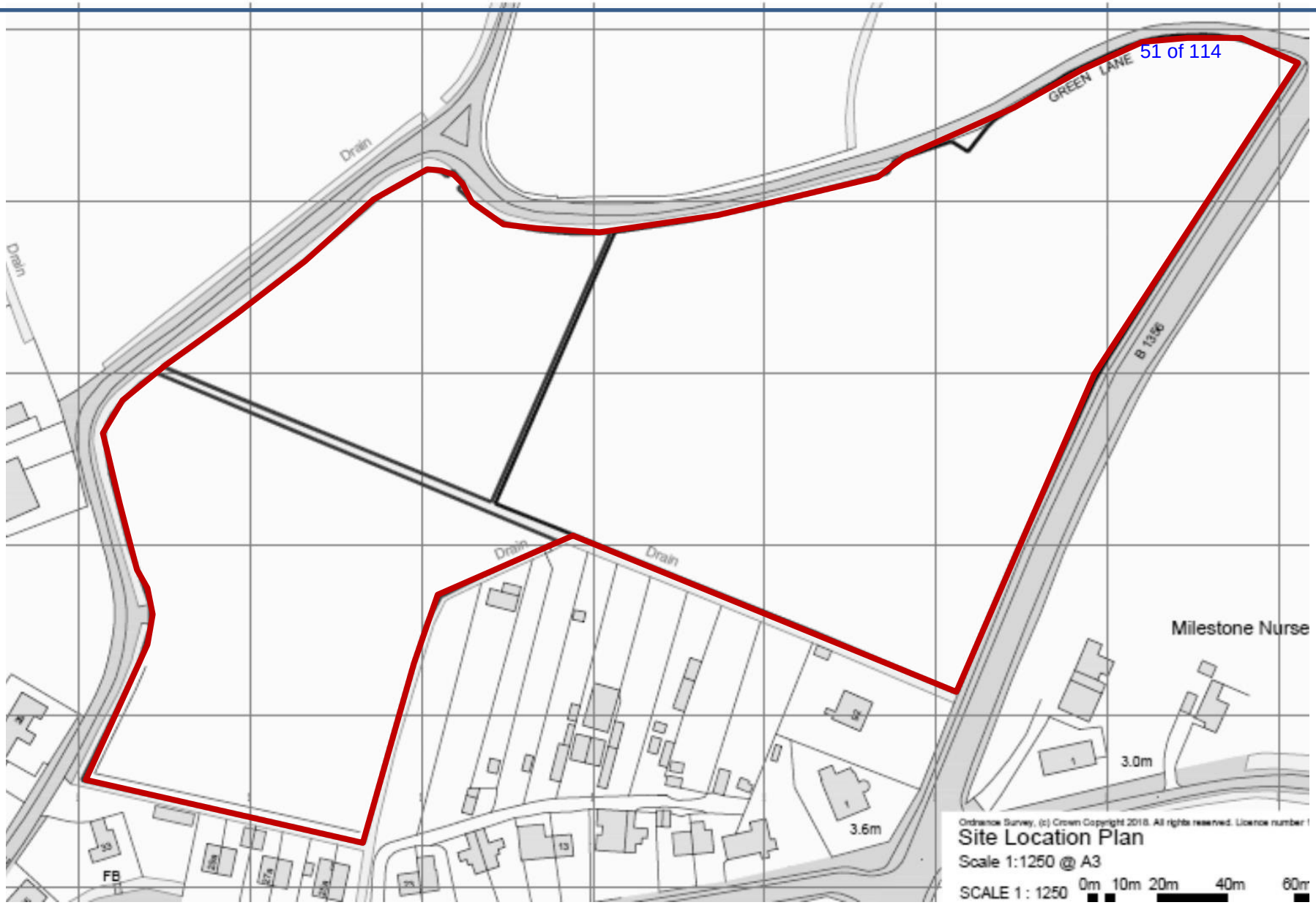
Appendix G CHEMICAL ANALYSIS RESULTS

Appendix A

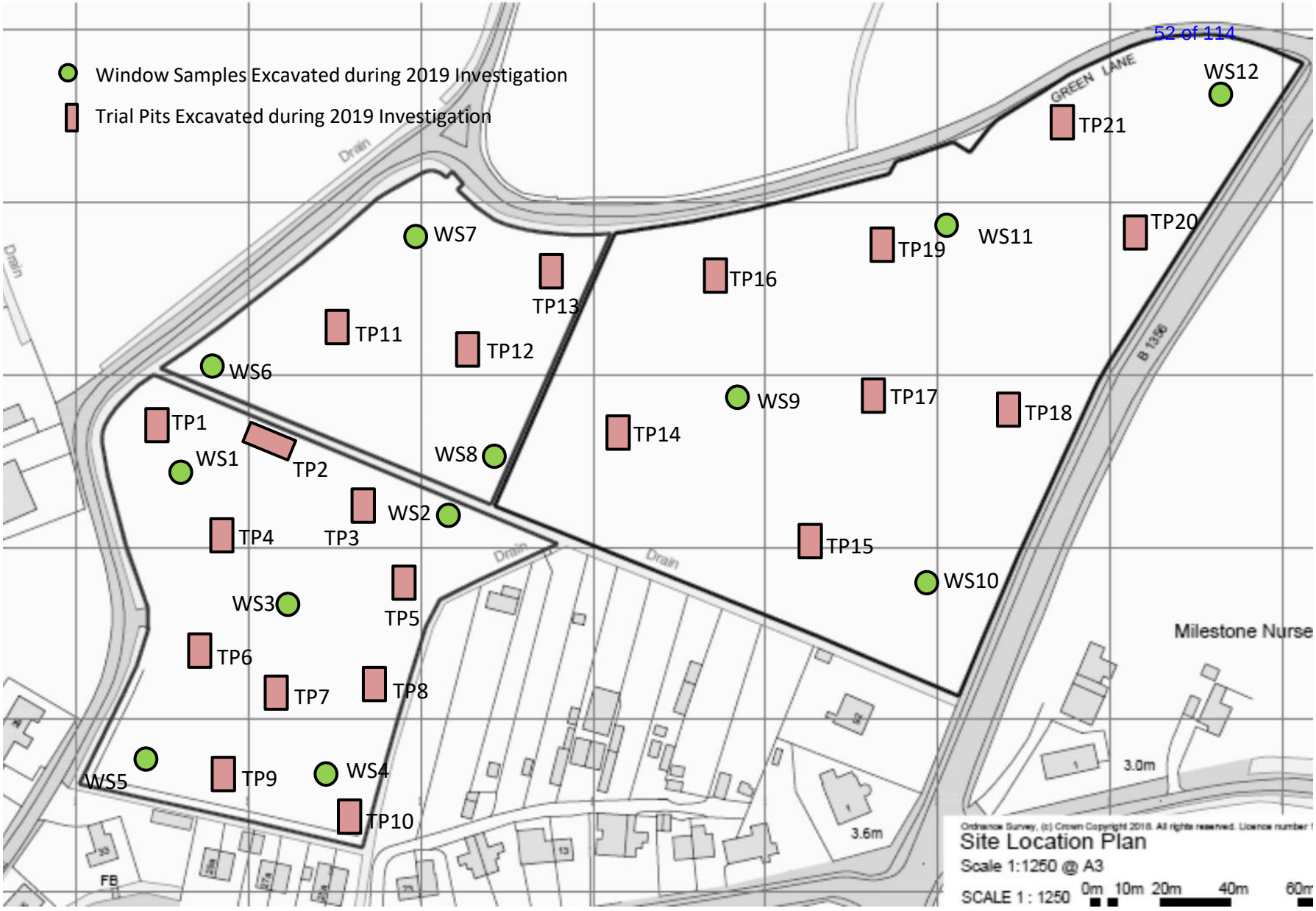
DRAWINGS



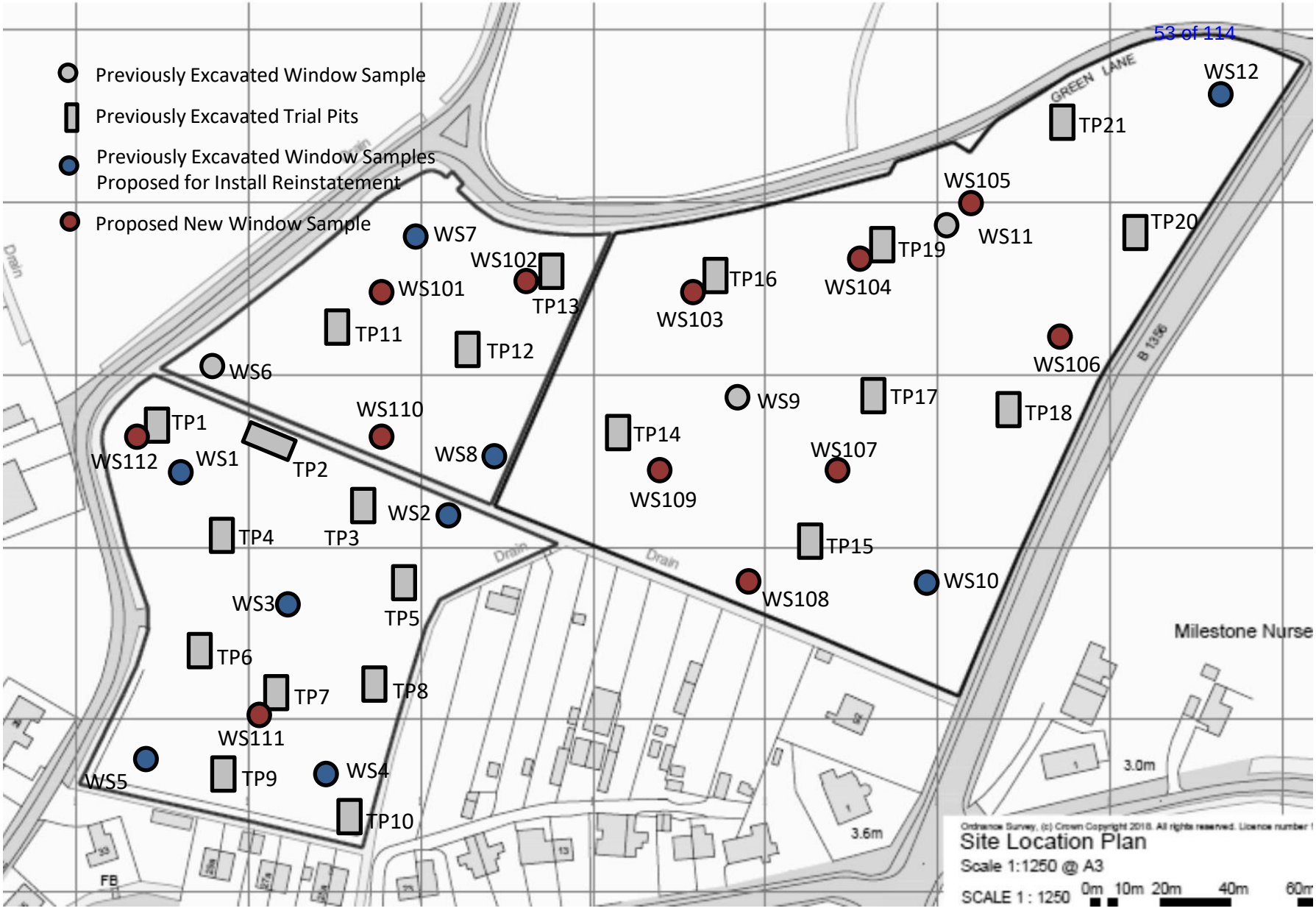
Grange Geo	**Green Lane, Pinchbeck** Site Location Plan	**Date**- July 2023	North	R18012-DWG1



Grange Geo	**Green Lane, Pinchbeck** Site Layout	**Date**- July 2023	North	R18012-DWG2



Grange Geo	**Green Lane, Pinchbeck** 2019 Ground Investigation Excavation Plan	**Date**- July 2023	North R18012-DWG3



Grange Geo	**Green Lane, Pinchbeck** Supplementary Excavation Plan	**Date**- July 2023	North R18012-DWG4

PLAN ANNOTATED BY GORDON 15.4.23

HGV access via gap in hedge

Site Layout Plan

Scale 1:500

SCALE 1 : 500 — 0m 5m 10m 20m 30m 40m 50m

SCALE 1 : 1 — 0m 10mm 20mm 40mm 60mm 80mm 100mm

Public Open Space Area

Total Site Area = 40703 m2

Total POS: 2469 + 825 + 2945 + 110 = 6349 = 15.6%

Area 1

Area 1 was submitted as an outline application on another application.
Reference: H14-0549-17

Surface Water Drainage System

Post flow outfall chamber with flow limiting device, surface water will flow southwards and discharge into the piped IDB drain at the junction of Milestone Lane and Surfleet Road.

Affordable Housing Contribution

Type B - 4 units	
Type C - 4 units	18 total affordable units
Type P - 5 units	=
Type Q - 2 units	29% of 63 plots
Type R - 3 units	

DO NOT SCALE THIS DRAWING. THE CONTRACTOR IS DEEMED TO HAVE CHECKED ALL DIMENSIONS ON SITE AND REPORT ANY DISCREPANCIES TO OGLESBY & LIMB LTD.
THE CONTENTS OF THIS DRAWING ARE COVERED BY COPYRIGHT AND REMAIN THE PROPERTY OF OGLESBY & LIMB LTD. WRITTEN APPROVAL MUST BE OBTAINED FROM OGLESBY & LIMB LTD PRIOR TO DUPLICATION OR REPRODUCTION OF THIS DRAWING OR ITS CONTENTS.
ANY DIMENSIONS NOT SHOWN ARE TO BE CHECKED AND AGREED WITH OGLESBY & LIMB LTD.

Footpath to provide pedestrian access from Green Lane to the estate
14ft gate openings for POS area maintenance vehicles

6 meter clear easement adjacent to watercourse to enable access to the Board's Bacons Lane Drain.
9 meter easement

Area 2
Area 1

play area
POS AREA
2469m2

Soil storage area

Access to be constructed

Hedge adjacent to junction to be managed to ensure visibility

Junction to provide vehicular and pedestrian access from Surfleet Road to the estate

Soil storage area

Dropped kerb to allow surface runoff to drain to the soak away in the POS area

Footpath to provide pedestrian access from Surfleet Road to the estate

Underground surface water storage using geocellular water storage crates

Outfall chamber with flow limiting device

sensory garden
POS AREA
2945m2

POS AREA
110m2

POS AREA
825m2

Refuse Collection

Dwarf wall with iron railing above
Footpath to provide pedestrian access from Bacon's Lane to the estate
Dropped kerb to allow surface runoff to drain to the soak away in the play area
14ft gate openings for dyke and POS area maintenance vehicles

9 meter easement
6 meter clear easement adjacent to watercourse to enable access to the Board's Bacons Lane Drain.

Building Types and Quantities

1 NR.	TYPE A - 3B4P Detached House (135m2)	
6 NR.	TYPE B - 2B3P Semi-detached House Each (74m2)	
6 NR.	TYPE C - 2B3P Semi-detached House Each (74m2)	
2 NR.	TYPE D - 4B5P Detached House (205m2)	
2 NR.	TYPE F - 5B9P Detached House (239m2)	
9 NR.	TYPE G - 5B8P Detached House (193m2)	
6 NR.	TYPE H - 3B5P Detached Bungalow (142m2)	
9 NR.	TYPE J - 2B5P Detached Bungalow (118m2)	
4 NR.	TYPE K - 3B5P Detached House (173m2)	
6 NR.	TYPE L - 2B4P Semi-detached Bungalow Each (82m2)	
1 NR.	TYPE N - 3B4P Detached House (126m2)	
6 NR.	TYPE P - 3B5P Semi-detached House Each (96m2)	
2 NR.	TYPE Q - 1B2P Semi-detached House Each (52m2)	
3 NR.	TYPE R - 2B3P Terrace House Each (74m2)	

= Surface water drainage with arrow depicting direction of flow
AH = Affordable Home
bl = Low Level Lighting Bollards
= Timber Fence
= Timber Fence Between Brick Piers
= Brick Wall
= Low Railing
= Hedge Row

Ref.	Date	Description	Initial
Rev E	12.02.2020	Increase in the size of types: B,C,P,Q and R. Adjustment to the layout of plots: 13,14,15 and 16. Adjustment to POS area. Adjustment to plots 8 and 11.	EJU
Rev D	21.11.2019	Minor adjustment to plot 2 and 3 layout. New type R. Increased allocation of affordable housing to 18 units. Increase in total plots to 63. Adjustment to POS area. Details of Boundary treatment added. Location adjustment to plot 17 and 18. Location adjustment to plot 25,26 and 27.	EJU
Rev C	20.09.2019	Minor changes to layout. Hedgerows removed from easement. New types P and Q. Removal of type M (terrace). Affordable housing allocated.	EJU
Rev A	12.07.2019	Minor changes to layout. Areas changed or affected on original layout: Plots 2,3,4,5,6,11,24,25,32,33,34,35,45,46, 47,48,49,50,51,52,53,54. South East POS area increase New types M and N New drainage strategy	EJU

Oglesby & Limb Ltd
Chartered Architect
Suite 1, Market Chambers
12 Market Place, Spalding, Lincs
PE11 1SL
Tel: 01775 761196
e-mail: design@o-l-ltd.co.uk

Client:
Kirk Homes Ltd

Project:
Proposed Residential Development, Green Lane, Pinchbeck, Lincolnshire PE11 3XT

Drawing Title:
Site Layout Plan
As Proposed
PLANNING APPLICATION ISSUE

Date: JAN 2019	Scale: as shown
Drawn by: EJU	Checked by: AJO

Drawing Number: A1273 - 10
Rev: E

STUDIO 11 ARCHITECTURE



20m 0 20 40 60
1:1000

NOTE: It is proposed that the enabling works and removal of contaminant hotspots take place prior to the relevant 'Construction Phase' rather than at commencement of the site.

Do not scale directly from this drawing. All discrepancies are to be brought to the attention of the below office.

The copyright to this drawing is owned by studio 11 architecture.

The General Contractor is to check all dimensions on site and report discrepancies to the designer.

All details shown on this drawing, including foundations, are based upon typical site conditions related to the area. No responsibility can be accepted for abnormal conditions which may be discovered during construction, unless reported to the designer, so that design amendments may be considered. Site soil surveys are recommended in respect of foundations to establish specific site conditions before foundation work is undertaken.

The details and information shown hereon relating to existing underground drains, main services, cables, etc. and existing structural details, are as obtained by normal survey observation method. Although all reasonable effort has been made, no guarantee can be made or given for the completeness or accuracy of this information.

KEY

- Construction Phase 1 (access off Surfleet Road)
- Construction Phase 2
- Construction Phase 3
- Construction Phase 4
- Construction Phase 5

matrix planning

REVISION	DATE	DRAWN	DESCRIPTION

ISSUE STATUS

STUDIO11 architecture

KING'S LYNN INNOVATION CENTRE,
INNOVATION DRIVE, KING'S LYNN,
PE30 5BY

T: 01553 970033
E: design@studio11architecture.co.uk
W: www.studio11architecture.co.uk

CLIENT R Bratley (Quadring) Ltd

PROJECT Residential development at Land South of Green Lane, Pinchbeck

DRAWING Construction Phasing Plan

DRAWN	PROJECT DESIGNER	PROJECT DIRECTOR
OS	KB	KB

DATE	SCALE	PAPER SIZE
06.06.2023	1:1000	A2

DRAWING NUMBER

#581.CPP.03

ARCHITECTURE

Appendix B

LOCAL AUTHORITY (SHDC) CORRESPONDENCE

steve@grangegeo.co.uk

From: Jeanette Reith <jenviro@outlook.com>
Sent: 18 March 2023 11:00
To: steve@grangegeo.co.uk
Cc: Contaminated Land
Subject: RE: Proposed Next Steps- Green Lane, Pinchbeck H14-0979-22

Dear Steve

Apologies for the delay in my response to you.
Further to our previous discussion I have liaised with my colleague, Sue Armour, in Environmental Protection (who is likely to be assessing the final report) and we are both satisfied with your proposal.
With regards to the seal thickness Sue has stated '*It's generally not recommended to shorten the seal below 1m, but given the situation here I would accept it*'.
I request that all the points raised in my comments of 01 February to the Planning Department are covered by your report.
Finally, any queries relating to the implementation of the planning permission should be directed to the Planning Department as we are unable to comment on this.

Kind regards

Jeanette Reith
Environmental Protection Contractor
South Holland District Council

From: steve@grangegeo.co.uk
Sent: 24 February 2023 14:58
To: jenviro@outlook.com
Cc: Andrew.hare@grangegeo.co.uk; 'Matrix Planning Ltd'
Subject: Proposed Next Steps- Green Lane, Pinchbeck

Hi Jeanette,

Further to our previous discussions regarding the site situated off Green Lane, Pinchbeck, please find attached a drawing which sets out our additional investigation programme.

We would propose the excavation of 12No. new window sample boreholes to depths of approximately 3-4m below ground level (bgl). As well as providing general coverage of the site, we would propose that six of the new excavations be undertaken in areas where previous investigation works have identified potential contamination issues (WS11 (Pb), TP19 (asbestos), TP16 (asbestos, Pb), TP13 (possible former channel), TP7 (Hg), and TP1 (asbestos) , in order to further examine potential associated risks.

A representative soil sample will be taken from each of the new excavations and scheduled for testing at an accredited laboratory, in accordance with current guidance. Soil samples will be tested for a contaminant suite which will include: Arsenic (As), Cadmium (Cd), Hexavalent and Total Chromium (Cr III and VI), Copper (Cu), Lead (Pb), Inorganic Mercury (Hg), Nickel (Ni), Selenium (Se), Vanadium (V), Zinc (Zn), Total Cyanide, pH, Organic Matter, Asbestos Screen, speciated and Total Poly-Aromatic Hydrocarbons (PAH). Additional testing may be undertaken, depending on the findings of the soil analysis, inclusive of asbestos quantification, metal leachability, and bioavailability testing. Given the findings of the previous investigation, which recorded elevated Manganese concentrations within samples of groundwater taken from the site, soil samples will also be tested for this determninand, in order to identify or rule out an on-site soil source for this contamination.

We would propose that each of the new locations be installed with ground gas/groundwater monitoring standpipes. In addition, it is proposed that nine of the original gas/groundwater monitoring positions, installed during the previous Phase 2 investigation be reinstated (where possible). Assuming each of the previous investigation positions are suitable for reinstatement, this will provide 21No. Gas/Groundwater monitoring/sampling positions.

It is noted that during previous investigation works, groundwater was in some locations identified at shallow depths (Ca. 1.0m bgl). We would welcome your thoughts regarding the selection of response zones in these locations. We appreciate that 1m of plain pipework, with a bentonite seal is generally considered a minimum requirement for installations.

Would you consider reductions in this seal thickness acceptable in areas where shallow groundwater is encountered?

We would propose an additional 6-week ground gas monitoring programme, inclusive of PID measurements. Water samples will be collected from each of the newly installed standpipes, and sent for laboratory testing.

The water analysis suite would include: Silver (Ag), Aluminium (Al), Arsenic (As), Boron (B) (water soluble), Barium (Ba), Calcium (Ca), Cadmium (Cd), Hexavalent and Total Chromium (Cr II and VI), Copper (Cu), Iron (Fe), Mercury (Hg), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Sodium (Na), Nickel (Ni), Lead (Pb), Antimony (Sb), Selenium (Se), Tin (Sn), Vanadium (V), Zinc (Zn), Free and Total Cyanide, pH, Sulphate, Total Phenols, Ammonium, Fluoride, Chloride, Bromate, Nitrate, Nitrite and Speciated Poly-Aromatic Hydrocarbons (PAH).

The findings of the investigation will be reported in a supplementary Phase 2 report, within which the potential sources, pathways, and receptors associated with the proposed residential redevelopment of the site will be re-evaluated, the CSM will be updated, and a Risk Assessment carried out.

A new Remediation Strategy will follow, which will address any potential risks identified, and present proposals for remedial works to ensure that the site is suitable for its intended end use.

For purpose of context, we would also make you aware that the project team is currently aiming to implement the existing Planning Permission by constructing a short access road onto the site with connection to Surfleet Road (which delineates the eastern boundary). This road will extend approximately 35m into the site and will possess a temporary granite top surface. These works will not prejudice the additional investigation programme described above, nor any subsequent remedial works, and indeed will be necessary to enable plant access to the site in support of future remediation works. You may receive correspondence to this effect from our planning consultant, and/or your colleagues at ELDC.

We would very much appreciate your thoughts with regard to this proposed programme of works, which we hope will address any and all concerns regarding contamination at the site.

Kind Regards

Grange Geo
Geotechnical & Environmental Specialists

Steve Woodall
BSc FGS MCIWEM
Consultant

Tel: 07800 646691
www.grangegeo.co.uk
Steve@grangegeo.co.uk

Appendix C

PHOTOGRAPHS









Grange Geo	**Green Lane, Pinchbeck** Photo Record	**Date**- July 2023		R18012-Appendix C





Appendix D

EXPLORATORY HOLE LOGS

Window Sample Log

WS No: 101

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
-0.1	ES		Topsoil, brown, clayey, sandy, SILT.		
0.5			Firm, brown and orange brown mottled, slightly sandy, silty CLAY.		
0.5-0.7	D		(Tidal Flat Deposits)		
			PEAT.		
1.0	SPT	N=9	(Tidal Flat Deposits)		
			Loose, grey, silty, fine SAND.		
			(Tidal Flat Deposits)		
1.5					
2.0	SPT	N=6			
3.0	SPT	N=11			
			End of borehole.		

General Comments:

1. Excavation terminated at 3.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: 102

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
0.1-0.3	ES		Made Ground, dark brown and brown mottled, slightly sandy, slightly gravelly, silty, CLAY. Gravels of fine to medium, angular to sub rounded brick, flint, sandstone and concrete.		
0.5					
0.6	D		Yellow brown, silty, fine SAND. (Tiodal Flat Deposits)		
1.0	SPT	N=16	Brown, organic rich silty CLAY. (Tiodal Flat Deposits)		
			Loose, grey, silty, fine SAND. (Tiodal Flat Deposits)		
1.5					
2.0	SPT	N=4			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: **103**

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, brown, slightly sandy, slightly gravelly, silty CLAY. Gravels of fine to course, angular to sub rounded, brick, limestone, concrete and rare plastic.		
0.5					
0.8	ES				
1.0	SPT	N=7			
			Loose, grey, silty, fine SAND.		
1.4	D		(Tidal Flat Deposits)		
1.5					
2.0	SPT	N=4			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:

Date: 26/04/2023

Logged by: AH

Checked:

Job No: R18102

Window Sample Log

WS No: **104**

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, brown, slightly sandy, gravelly, CLAY. Gravels of medium to coarse, angular to sub rounded, brick, concrete and flint.		
0.5					
			Firm, grey and orange brown mottled, slightly sandy, silty, CLAY. (Tidal Flat Deposits)		
1.0	SPT	N=12			
			Medium dense, grey brown, silty, fine SAND. (Tidal Flat Deposits)		
1.5					
2.0	SPT	N=8			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:

Date: 26/04/2023

Logged by: AH

Checked:

Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: 105

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, brown, silty CLAY with rare brick gravel.		
0.5			Brown and orange brown mottled, slightly clayey, sandy, SILT. (Tidal Flat Deposits)		
1.0	SPT	N=13	Medium dense, light brown, silty, fine SAND. (Tidal Flat Deposits)		
1.5					
2.0	SPT	N=10			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: 106

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Topsoil, brown, clayey, sandy, SILT.		
0.5			Yellow brown and orange brown mottled, slightly clayey, silty SAND. (Tidal Flat Deposits)		
1.0	SPT	N=14	Medium dense, light brown, silty, fine SAND. (Tidal Flat Deposits)		
1.5					
2.0	SPT	N=7			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Window Sample Log

WS No: **107**

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Topsoil, brown, clayey, sandy, SILT.		
0.5			Grey brown and yellow brown mottled, very sandy SILT. (Tidal Flat Deposits)		
1.0	SPT	N=12	Medium dense, light brown, silty, fine SAND. (Tidal Flat Deposits)		
1.5					
2.0	SPT	N=7			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:

Date: 26/04/2023

Logged by: AH

Checked:

Job No: R18102

Window Sample Log

WS No: 108

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Topsoil, dark brown, sandy, silty CLAY.		
0.5			Loose, light brown, silty, fine SAND. (Tidal Flat Deposits)		
			0.80 becoming slightly silty.		
1.0	SPT	N=9			
1.5					
2.0	SPT	N=4			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: 109

Client:
Project: Pinchbeck, Spalding

Sheet: 1 of 1
Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, slightly sandy, slightly gravelly, CLAY. Gravels of fine to coarse, angular to sub rounded, brick, flint, sandstone and rare ash.		
0.5			Light brown and grey mottled, silty, fine SAND. (Tidal Flat Deposits)		
1.0	SPT	N=13			
			Medium dense, to loose, grey brown, fine, SAND., (Tidal Flat Deposits)		
1.5					
2.0	SPT	N=4			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 26/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Window Sample Log

WS No: 110

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Topsoil, brown, clayey, sandy, SILT.		
0.5			Grey brown, silty, fine SAND. (Tidal Flat Deposits)		
1.0	SPT	N=16	Stiff, dark brown, organic CLAY. (Tidal Flat Deposits)		
			Grey, silty CLAY with abundant fine shell fragments. (Tidal Flat Deposits)		
1.5			Grey brown, slightly silty, fine SAND. (Tidal Flat Deposits)		
2.0	SPT	N=9	End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:

Date: 26/04/2023

Logged by: AH

Checked:

Job No: R18102

Window Sample Log

WS No: 111

Client:
Project: Pinchbeck, Spalding

Sheet: 1 of 1
Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, brown, slightly gravelly, silty, CLAY. Gravels of brick and rare plastic.		
0.5					
1.0	SPT	N=0			
			PEAT (Tidal Flat Deposits)		
1.5			Grey, silty, fine SAND.		
2.0	SPT	N=8			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 27/04/2023
Logged by: AH
Checked:
Job No: R18102

Window Sample Log

WS No: 112

Client:

Sheet: 1 of 1

Project: Pinchbeck, Spalding

Method: Window Sampling

Sample Depth (m)	Sample Type	Testing result	Description	Depth mBGL	Legend
			Made Ground, brown, slightly gravelly, silty, CLAY. Gravels of brick and rare plastic.		
0.5					
			Made Ground, brown, slightly gravelly, organic CLAY with occasional plastic fragments.		
1.0	SPT	N=6	PEAT (Tidal Flat Deposits)		
1.5			Grey, silty, fine SAND.		
2.0	SPT	N=3			
			End of borehole.		

General Comments:

1. Excavation terminated at 2.0m
2. Water strike at approximately 2m based on material observations.
3. Standpipe installed to 1.0m, response zone 0.5m-1m bgl.

Scale:
Date: 27/04/2023
Logged by: AH
Checked:
Job No: R18102

Grange Geo Consulting Ltd

Appendix E

GAS/GROUNDWATER MONITORING CERTIFICATES

E S S

Environmental Site Sampling Ltd

16th May 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6481

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 16th May 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS
Environmental Site Sampling Ltd

In-situ Analysis: GGE/6481

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

16/05/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	<0.1	0.06	0.7	<0.1	<0.1	<2	<2	5.8	5.8	15.2	15.2	<1	<1	Dry 0.91m	0.91m
WS 102	<0.1	0.08	0.8	<0.1	<0.1	<2	<2	2.8	2.8	17.6	17.6	<1	<1	Dry 0.83m	0.83m
WS 103	0.1	0.12	0.6	<0.1	<0.1	<2	<2	4.5	4.5	16.1	16.1	<1	<1	Dry 0.98m	0.98m
WS 104	0.1	0.11	0.3	<0.1	<0.1	<2	<2	3.4	3.4	17.3	17.3	<1	<1	Dry 0.95m	0.95m
WS 105	0.2	0.22	0.7	<0.1	<0.1	<2	<2	1.3	1.3	19.8	19.8	<1	<1	Dry 0.82m	0.82m
WS 106	0.1	0.14	0.8	<0.1	<0.1	<2	<2	0.2	0.2	20.1	20.1	<1	<1	Dry 0.93m	0.93m
WS 107	<0.1	0.08	1.4	<0.1	<0.1	<2	<2	0.5	0.5	20.0	20.0	<1	<1	Dry 0.94m	0.94m
WS 108	0.2	0.24	1.2	<0.1	<0.1	<2	<2	0.6	0.6	20.1	20.1	<1	<1	Dry 0.93m	0.93m
WS 109	0.1	0.19	1.6	<0.1	<0.1	<2	<2	1.6	1.6	19.1	19.1	<1	<1	Dry 0.98m	0.98m
WS 110	0.1	0.17	0.9	<0.1	<0.1	<2	<2	1.9	1.9	18.7	18.7	<1	<1	Dry 0.83m	0.83m
WS 111	0.1	0.19	0.7	<0.1	<0.1	<2	<2	2.3	2.3	18.6	18.6	<1	<1	Dry 0.81m	0.81m
WS 112	0.1	0.18	0.4	<0.1	<0.1	<2	<2	6.2	6.2	12.9	12.9	<1	<1	Dry 0.78m	0.78m
WS 1	0.1	0.14	1.4	<0.1	<0.1	<2	<2	9.9	9.9	7.9	7.9	<1	<1	1.25m	1.78m
WS 3	<0.1	0.08	0.2	<0.1	<0.1	<2	<2	0.8	0.8	19.6	19.6	<1	<1	1.24m	2.64m
WS 4	<0.1	0.07	0.3	<0.1	<0.1	<2	<2	5.7	5.7	12.2	12.2	<1	<1	1.10m	2.21m
WS 5	0.2	0.24	0.3	<0.1	<0.1	<2	<2	2.2	2.2	18.2	18.2	<1	<1	1.05m	2.47m
WS 7	0.1	0.11	0.1	0.6	0.6	12	12	6.9	6.9	13.4	13.4	<1	<1	1.01m	2.76m
WS 8	<0.1	0.06	0.5	<0.1	<0.1	<2	<2	2.4	2.4	18.5	18.5	<1	<1	1.63m	2.54m
WS 10	0.2	0.26	0.1	<0.1	<0.1	<2	<2	8.8	8.8	10.2	10.2	<1	<1	1.34m	2.83m
WS 12	0.1	0.12	0.2	<0.1	<0.1	<2	<2	3.8	3.8	16.1	16.1	<1	<1	1.27m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6481

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	16th May 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1024mb
Atmospheric Pressure On-site (mb):	1026mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1026mb
Weather During Visit:	Sunny, Dry, Wind NE, 4m/s, 12°C
Comments:	

E S S

Environmental Site Sampling Ltd

24th May 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6487

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 24th May 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS
Environmental Site Sampling Ltd

In-situ Analysis: GGE/6487

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

24/05/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	<0.1	0.05	0.6	<0.1	<0.1	<2	<2	8.1	8.1	12.6	12.6	<1	<1	Dry 0.91m	0.91m
WS 102	0.1	0.12	0.3	<0.1	<0.1	<2	<2	5.4	5.4	14.2	14.2	<1	<1	Dry 0.83m	0.83m
WS 103	0.2	0.21	0.4	<0.1	<0.1	<2	<2	5.8	5.8	14.6	14.6	<1	<1	Dry 0.98m	0.98m
WS 104	<0.1	0.04	1.0	<0.1	<0.1	<2	<2	3.7	3.7	17.1	17.1	<1	<1	Dry 0.95m	0.95m
WS 105	0.1	0.10	0.7	<0.1	<0.1	<2	<2	1.6	1.6	19.3	19.3	<1	<1	Dry 0.82m	0.82m
WS 106	0.1	0.16	0.3	<0.1	<0.1	<2	<2	0.3	0.3	20.0	20.0	<1	<1	Dry 0.93m	0.93m
WS 107	<0.1	0.03	1.0	<0.1	<0.1	<2	<2	0.6	0.6	19.8	19.8	<1	<1	Dry 0.94m	0.94m
WS 108	0.1	0.13	0.9	<0.1	<0.1	<2	<2	0.8	0.8	19.4	19.4	<1	<1	Dry 0.93m	0.93m
WS 109	<0.1	0.06	1.1	<0.1	<0.1	<2	<2	1.7	1.7	18.9	18.9	<1	<1	Dry 0.98m	0.98m
WS 110	0.1	0.14	0.4	<0.1	<0.1	<2	<2	2.6	2.6	17.4	17.4	<1	<1	Dry 0.83m	0.83m
WS 111	<0.1	0.03	0.6	<0.1	<0.1	<2	<2	2.1	2.1	18.4	18.4	<1	<1	Dry 0.81m	0.81m
WS 112	<0.1	0.07	1.2	<0.1	<0.1	<2	<2	6.4	6.4	13.8	13.8	<1	<1	Dry 0.78m	0.78m
WS 1	0.2	0.23	1.5	<0.1	<0.1	<2	<2	6.1	6.1	12.9	12.9	<1	<1	1.35m	1.78m
WS 3	<0.1	0.01	0.4	<0.1	<0.1	<2	<2	0.9	0.9	19.4	19.4	<1	<1	1.31m	2.64m
WS 4	<0.1	0.04	0.1	<0.1	<0.1	<2	<2	5.9	5.9	11.7	11.7	<1	<1	1.12m	2.21m
WS 5	0.2	0.22	0.4	<0.1	<0.1	<2	<2	1.8	1.8	18.0	18.0	<1	<1	1.09m	2.47m
WS 7	<0.1	0.05	1.1	0.2	0.2	4	4	3.9	3.9	16.3	16.3	<1	<1	1.16m	2.76m
WS 8	0.2	0.26	0.2	<0.1	<0.1	<2	<2	2.2	2.2	18.2	18.2	<1	<1	1.65m	2.54m
WS 10	0.1	0.17	1.4	<0.1	<0.1	<2	<2	9.9	9.9	6.7	6.7	<1	<1	1.45m	2.83m
WS 12	0.1	0.14	0.3	<0.1	<0.1	<2	<2	3.6	3.6	15.8	15.8	<1	<1	1.51m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6487

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	24th May 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1026mb
Atmospheric Pressure On-site (mb):	1028mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1024mb
Weather During Visit:	Sunny, Dry, Wind NW, 2m/s, 17°C
Comments:	

E S S

Environmental Site Sampling Ltd

6th June 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6491

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 6th June 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6491

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

06/06/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	0.1	0.12	0.4	<0.1	<0.1	<2	<2	9.4	9.4	12.3	12.3	<1	<1	Dry 0.91m	0.91m
WS 102	<0.1	0.04	0.3	<0.1	<0.1	<2	<2	5.9	5.9	12.9	12.9	<1	<1	Dry 0.83m	0.83m
WS 103	<0.1	0.02	0.6	<0.1	<0.1	<2	<2	5.1	5.1	14.9	14.9	<1	<1	Dry 0.98m	0.98m
WS 104	<0.1	0.05	1.2	<0.1	<0.1	<2	<2	3.1	3.1	16.2	16.2	<1	<1	Dry 0.95m	0.95m
WS 105	0.2	0.21	0.4	<0.1	<0.1	<2	<2	2.3	2.3	18.6	18.6	<1	<1	Dry 0.82m	0.82m
WS 106	0.1	0.14	0.5	<0.1	<0.1	<2	<2	0.1	0.1	20.1	20.1	<1	<1	Dry 0.93m	0.93m
WS 107	<0.1	0.09	1.4	<0.1	<0.1	<2	<2	0.7	0.7	19.8	19.8	<1	<1	Dry 0.94m	0.94m
WS 108	0.1	0.15	0.6	<0.1	<0.1	<2	<2	1.3	1.3	19.7	19.7	<1	<1	Dry 0.93m	0.93m
WS 109	<0.1	0.07	0.9	<0.1	<0.1	<2	<2	2.2	2.2	18.0	18.0	<1	<1	Dry 0.98m	0.98m
WS 110	<0.1	0.09	0.2	<0.1	<0.1	<2	<2	3.4	3.4	17.3	17.3	<1	<1	Dry 0.83m	0.83m
WS 111	0.3	0.34	0.3	<0.1	<0.1	<2	<2	1.6	1.6	18.9	18.9	<1	<1	Dry 0.81m	0.81m
WS 112	0.1	0.12	0.1	<0.1	<0.1	<2	<2	6.7	6.7	12.3	12.3	<1	<1	Dry 0.78m	0.78m
WS 1	0.2	0.22	0.9	<0.1	<0.1	<2	<2	6.4	6.4	11.9	11.9	<1	<1	1.57m	1.78m
WS 3	<0.1	0.06	0.7	<0.1	<0.1	<2	<2	1.1	1.1	19.6	19.6	<1	<1	1.51m	2.64m
WS 4	0.1	0.11	0.3	<0.1	<0.1	<2	<2	3.6	3.6	12.8	12.8	<1	<1	1.33m	2.21m
WS 5	<0.1	0.07	0.6	<0.1	<0.1	<2	<2	2.1	2.1	18.6	18.6	<1	<1	1.34m	2.47m
WS 7	0.2	0.23	0.7	0.4	0.4	8	8	4.2	4.2	16.1	16.1	<1	<1	1.36m	2.76m
WS 8	0.1	0.16	1.1	<0.1	<0.1	<2	<2	2.1	2.1	18.4	18.4	<1	<1	1.90m	2.54m
WS 10	<0.1	0.04	0.9	<0.1	<0.1	<2	<2	9.8	9.8	6.4	6.4	<1	<1	1.54m	2.83m
WS 12	0.1	0.12	1.3	<0.1	<0.1	<2	<2	3.4	3.4	16.1	16.1	<1	<1	1.39m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6491

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	6th June 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1030mb
Atmospheric Pressure On-site (mb):	1032mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1025mb
Weather During Visit:	Overcast, Drizzle, Wind NE, 4m/s, 14°C
Comments:	

E S S

Environmental Site Sampling Ltd

13th June 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6496

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 13th June 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6496

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

13/06/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	0.2	0.26	0.3	<0.1	<0.1	<2	<2	9.6	9.6	11.8	11.8	<1	<1	Dry 0.91m	0.91m
WS 102	<0.1	0.04	0.6	<0.1	<0.1	<2	<2	7.1	7.1	12.9	12.9	<1	<1	Dry 0.83m	0.83m
WS 103	0.1	0.12	0.5	<0.1	<0.1	<2	<2	4.7	4.7	16.3	16.3	<1	<1	Dry 0.98m	0.98m
WS 104	<0.1	0.07	0.4	<0.1	<0.1	<2	<2	4.0	4.0	17.4	17.4	<1	<1	Dry 0.95m	0.95m
WS 105	0.1	0.13	0.9	<0.1	<0.1	<2	<2	1.6	1.6	19.2	19.2	<1	<1	Dry 0.82m	0.82m
WS 106	<0.1	0.07	0.6	<0.1	<0.1	<2	<2	0.5	0.5	19.9	19.9	<1	<1	Dry 0.93m	0.93m
WS 107	0.1	0.12	0.4	<0.1	<0.1	<2	<2	0.6	0.6	19.8	19.8	<1	<1	Dry 0.94m	0.94m
WS 108	<0.1	0.06	0.7	<0.1	<0.1	<2	<2	1.4	1.4	19.4	19.4	<1	<1	Dry 0.93m	0.93m
WS 109	0.1	0.12	0.3	<0.1	<0.1	<2	<2	2.6	2.6	17.7	17.7	<1	<1	Dry 0.98m	0.98m
WS 110	0.2	0.23	0.4	<0.1	<0.1	<2	<2	4.4	4.4	15.3	15.3	<1	<1	Dry 0.83m	0.83m
WS 111	<0.1	0.06	0.2	<0.1	<0.1	<2	<2	1.3	1.3	19.2	19.2	<1	<1	Dry 0.81m	0.81m
WS 112	<0.1	0.05	0.4	<0.1	<0.1	<2	<2	6.4	6.4	11.8	11.8	<1	<1	Dry 0.78m	0.78m
WS 1	0.1	0.11	1.1	<0.1	<0.1	<2	<2	5.7	5.7	12.3	12.3	<1	<1	1.59m	1.78m
WS 3	0.1	0.16	0.7	<0.1	<0.1	<2	<2	1.4	1.4	19.1	19.1	<1	<1	1.52m	2.64m
WS 4	0.2	0.21	0.3	<0.1	<0.1	<2	<2	3.9	3.9	11.7	11.7	<1	<1	1.36m	2.21m
WS 5	<0.1	0.04	0.8	<0.1	<0.1	<2	<2	1.8	1.8	18.8	18.8	<1	<1	1.99m	2.47m
WS 7	0.1	0.13	0.9	0.2	0.2	4	4	10.3	10.3	9.2	9.2	<1	<1	1.44m	2.76m
WS 8	<0.1	0.05	0.3	<0.1	<0.1	<2	<2	2.3	2.3	17.7	17.7	<1	<1	2.01m	2.54m
WS 10	<0.1	0.03	0.3	<0.1	<0.1	<2	<2	14.7	14.7	6.3	6.3	<1	<1	1.58m	2.83m
WS 12	<0.1	0.05	0.2	<0.1	<0.1	<2	<2	5.3	5.3	15.7	15.7	<1	<1	1.82m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6496

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	13th June 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1015mb
Atmospheric Pressure On-site (mb):	1018mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1017mb
Weather During Visit:	Sunny, Dry, Wind E, 2m/s, 21°C
Comments:	

E S S

Environmental Site Sampling Ltd

20th June 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6502

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 20th June 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6502

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

20/06/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	<0.1	0.04	0.8	<0.1	<0.1	<2	<2	11.1	11.1	10.6	10.6	<1	<1	Dry 0.91m	0.91m
WS 102	0.1	0.16	0.6	<0.1	<0.1	<2	<2	7.9	7.9	12.8	12.8	<1	<1	Dry 0.83m	0.83m
WS 103	<0.1	0.04	0.2	<0.1	<0.1	<2	<2	5.1	5.1	15.4	15.4	<1	<1	Dry 0.98m	0.98m
WS 104	<0.1	0.06	0.3	<0.1	<0.1	<2	<2	3.8	3.8	18.1	18.1	<1	<1	Dry 0.95m	0.95m
WS 105	0.2	0.24	0.7	<0.1	<0.1	<2	<2	1.3	1.3	19.3	19.3	<1	<1	Dry 0.82m	0.82m
WS 106	0.1	0.15	0.6	<0.1	<0.1	<2	<2	0.6	0.6	20.0	20.0	<1	<1	Dry 0.93m	0.93m
WS 107	<0.1	0.04	0.3	<0.1	<0.1	<2	<2	0.7	0.7	19.8	19.8	<1	<1	Dry 0.94m	0.94m
WS 108	0.1	0.11	0.6	<0.1	<0.1	<2	<2	1.8	1.8	19.2	19.2	<1	<1	Dry 0.93m	0.93m
WS 109	0.2	0.26	0.3	<0.1	<0.1	<2	<2	2.1	2.1	18.2	18.2	<1	<1	Dry 0.98m	0.98m
WS 110	0.1	0.07	0.2	<0.1	<0.1	<2	<2	5.7	5.7	14.1	14.1	<1	<1	Dry 0.83m	0.83m
WS 111	<0.1	0.04	0.6	<0.1	<0.1	<2	<2	1.6	1.6	18.9	18.9	<1	<1	Dry 0.81m	0.81m
WS 112	<0.1	0.07	0.4	<0.1	<0.1	<2	<2	7.1	7.1	10.9	10.9	<1	<1	Dry 0.78m	0.78m
WS 1	0.1	0.14	1.3	<0.1	<0.1	<2	<2	5.5	5.5	11.6	11.6	<1	<1	1.57m	1.78m
WS 3	<0.1	0.09	0.6	<0.1	<0.1	<2	<2	1.6	1.6	18.8	18.8	<1	<1	1.59m	2.64m
WS 4	0.2	0.21	1.0	<0.1	<0.1	<2	<2	7.8	7.8	12.4	12.4	<1	<1	1.49m	2.21m
WS 5	0.1	0.12	0.8	<0.1	<0.1	<2	<2	1.7	1.7	18.9	18.9	<1	<1	2.01m	2.47m
WS 7	0.1	0.14	0.9	0.3	0.3	6	6	13.6	13.6	4.8	4.8	<1	<1	1.51m	2.76m
WS 8	<0.1	0.02	0.6	<0.1	<0.1	<2	<2	2.2	2.2	17.1	17.1	<1	<1	2.06m	2.54m
WS 10	0.2	0.24	0.8	<0.1	<0.1	<2	<2	16.3	16.3	5.7	5.7	<1	<1	1.69m	2.83m
WS 12	0.1	0.17	1.1	<0.1	<0.1	<2	<2	5.7	5.7	15.9	15.9	<1	<1	1.81m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6502

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	20th June 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1006mb
Atmospheric Pressure On-site (mb):	1010mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1011mb
Weather During Visit:	Overcast, Dry, Wind SW, 4m/s, 17°C
Comments:	

E S S

Environmental Site Sampling Ltd

27th June 2023

Environmental Site Sampling Ltd
94 Dillotford Avenue
Styvechale
Coventry
CV3 5DU

Tel : (024) 7669 0514
Mobile : 07971 664 118

e.mail: cosgrove_patrick@hotmail.com

Mr S Woodall
Grange Geo
43 Winchilsea Avenue
Newark-on-Trent
NG24 4AD

In-situ Analysis Report: GGE/6508

Dear Mr Woodall,

Please find enclosed a copy of the in-situ ground gas and vapour analysis undertaken at Green Lane, Pinchbeck, on 27th June 2023.

I trust you find these satisfactory. Should you have any queries please contact us.

Yours Sincerely,

Patrick Cosgrove

P V Cosgrove BSc MSc
Environmental Site Sampling Ltd

ESS
Environmental Site Sampling Ltd

In-situ Analysis: GGE/6508

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

27/06/23

Borehole	Gas Flow (l/hr)	Borehole Pressure (mb)	PID VOC (ppm)	Methane (%vol)		Methane (%LEL)		Carbon Dioxide (%vol)		Oxygen (%vol)		Other Gases (ppm)		Water Level (Meters)	Install Depth (Meters)
			Peak	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	H_2S	CO		
WS 101	0.1	0.14	1.1	<0.1	<0.1	<2	<2	10.4	10.4	10.9	10.9	<1	<1	Dry 0.91m	0.91m
WS 102	0.1	0.14	0.6	<0.1	<0.1	<2	<2	8.1	8.1	12.6	12.6	<1	<1	Dry 0.83m	0.83m
WS 103	<0.1	0.06	0.3	<0.1	<0.1	<2	<2	7.1	7.1	14.3	14.3	<1	<1	Dry 0.98m	0.98m
WS 104	0.1	0.05	0.7	<0.1	<0.1	<2	<2	2.8	2.8	18.7	18.7	<1	<1	Dry 0.95m	0.95m
WS 105	0.2	0.22	0.4	<0.1	<0.1	<2	<2	1.5	1.5	19.6	19.6	<1	<1	Dry 0.82m	0.82m
WS 106	0.1	0.14	0.2	<0.1	<0.1	<2	<2	0.8	0.8	19.8	19.8	<1	<1	Dry 0.93m	0.93m
WS 107	<0.1	0.06	0.5	<0.1	<0.1	<2	<2	0.7	0.7	19.7	19.7	<1	<1	Dry 0.94m	0.94m
WS 108	<0.1	0.04	0.2	<0.1	<0.1	<2	<2	1.2	1.2	19.1	19.1	<1	<1	Dry 0.93m	0.93m
WS 109	0.1	0.16	0.1	<0.1	<0.1	<2	<2	2.6	2.6	18.0	18.0	<1	<1	Dry 0.98m	0.98m
WS 110	<0.1	0.07	0.3	<0.1	<0.1	<2	<2	6.2	6.2	12.6	12.6	<1	<1	Dry 0.83m	0.83m
WS 111	<0.1	0.02	0.6	<0.1	<0.1	<2	<2	0.9	0.9	19.5	19.5	<1	<1	Dry 0.81m	0.81m
WS 112	0.1	0.10	0.4	<0.1	<0.1	<2	<2	6.3	6.3	11.6	11.6	<1	<1	Dry 0.78m	0.78m
WS 1	<0.1	0.08	0.3	<0.1	<0.1	<2	<2	4.8	4.8	11.9	11.9	<1	<1	1.57m	1.78m
WS 3	0.1	0.14	0.9	<0.1	<0.1	<2	<2	1.9	1.9	17.7	17.7	<1	<1	1.61m	2.64m
WS 4	0.2	0.23	0.3	<0.1	<0.1	<2	<2	6.8	6.8	14.2	14.2	<1	<1	1.50m	2.21m
WS 5	0.2	0.21	0.2	<0.1	<0.1	<2	<2	1.2	1.2	18.7	18.7	<1	<1	1.99m	2.47m
WS 7	0.1	0.11	0.9	0.2	0.2	4	4	12.7	12.7	6.9	6.9	<1	<1	1.59m	2.76m
WS 8	<0.1	0.02	0.1	<0.1	<0.1	<2	<2	2.5	2.5	16.7	16.7	<1	<1	2.09m	2.54m
WS 10	0.2	0.26	0.6	<0.1	<0.1	<2	<2	15.8	15.8	6.1	6.1	<1	<1	1.68m	2.83m
WS 12	<0.1	0.04	0.6	<0.1	<0.1	<2	<2	5.3	5.3	16.5	16.5	<1	<1	1.96m	2.01m

Notes:
Monitoring order is from left to right.
Steady concentrations are measured up to 3 minutes.

E S S

Environmental Site Sampling Ltd

In-situ Analysis: GGE/6508

Client: Grange Geo
Project: R18012, Green Lane, Pinchbeck

Additional Information	
Date Monitoring Undertaken:	27th June 2023
Monitoring Undertaken By:	P Cosgrove
Equipment Used:	GA2000+ S/N 11567
Atmospheric Pressure Pinchbeck a.m. (mb):	1020mb
Atmospheric Pressure On-site (mb):	1021mb
Atmospheric Pressure Pinchbeck p.m. (mb):	1017mb
Weather During Visit:	Overcast, Dry, Wind SW, 5m/s, 16°C
Comments:	

Appendix F

GRANGE GEOCONSULTING LTD METHODOLOGY

RISK ASSESSMENT RATIONALE

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in BS5930:1999 and BS10175:2001. Important aspects of the risk assessment process are transparency and justification. The rationale behind the risk assessments presented is given in this appendix.

A preliminary risk assessment is made of both geotechnical and geo-environmental hazards identified at the desk study stage and confirmed (or amended) at the ground investigation stage. This is based on a simple matrix of probability of occurrence versus the consequence, as explained below. In the case of geo-environmental hazards, the risk assessment process proceeds to the next level, the generic risk assessment, in which actual contaminant concentrations are considered.

Preliminary Risk Assessment (Geotechnical Risk Register)

The preliminary geotechnical risk register is compiled in accordance with the Highways Agency Design Manual for Roads and Bridges HD/02. This requires an estimation of the *probability* of an event happening multiplied by the *impact* or consequences of that event. Five levels of probability and impact are given scores, and these are multiplied to give a risk rating and a qualitative risk level is assigned as in Table A based on the terminology of Clayton (2001).

Table A: Geotechnical Risk Rating

Assessment of Geotechnical Risks (Risk Register)				
Probability (P)	**Impact (I)**	**Impact in terms of cost or time (% of construction cost or time)**	**Risk Rating (R = P x I)**	**Risk Level**
Very likely (5)	Very High (5)	>25%	17 to 25	Intolerable
Likely (4)	High (4)	10 to 25%	13 to 16	Intolerable
Probable (3)	Medium (3)	4 to 10%	9 to 12	Substantial
Unlikely (2)	Low (2)	1 to 4%	5 to 8	Tolerable
Negligible (1)	Very Low (1)	<1%	1 to 4	Trivial

Preliminary Risk Assessment (Geoenvironmental Consequences and Probability)

The Preliminary Risk Assessment includes a geo-environmental Hazard Identification, which seeks to list all the suspected contaminant **sources**, the **receptors** that might be harmed by those sources and the **pathways** via which the sources might reach the receptors to cause the harm. The source-pathway-receptor concept is known as a pollution linkage, and only when a linkage is complete is there any possibility of risk of harm arising.

The Hazard Identification evaluates all the **possible** pollution linkages in tabular form. Professional judgement is then used to evaluate which of these pollution linkages may be considered as **plausible**. Plausible pollution linkages are unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and the chemical analysis of soil and water samples.

Where no plausible linkage identified, the linkage is classed as ‘no linkage’ in the summary table and no further action is required. If a linkage is plausible, a comparison is made of consequence against probability in general accordance with the guidance given in CIRIA Report C552 (Rudland *et al* 2001). Classification of consequences and probability are given in CIRIA C552 Tables 6.3 and 6.4, respectively, but there are

several inconsistencies in the original Table 6.3, in particular relating to 'significant harm or significant possibility of significant harm' (SH/SPOSH). Consequently, the table has been updated by Grange Geo in line with current practice and is given in Table B. Also added are scores from 1 to 4 for each category.

The basis of the classification is that 'severe' and 'major' are likely to result in SH/SPOSH as defined by the EPA 1990, Part 2A, with 'severe' resulting in acute harm. 'Moderate' lies below the level of SH/SPOSH but above the level of 'no harm' as implied by the relevant Generic assessment criterion (GAC, see below). Minor lies below the 'no harm' level.

Table B: Classification of Consequences of Geoenvironmental Risks

Classification of Consequences for Geoenvironmental Risks		
Classification	**Definition**	**Examples**
Severe (4 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. I.e. >>SH/SPOSH, concentrations are high enough to cause acute (short-term) effects.	Human health: short-term (acute) effects likely to result in significant harm. E.g. high conc. of cyanide at the surface of an informal recreational area. Planting: complete and rapid die-back of landscaped areas. Controlled waters: short-term pollution, e.g. major spillage into controlled water. Buildings etc.: catastrophic damage, e.g. explosion causing collapse. Ecosystems: short-term risk to an ecosystem or organism forming part of that ecosystem in a designated protected area, e.g. by contamination spillage. Site workers: risk assessment required to determine PPE, and this may involve USEPA Level A, B or C protection.
Major (3 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. I.e. >SH/SPOSH.	Human health: long-term (chronic) effects likely to result in significant harm. E.g. high conc. of contaminants close to the surface of a development site. Planting: stressed or dead plants in landscaped areas. Controlled waters: pollution of sensitive water resources, e.g. leaching into major or minor aquifers or rivers. Buildings etc.: damage renders unsafe to occupy. Ecosystems: death of species in an ecosystem in a designated protected area, e.g. by contamination spillage. Site workers: risk assessment required to determine PPE, and this may involve USEPA Level B, C or D protection.

Classification of Consequences for Geoenvironmental Risks		
Classification	**Definition**	**Examples**
Moderate (2 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of no harm but not unacceptable intake or contact. I.e. >SVG/GAC but <SH/SPOSH.	Human health: harm but probably not significant harm unless particularly sensitive individual within the receptor group. May be aesthetic/olfactory impacts. Planting: damage to plants in landscaped areas, e.g. stunted growth, discoloration. Controlled waters: pollution of non-sensitive water bodies e.g. leaching into non-classified groundwater or minor ditches. Buildings etc.: damage to sensitive buildings etc. Ecosystems: minor change in an ecosystem in a designated protected area, but not significant harm. Site workers: risk assessment required to determine PPE, and this may involve USEPA Level C or D protection.
Minor (1 point)	Concentration of contaminants is likely to (or is known from previous data to) be less than that indicative of no harm. I.e. <SGV/GAC.	No measurable effects, but simple PPE required (USEPA Level D protection, i.e. overalls, boots, goggles, hard hat).

CIRIA Table 6.4 is reproduced as Table C below, but also with the addition of scores from 1 to 4. This provides an estimate of the probability that the event described by the pollution linkage will occur. For example, the likelihood that pollution of groundwater will occur by leaching of metals into the aquifer.

Table C: Classification of Probability of Geoenvironmental Risks

Classification of Probability of Geoenvironmental Risks	
Classification	**Definition**
High (4 points)	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Medium (3 points)	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event in not inevitable, but possible in the short term and likely over the long term.
Low (2 points)	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is no means certain that even over a longer period such event could take place and is less likely in the shorter term.
Unlikely (1 point)	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

The perceived level of risk for each pathway is then derived from the probability versus consequences matrix, modified after CIRIA C552 Table 6.5, given in Table D. The scores are summed accordingly and the result assigned a risk level by dividing the range between the minimum score of 1 and the maximum score of 16 equally into 5 categories i.e. 1 to <4 is very low risk, 4 to <7 is low risk, 7 to <10 is moderate risk, 10 to <13 is high risk and 13 to 16 is very high risk.

Table D: Qualitative Risk Level from Consequence and Probability

		Consequence			
Probability	*product*	**Severe (4)**	**Major (3)**	**Moderate (2)**	**Minor (1)**
	High (4)	16 = Very high risk	12 = High risk	8 = Moderate risk	4 = Low risk
	Medium (3)	12 = High risk	9 = Moderate risk	6 = Low risk	3 = Very low risk
	Low (2)	8 = Moderate risk	6 = Low risk	4 = Low risk	2 = Very low risk
	Unlikely (1)	4 = Low risk	3 = Very low risk	2 = Very low risk	1 = Very low risk

This approach assumes an equivalence between probability and consequences and ignores the difficulty that can arise where to probability of occurrence appears to be almost negligible, but the consequences are very severe. In such conditions, there is a degree of subjectivity in assessing the level of risk and it could be low, moderate or high. Such risks may require specialist consideration beyond the scope of this standard report.

A description of the classified risks and the likely action required can be determined from Table E.

Table E: Description of the Classified Risks and Likely Action Required

Description of Classified Risks and Likely Action Required	
Very High Risk	A significant pollution linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A pollution linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A pollution linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of no possibility of harm. Precautionary investigations and risk assessment advisable on change of use.
Very Low Risk	No pollution linkage likely to exist under current or future conditions. Site not capable of being determined under Part 2A (in accordance with PPS23) where the Local Authority inspects the site. No further action recommended.

Contaminant Analysis of Samples

CLR 8 (Environment Agency 2002b), the DoE Industry Profile documents and ISO10381-5 provide good summaries of priority pollutants for UK sites. Additionally, the Environment Agency has produced a list of priority pollutants for ecological risk assessment in a consultation document (Environment Agency 2003a). These documents have been used, with the findings of the Phase 1 investigation, to scope the analyses of chemicals of potential concern.

Grange Geo considers there to be a minimum requirement for soil chemical analysis, even for Greenfield sites, to satisfy the 'suitable for use' criterion of the planning regime. The GACs adopted by Grange Geo for the Site are given in the following table.

There is no safe acceptable level for asbestos in soils, detect or non-detect is recorded with asbestos quantification undertaken on samples found to contain asbestos.

Table F presents the Generic Assessment Criteria (GAC) for the residential with plant uptake (including the consumption of home-grown produce).

Table F: GAC for residential with plant uptake (including the consumption of home-grown produce)
Based on a 1% Soil Organic Matter Content (most conservative approach)
Based on SGVs, C4SL and S4UL values

Heavy Metals	
Cyanide	4.6
Arsenic	32
Beryllium	1.7
Boron	290
Cadmium	10
Chromium	627
Chromium VI	4.3
Copper	2330
Lead	200
Mercury (elemental)	1
Mercury (inorganic)	40
Nickel	130
Selenium	250
Vanadium	75
Zinc	3700
BTEX	
Benzene	0.087
Toluene	130
Ethyl Benzene	47
m/p Xylenes	56
o Xylenes	60
Xylenes	56
Speciated PAHs	
Naphthalene	1.5
Acenaphthylene	170
Acenaphthene	210

Fluorene	160
Phenanthrene	92
Anthracene	2300
Fluoranthene	260
Pyrene	560
Benzo[a]anthracene	3.1
Chrysene	6
Benzo[b]fluoranthene	2.6
Benzo[k]fluoranthene	8.5
Benzo[a]pyrene	2.2
Indeno[123-cd]pyrene	3.2
Dibenzo[ah]anthracene	0.24
Benzo[ghi]perylene	44
Asbestos	
Asbestos	Non-detected
Speciated TPH	
Aliphatic C5 - C6	30
Aliphatic C6 - C8	73
Aliphatic C8 - C10	19
Aliphatic C10 - C12	93
Aliphatic C12 - C16	740
Aliphatic C16 - C21	45000
Aliphatic C21 - C35	45000
Aromatic C5 - C7	65
Aromatic C7 - 8	120
Aromatic C8 - C10	27
Aromatic C10 - 12	69
Aromatic C12 - C16	140
Aromatic C16 - C21	250
Aromatic C21 - C35	890

Appendix G

CHEMICAL ANALYSIS RESULTS

Andrew Hare
Grange Geo Consulting Ltd
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Analytical Report Number : 23-31407

Project / Site name:	Pinchbeck	**Samples received on:**	28/04/2023
Your job number:	R18012	**Samples instructed on/ Analysis started on:**	28/04/2023
Your order number:		**Analysis completed by:**	10/05/2023
Report Issue Number:	1	**Report issued on:**	10/05/2023
Samples Analysed:	12 soil samples		

Signed: Izabela Wójcik

Izabela Wójcik
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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Analytical Report Number: 23-31407
Project / Site name: Pinchbeck

Lab Sample Number				2665757	2665758	2665759	2665760	2665761
Sample Reference				WS101	WS102	WS103	WS104	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10-0.20	0.10-0.30	0.80	0.30-0.60	0.30-0.50
Date Sampled				26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	89	< 0.1
Moisture Content	%	0.01	NONE	17	17	21	13	21
Total mass of sample received	kg	0.001	NONE	0.4	0.4	1.4	1.4	1.4
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Chrysotile- Loose Fibres	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS	EWS	EWS	EWS

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.9	7.8	7.8	8.1	8.1
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	2.4	2.6	4.6	1.3	1.2

Speciated PAHs

Naphthalene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	NONE	< 0.05	0.16	0.29	0.09	< 0.05
Anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05	0.08	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	NONE	0.12	0.32	0.8	0.16	< 0.05
Pyrene	mg/kg	0.05	NONE	0.11	0.3	0.73	0.17	< 0.05
Benzo(a)anthracene	mg/kg	0.05	NONE	0.05	0.18	0.62	0.08	< 0.05
Chrysene	mg/kg	0.05	NONE	0.05	0.2	0.51	0.11	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	NONE	0.1	0.27	0.93	0.16	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	NONE	< 0.05	0.13	0.3	0.06	< 0.05
Benzo(a)pyrene	mg/kg	0.05	NONE	0.07	0.23	0.79	0.12	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	< 0.05	0.13	0.48	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05	0.08	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	NONE	< 0.05	0.15	0.57	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	NONE	< 0.80	2.07	6.18	0.95	< 0.80

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	15	13	15	8.4	11
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.7	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	22	63	13	15
Copper (aqua regia extractable)	mg/kg	1	MCERTS	39	17	57	9.5	9.1
Lead (aqua regia extractable)	mg/kg	1	MCERTS	22	43	1100	34	12
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	430	400	320	290	380
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.4	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	20	30	11	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	34	38	28	23	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	53	62	150	40	41

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 23-31407
Project / Site name: Pinchbeck

Lab Sample Number				2665762	2665763	2665764	2665765	2665766
Sample Reference				WS106	WS107	WS108	WS109	WS110
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.00-0.30	0.20	0.20	0.10-0.30	0.20
Date Sampled				26/04/2023	26/04/2023	26/04/2023	26/04/2023	26/04/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	46	< 0.1
Moisture Content	%	0.01	NONE	17	16	17	18	16
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4	1.4	0.4
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Chrysotile, Amosite- Loose Fibres	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS	EWS	EWS	EWS
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.8	8	7.8	7.6	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	2	2.2	2.5	8.8	1.8
Speciated PAHs								
Naphthalene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	0.19	< 0.05
Anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	NONE	0.18	0.11	0.13	0.56	< 0.05
Pyrene	mg/kg	0.05	NONE	0.15	0.1	0.11	0.48	< 0.05
Benzo(a)anthracene	mg/kg	0.05	NONE	0.08	< 0.05	0.06	0.31	< 0.05
Chrysene	mg/kg	0.05	NONE	0.09	< 0.05	< 0.05	0.31	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	NONE	0.13	0.07	0.07	0.41	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	0.17	< 0.05
Benzo(a)pyrene	mg/kg	0.05	NONE	0.09	< 0.05	< 0.05	0.31	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	0.14	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	NONE	< 0.05	< 0.05	< 0.05	0.13	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	NONE	< 0.80	< 0.80	< 0.80	3.01	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	11	11	10	9.8	9.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	0.6	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	16	15	18	15
Copper (aqua regia extractable)	mg/kg	1	MCERTS	9.5	9.9	11	36	16
Lead (aqua regia extractable)	mg/kg	1	MCERTS	20	18	20	160	23
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	350	360	340	280	350
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	14	13	17	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	26	27	25	33	25
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	44	45	45	150	47

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Analytical Report Number: 23-31407
Project / Site name: Pinchbeck

Lab Sample Number				2665767	2665768
Sample Reference				WS112	WS11
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	1.30
Date Sampled				27/04/2023	27/04/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	30	46
Total mass of sample received	kg	0.001	NONE	1.4	0.4
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	KWB	KWB

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.5	6.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	5.9	12

Speciated PAHs

Naphthalene	mg/kg	0.05	NONE	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	NONE	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	NONE	< 0.05	< 0.05
Fluorene	mg/kg	0.05	NONE	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	NONE	< 0.05	0.22
Anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	NONE	0.13	0.65
Pyrene	mg/kg	0.05	NONE	0.12	0.55
Benzo(a)anthracene	mg/kg	0.05	NONE	< 0.05	0.28
Chrysene	mg/kg	0.05	NONE	< 0.05	0.34
Benzo(b)fluoranthene	mg/kg	0.05	NONE	0.09	0.34
Benzo(k)fluoranthene	mg/kg	0.05	NONE	< 0.05	0.25
Benzo(a)pyrene	mg/kg	0.05	NONE	< 0.05	0.32
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	< 0.05	0.21
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	NONE	< 0.05	0.25

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	NONE	< 0.80	3.41

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	10
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	11	9
Copper (aqua regia extractable)	mg/kg	1	MCERTS	13	13
Lead (aqua regia extractable)	mg/kg	1	MCERTS	22	25
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	340	160
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	10	8.8
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	20	15
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	120	110

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Analytical Report Number : 23-31407
Project / Site name: Pinchbeck

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2665757	WS101	None Supplied	0.10-0.20	Brown clay and sand.
2665758	WS102	None Supplied	0.10-0.30	Brown clay and sand with vegetation.
2665759	WS103	None Supplied	0.8	Brown clay and sand with vegetation.
2665760	WS104	None Supplied	0.30-0.60	Brown clay and sand with stones.
2665761	WS105	None Supplied	0.30-0.50	Brown clay and sand with vegetation.
2665762	WS106	None Supplied	0.00-0.30	Brown sandy clay.
2665763	WS107	None Supplied	0.2	Brown sandy clay with vegetation.
2665764	WS108	None Supplied	0.2	Brown sandy clay.
2665765	WS109	None Supplied	0.10-0.30	Brown clay and sand with stones.
2665766	WS110	None Supplied	0.2	Brown sand with vegetation.
2665767	WS112	None Supplied	1	Brown clay and sand.
2665768	WS11	None Supplied	1.3	Brown clay and sand.

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Analytical Report Number : 23-31407
Project / Site name: Pinchbeck

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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UKAS TESTING
4041

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Analytical Report Number : 23-38088

Project / Site name:	Pinchbeck	**Samples received on:**	07/06/2023
Your job number:	R18012	**Samples instructed on/ Analysis started on:**	07/06/2023
Your order number:		**Analysis completed by:**	15/06/2023
Report Issue Number:	1	**Report issued on:**	15/06/2023
Samples Analysed:	7 water samples		

Signed:

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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UKAS TESTING
4041

Analytical Environmental Science

Analytical Report Number: 23-38088
Project / Site name: Pinchbeck

Lab Sample Number				2706031	2706032	2706033	2706034	2706035
Sample Reference				WS3	WS4	WS5	WS7	WS8
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				06/06/2023	06/06/2023	06/06/2023	06/06/2023	06/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH (L005B)	pH Units	N/A	ISO 17025	6.9	6.9	7	7	7.1
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Sulphate as SO4	mg/l	0.045	ISO 17025	213	121	12.9	7.12	85
Chloride	mg/l	0.15	ISO 17025	16	14	26	18	11
Fluoride	µg/l	50	ISO 17025	750	360	540	640	390
Ammoniacal Nitrogen as NH4	µg/l	15	ISO 17025	930	1100	51000	23000	57
Nitrate as N	mg/l	0.01	ISO 17025	0.26	10.5	0.59	0.27	5.41
Nitrate as NO3	mg/l	0.05	ISO 17025	1.14	46.5	2.59	1.19	24
Nitrite as N	µg/l	1	ISO 17025	2.1	6.8	2.4	< 1.0	63
Nitrite as NO2	µg/l	5	ISO 17025	7	23	7.8	< 5.0	210
Hardness - Total	mgCaCO3/l	1	ISO 17025	764	669	874	778	715
Bromate by IC	mg/l	0.002	ISO 17025	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Total Phenols								
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16
Heavy Metals / Metalloids								
Boron (dissolved)	µg/l	10	ISO 17025	560	440	330	260	370
Calcium (dissolved)	mg/l	0.012	ISO 17025	250	240	300	290	230
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (III)	µg/l	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Iron (dissolved)	mg/l	0.004	ISO 17025	0.029	0.095	1.9	0.17	0.068
Magnesium (dissolved)	mg/l	0.005	ISO 17025	35	17	32	15	34
Sodium (dissolved)	mg/l	0.01	ISO 17025	24	11	20	13	16
Zinc (total)	µg/l	0.5	ISO 17025	56	6.1	8.2	130	44

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4041

Analytical i2 Environmental Science

Analytical Report Number: 23-38088
Project / Site name: Pinchbeck

Lab Sample Number				2706031	2706032	2706033	2706034	2706035
Sample Reference				WS3	WS4	WS5	WS7	WS8
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				06/06/2023	06/06/2023	06/06/2023	06/06/2023	06/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Aluminium (dissolved)	µg/l	1	ISO 17025	6.3	19	9.2	9.3	4.7
Antimony (dissolved)	µg/l	0.4	ISO 17025	1.2	1.8	1.3	1.2	1.1
Arsenic (dissolved)	µg/l	0.15	ISO 17025	13.5	3.18	26.9	9.97	1.99
Barium (dissolved)	µg/l	0.06	ISO 17025	140	100	180	240	120
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	0.04	0.02	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.2	0.5	0.5	0.5	0.3
Cobalt (dissolved)	µg/l	0.2	ISO 17025	2.5	3.1	1.3	1.6	0.4
Copper (dissolved)	µg/l	0.5	ISO 17025	3.3	8.1	1.4	2.2	5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	530	230	1000	930	150
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Molybdenum (dissolved)	µg/l	0.05	ISO 17025	8.4	12	2.1	1.3	11
Nickel (dissolved)	µg/l	0.5	ISO 17025	6.6	7.4	3.1	3.8	4.1
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.8	0.8	0.8	0.8	0.9
Silver (dissolved)	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Tin (dissolved)	µg/l	0.2	ISO 17025	< 0.20	< 0.20	< 0.20	< 0.20	0.22
Vanadium (dissolved)	µg/l	0.2	ISO 17025	1.4	2.7	3.5	2.5	1.4
Zinc (dissolved)	µg/l	0.5	ISO 17025	7.3	3.2	5.7	6	5

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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4041

Analytical i2 Environmental Science

Analytical Report Number: 23-38088
Project / Site name: Pinchbeck

Lab Sample Number				2706036	2706037
Sample Reference				WS10	WS12
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				06/06/2023	06/06/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
General Inorganics					
pH (L005B)	pH Units	N/A	ISO 17025	6.9	7
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10
Sulphate as SO4	mg/l	0.045	ISO 17025	5.67	71.3
Chloride	mg/l	0.15	ISO 17025	9.6	11
Fluoride	µg/l	50	ISO 17025	490	380
Ammoniacal Nitrogen as NH4	µg/l	15	ISO 17025	11000	280
Nitrate as N	mg/l	0.01	ISO 17025	0.62	13.8
Nitrate as NO3	mg/l	0.05	ISO 17025	2.75	61
Nitrite as N	µg/l	1	ISO 17025	13	260
Nitrite as NO2	µg/l	5	ISO 17025	42	860
Hardness - Total	mgCaCO3/l	1	ISO 17025	976	681
Bromate by IC	mg/l	0.002	ISO 17025	< 0.002	< 0.002
Total Phenols					
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10
Speciated PAHs					
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Total PAH					
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16
Heavy Metals / Metalloids					
Boron (dissolved)	µg/l	10	ISO 17025	450	260
Calcium (dissolved)	mg/l	0.012	ISO 17025	300	240
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (III)	µg/l	5	NONE	< 5.0	< 5.0
Iron (dissolved)	mg/l	0.004	ISO 17025	0.1	0.041
Magnesium (dissolved)	mg/l	0.005	ISO 17025	53	20
Sodium (dissolved)	mg/l	0.01	ISO 17025	14	13
Zinc (total)	µg/l	0.5	ISO 17025	43	67

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4041

Analytical i2 Environmental Science

Analytical Report Number: 23-38088
Project / Site name: Pinchbeck

Lab Sample Number				2706036	2706037
Sample Reference				WS10	WS12
Sample Number				None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied
Date Sampled				06/06/2023	06/06/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Aluminium (dissolved)	µg/l	1	ISO 17025	15	5.9
Antimony (dissolved)	µg/l	0.4	ISO 17025	1	1.6
Arsenic (dissolved)	µg/l	0.15	ISO 17025	8.21	2.35
Barium (dissolved)	µg/l	0.06	ISO 17025	110	430
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.03
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.4	0.4
Cobalt (dissolved)	µg/l	0.2	ISO 17025	1.7	1.2
Copper (dissolved)	µg/l	0.5	ISO 17025	0.9	10
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	1200	140
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05
Molybdenum (dissolved)	µg/l	0.05	ISO 17025	2.3	8.5
Nickel (dissolved)	µg/l	0.5	ISO 17025	4.1	8
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.6	0.9
Silver (dissolved)	µg/l	0.05	NONE	< 0.05	< 0.05
Tin (dissolved)	µg/l	0.2	ISO 17025	< 0.20	< 0.20
Vanadium (dissolved)	µg/l	0.2	ISO 17025	1.5	1.4
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.7	6.4

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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4041

Analytical i2 Environmental Science

Analytical Report Number : 23-38088
Project / Site name: Pinchbeck

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (total)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Fluoride in water	Determination of fluoride in water by 1:1 ratio with a buffer solution followed by Ion Selective Electrode. Accredited matrices: SW, PW, GW.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrite in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry).Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Nitrate in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Ammonium as NH4 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025

4041

Analytical Report Number : 23-38088
Project / Site name: Pinchbeck

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Cr (III) in water	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025
Bromate in Water	Determination of bromate in waters based on ion chromatography. Accredited matrices GW, PW, SW.	In house method based on Standard Methods for the Analysis of Water and Waste Water, method 4500	L008-PL	W	ISO 17025
Chloride in water	Determination of Chloride (diissolved) colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.