



Ground Investigation Report

Brunel Retail Park, Kiln Lane, Reading, RG2 0HS

A REPORT PREPARED

FOR AND ON BEHALF OF ABERDEEN UK PROPERTY FUND

C/O ABERDEEN STANDARD INVESTMENTS, 1 GEORGE STREET, EDINBURGH, EH2 2LL

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For and on behalf of
Paragon Building Consultancy Limited

NON-TECHNICAL SUMMARY

Rationale For The Investigation

1. The subject site is located within the wider site demise defined as Brunel Retail Park, for which Aberdeen UK Property Fund are the current freeholder. The client intends to divest this asset. However, during a due diligence walkover of the property, by Paragon Building Consultancy (Paragon), several areas of potential ground movement and settlement were observed. These areas appeared worst affected at the rear of Units 1-5, which is herein referred to as the subject site.
2. We were provided with a Phase 1 Environmental Audit prepared by Delta Simons. Within their Phase 1 Environmental Assessment, it was highlighted that the subject site had been subject to historical clay extraction and subsequent landfilling. However, no site-specific ground investigation data could be provided by the client to confirm the nature of the underlying materials.
3. Owing to the potential linkage between degradation of landfill materials and settlement, and an absence of ground condition data or As Built information about the site, an investigation was recommended. A Structural Engineer (Bradbrook Consulting) and Paragon provided the scope for the investigation. This involved drilling three deep boreholes through the fill to the natural strata below, the hand excavation of foundation inspection pits to the building where structural movement was observed, in situ and ex situ laboratory testing, a visual appraisal of an adjacent slope, gas and ground water monitoring and a CCTV drainage survey.
4. Bradbrook Consulting attended site with Paragon to undertake a visual inspection and have provided a report under separate cover. The findings of which had been used to aid the discussion within this report.

Ground Conditions

5. The boreholes advanced at the site found infilled material between depths of 0.75m bgl and 10.10m bgl. The infilled material was of low strength clays and granular sand and gravel with red brick fragments, wood, glass, shale, ceramic, rubber and an organic odour. By drilling boreholes at the site, it has been possible to establish that the site is directly underlain by a thick layer of fill type material. This has been identified by its black organic nature and owing to the anthropogenic materials within it. The fill material also comprised residual contamination within it and was gas producing, suggesting it is of an anthropogenic / fill nature (environmental results are discussed further below).
6. Made Ground or fill materials are, by nature, highly variable in both composition and bearing capacity and can be subject to large and ongoing differential settlements when loaded. It is therefore generally unsuitable for use as a bearing stratum. The in situ geotechnical testing has identified the strength of the Made Ground is highly variable with SPT 'N' values ranging between 3 and 15. From a review of the uncorrected SPT results carried out in the Made Ground, the material is shown to be variable in density but generally soft and poorly consolidated. Therefore, a material of this nature would typically be susceptible to settlement once subject to loading if structural elements are founded in or on to this material.

Settlement To The Yard Area

7. Due to the poorly consolidated nature of the fill materials described above settlement has occurred since the rear yard area was installed. By excavating hand pits, it has revealed that the brick pavements in the rear yard are situated on a sand layer, over tarmac with a sub-base of roadstone over fill material. It was not possible to carry out in situ CBR testing at the time of the investigation, however, the geotechnical engineer indicated that given the underlying low density and poorly consolidated Made Ground a CBR value of <0.5% would be anticipated. Therefore, owing to the nature of heavy and regular vehicle movements in the rear yard area, this would be considered as insufficient. This is expected to be a contributing factor towards the undulating movement observed within the yard area, which is worse in some areas than others.

Settlement To The Building

8. Paragon observed approximately 100mm of settlement of the pavement to the rear yard which extends along the back of Units 2, 3a and 3b. This is particularly evident to Units 1 to 3b but is also noticeable to the pavement which continues along the rear of Unit 4, albeit to a lesser extent. This is evidenced by rodent boxes fixed to the rear elevation walls, which were previously sat on the pavement that are now suspended above the ground identifying the extent the pavement has sank. Similar signs of settlement related damage have not been seen within the building footprint or along the western elevation of the structure. This implies that the building itself may be relatively stable compared to the rear yard area. It is anticipated that the existing building is on piled foundations (however, we have not had sight of As Built drawings) whereas the rear yard is situated on a sub-base of roadstone over fill material as per our site observations discussed above.
9. The infilled material was underlain by sands and clays. The strength of the clay was determined as firm to stiff ('N' values ranged between 13 and 20), and the sand was very dense with 'N' values of 34 to >50. In addition, the clay soils were noted to have a medium volume change potential. A single triaxial test was completed on the Clay which determined a shear stress C_u of 17-25kPa with an angle of shearing resistance of 1.5°.
10. The soil properties of the sand and clay are deemed to be commensurate with natural strata, asserted to be the Lambeth Group, which is mapped in this area. We have no detailed As Built information to confirm the type of foundations present. Therefore, foundation inspection pits were excavated. The surrounding soils were subject to collapse during excavation and so the findings were inconclusive in this regard although a feature that may have been indicative of a pile cap was noted in two of the pits. Following on-site discussions with a structural engineer, and given the nature of the structure, it is considered likely that the building is piled. With reference to the abovementioned Delta Simons report, other parts of the retail park (Units 12 and 13) were asserted to have been piled to depths of 7m below the sand and clay layer. If the piles at this part of the subject site extend on or into the natural strata through the deep level of fill, this would explain why the building is seemingly less impacted by settlement than the surrounding yard area.

	Visual Appraisal – Slope
11.	Other factors were considered in relation to the movement observed, such as slope failure. The slope to the west of the site was identified to be very steep and a number of bent trees were present indicating some degree of movement has taken place historically. Visual inspections completed as part of the investigations to date by a building surveyor, structural engineer and geotechnical engineer did not identify damage to the building that was definitively attributable to slope failure. The undulation identified to the rear yard area was more consistent with circular depressions rather than a more rigid subsidence effect where large cracks open as a result of lateral movement. As such, settlement is considered to be the more likely cause to the movement observed at the site. Potential For Future Settlement
12.	Detailed settlement analysis was outside of the scope of this investigation. However, testing was completed to assess the composition of the fill. The composition of the fill established by testing has identified that the organic content of the fill is currently low; the frequency of large organic fragments identified was low. This is important as it means that the volume of material capable of degradation in future is low. Furthermore, groundwater was not identified within the Made Ground, it was encountered within the natural soils between depths of 9.50m bgl and 11.50m bgl. Therefore, the fill is considered to be fairly stable going forward as a resting water level / leachate in the fill would be unlikely to contribute to continued / further settlement assuming that recommendations below are implemented.
13.	As part of the CCTV survey completed some defects to drainage were noted. Despite the movement visible at the surface within the yard area, the damage to drainage below does not appear to very extensive, which is positive. There are however some urgent defects that should be addressed (as per recommendations below).
14.	It is considered that movement from the slope (if any) would be a long-term consideration and boreholes at the crest and toe of the slope would be required to fully understand potential instability and potential future failure mechanisms. Regular inspections would determine if additional works on the slope are required. However, in the short term to limit the risk of potential slope inundation from damaged drains / pipes, then repairs should be carried out accordingly as discussed below. Limiting water within the fill matrix would also reduce the potential for further ongoing settlement as continued degradation of remaining organic fractions would be reduced. Damage to rear elevation
15.	One section of the blockwork to the rear of Unit 3a was noted to have deflected outward by approximately 50mm from vertical. It was asserted by others that this was due to internal impact damage by a forklift or similar. From an internal inspection by a Paragon Building Surveyor, it is understood that ancillary accommodation in the form of toilets and an office are located within the building behind this section of the wall and there is no obvious sign of impact damage. Therefore, pits were excavated along this elevation to observe whether there was an underlying issue that could be observed.

16.	A structural engineer from Bradbrook Consulting was present when the trial pits were excavated and an articulation slab was identified within the trial pits running parallel to the building wall. Where Made Ground / fill positioned below this feature has settled, it appears that the articulation slab has dropped causing an uplift affect. This uplift has pushed up against a bull nose kerb at the base of the block work wall and caused the rotational effect as the block work wall was pushed outwards. A sketch was prepared by Bradbrook Consulting to demonstrate the theory and is presented as Figure 4 of Appendix 1. Recommendations have been made below for the repair to this wall section, and localised breaking out of the articulation slab to prevent further contact.
17.	In the time and remit of this investigation, it has not been possible to inspect the entire length of the articulation slab to ensure the rotational effect is not being caused elsewhere. If identified, additional areas of the articulation slab will need to be broken out to prevent contact with the bull nose kerb at the base of the blockwork. However, this does not appear to be the case from visual inspections completed to date extensively across the site, with the exception of Unit 3b. It is considered that this process may have also occurred at the rear of this unit as a minor area of blockwork was also slightly pushed out. As these two units (3a and 3b) were the only identified areas where the rotational effect has been observed, it is considered to be a localised defect, specifically at areas where the articulation slab is in contact with the wall.
	Environmental Findings
18.	Chemical testing was completed principally to establish if the site was underlain by fill materials. The results of the chemical analysis of soils identified concentrations of contaminants that were indicative of anthropogenic impact. It should be noted however that these concentrations are not considered to present a risk to existing site users as they are below thresholds for a commercial use.
19.	Asbestos fibres were identified within the Made Ground. However, asbestos is not considered mobile within the ground and the extensive hardstanding mitigates the risk to existing site users. If site workers break ground to complete repairs at the site then control measures would need to be put in place in this regard.
20.	The chemical analysis of the groundwater has not identified significant contamination. However, water quality parameters indicate a poor water quality. This is likely to be attributed to the wider landfilled areas off-site as the water was identified below a layer of natural clay geology, beneath the Made Ground.
21.	Indicative gas monitoring was undertaken to assess the potential for gas generation within the fill material. Gas vents are present around the perimeter of the building and internal gas monitoring results were made available to Paragon. Therefore, it was important to assess whether gases were present within the ground to confirm the presence of fill materials but also to assess the adequacy of gas protection if gassing materials were present.
22.	The monitoring identified concentrations of methane (commensurate with fill) and based on a single gas monitoring visit, the results suggested the site falls within Characteristic Situation 2. Further monitoring has been recommended to fully assess the ground gas regime and whether the installed vents are suitable for the types and concentration of gases identified. However, based on the third-party internal gas monitoring data provided, it would appear unlikely that the gas protection measures have been significantly impacted by settlement and / or that there is an adequate degree of ventilation / protection also offered by the floor slab, as elevated concentrations of ground gas have not been identified internally.

RECOMMENDATIONS

Repairs To Service Yards

1. Repairs to the settlement in the rear yard area are recommended. As poorly consolidated fill has been identified below the yard area, this would require compaction to create a suitable sub-base with clean down of each paviour prior to relaying. Based on the poorly composed materials below, it is unlikely that a straightforward lift and re-lay approach would be suitable. Therefore, an estimated rate of repair is asserted to be £120/m². It is understood that the site's asset managers indicated that there was approximately 55m² requiring localised repairs. Based on the topographical survey completed and using a Geographical Information System (GIS) to measure the impacted areas, Paragon considers the most currently significant / visually obvious areas to be more in the region of 65m². Therefore, the estimated repair costs of these areas would be estimated at £7,800 excluding VAT and professional fees. This estimate covers repair the worst affected areas of the yard only, as opposed to complete replacement.
2. Note that this rate is subject to survey and agreeing the extent of work required. It would be necessary to ensure that a suitable CBR can be reached for the nature of vehicle movements within the service yard. This is likely to require extensive compaction potentially localised ground improvement which would only be established following site wide specific testing in this regard.
3. Whilst a localised approach to repair may be acceptable to address areas that have settled more significantly. Under this phased scenario, it would be prudent to undertake regular inspection of the rear yard areas to ensure that if further settlement is identified in future, that it is quickly rectified. Based on the ground conditions encountered, if certain localised areas are remedied / reinforced, then adjacent areas that remain on poorly composed / uncompacted fill may be subject to differential settlement and may drop versus the treated areas particularly where subject to heavy vehicle movements. This could result in further areas needing to be relayed and repair costs could increase significantly.

Repairs To The Defect Wall And Articulation Slab

4. It is recommended that an additional request is made for As Built drawings and building control records to fully establish the nature of the articulation slab that has been subject to movement. Whilst the movement appears to be localised, it is recommended that repairs to the blockwork are made as soon as possible to prevent further movement.
5. Repair to this wall section would be required together with localised breaking out of the articulation slab to prevent further contact. Repairs to the external wall, may also include breaking out of the concrete slab. This should be undertaken locally to ensure it does not create a problem elsewhere. Rotation to the wall may also have caused inner skin wall damage that may also need repairs. At the time of the investigation, Paragon were unable to access the inside of the buildings and as such could not make a full assessment.

6. A budget cost to remove the existing cavity blockwork wall to the rear of Unit 3a, circa 25m², and replace with new including internal finishes has been estimated by Paragon between **£15,000 and £20,000** excluding VAT and professional fees. Note that this rate is subject to survey and agreeing the extent of work required. For example, it would be recommended to inspect the entire length of the articulation slab (by lifting paving slabs by hand) to ensure the rotational effect is not being caused elsewhere, for example by Unit 3b. If identified, additional areas of the articulation slab will need to be broken out to prevent contact with the bull nose kerb at the base of the blockwork and repairs may need to be extended. However, this does not appear to be the case from visual inspections around the remainder of the structure completed to date.

Repairs And Maintenance To Drainage

7. The recommendations from the CCTV drainage survey (WJ Shirley, 2019) should be implemented to ensure the drainage network is functioning adequately (full recommendations and costs detailed in the main report). Whilst general settlement is unlikely to continue to occur, damaged drains could discharge water directly to fill which could lead to exacerbated movement (either within the fill or associated with the slope). It is important that this network is regularly inspected, along with a regular general inspection of the rear yard and the following high urgency repairs are completed to prevent inundation of the ground below the site. Whilst some of the following defects are not directly within the area of the subject site, it would be recommended to reduce the potential for inundation by water below ground for the reasons mentioned above.

The key / urgent actions are considered to be:

- There is a collapsed drain near MH13. This will need excavation and renewal to repair.
- There are also three displaced joints which we recommend are repaired to prevent further deterioration and possible collapse. These can currently be repaired in-situ by patch lining but have the potential to deteriorate and collapse if not dealt with.
- We recommend one of these (D9) within the subject site area is repaired within the next 3 months to prevent likely collapse.
- There is a cracked cover slab at inspection chamber MH15. We recommend this is monitored.

Specifically, the cost of repairs stated above would be **£6,800** excluding VAT, which accounts for repairing displaced joints and collapsed drains – these are considered to be most relevant to reduce risk of inundation of the fill. The report by WJ Shirley is appended to this report.

Environmental

8. As gassing fill material has been identified at the site, ongoing monitoring of the recently installed wells, gas vents, and within the building could be undertaken to verify the adequacy of gas protection measures. This is recommended in the absence of design information about the gas protection measures.
9. Internal and external gas monitoring around the entire site is estimated at **c. £2,000 per visit**.

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VENDOR'S PHASE 2 GROUND INVESTIGATION REPORT

CLIENT NAME: Aberdeen UK Property Fund c/o Aberdeen Standard Investments

PROPERTY ADDRESS: Brunel Retail Park
Kiln Lane, Reading

INSPECTION DATE: 6 – 10 January 2020



1.0 INSTRUCTIONS

1.1	Paragon Building Consultancy Limited was instructed by Aberdeen UK Property Fund c/o Aberdeen Standard Investments on 29 November 2019 to complete a Phase 2 Ground Investigation on a site referred to as Brunel Retail Park, Kiln Lane, Reading. The investigation included an intrusive investigation, laboratory analysis and risk assessment. The investigation has been commissioned for due diligence purposes in connection with the sale of the asset due to its positioning in a known area of landfilling.
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2.0 AIMS AND OBJECTIVES

2.1	The aims of this report are to: • To provide preliminary information on the geotechnical and environmental quality of the ground present onsite. • To assess the nature of landfilled materials below the site. • To assess the potential for ground settlement or movement at the site. • To visually assess structural elements of the building, where possible, such as foundations. • To carry out an appraisal of gas risk at the site. • Make a visual assessment of the slope adjacent to the site. • To carry out a CCTV drainage survey at the site.
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2.2	The objectives of this report are to provide ground conditions information and recommendations in connection with the continued use of the property as retail premises. • Determine the geochemical and physical properties of the materials below the site to assess the nature of landfilled material. • Determine the composition and characteristics of the ground for geotechnical recommendations and identify any links with ground and structural movement identified at the site. • Provide a visual appraisal of the slope. • Determine the potential for ground gas generation at the site and any subsequent recommendations. • Provide recommendations with costs associated with any structural repairs (if any).
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3.0 SCOPE OF WORKS

3.1	The ground investigation was undertaken in general accordance with the Code of Practice for Site Investigation British Standard BS5930 (2015) and Code of Practice for the Investigation of Potentially Contaminated Sites BS10175:2011+A2:2017.
3.2	This report details the results from a two-stage process: A Phase 1 Desk Study and a Phase 2 Site Investigation. • An earlier Phase I Environmental Assessment was previously prepared by Delta Simons (ref: 18-1905.02, July 2019) on behalf of Aberdeen UK Property Fund. This document has been provided to Paragon by the client and some of the background information from it is summarised below. The original Phase 1 should be read in conjunction with this report; the following is a summary. • A Phase 2 Ground Investigation was undertaken to meet the aims and objectives set out above. This comprised an intrusive investigation (drilling, trial pitting etc), laboratory testing of soils, groundwater and gas onsite monitoring and environmental and geotechnical risk assessment.
3.3	The scope of works included: • A Ground Penetrating Radar (GPR) and topographic level survey of the intrusive investigation locations and investigation area; • CCTV Drainage Survey; • 3No. 12m deep shell and auger boreholes with combined gas/groundwater monitoring wells installed between 4m and 12m depth within the borehole; • 4No. hand excavated foundation inspection pits; and • Geotechnical Laboratory Testing including Atterberg Limits, Particle Size Density tests and Sulphate tests.

4.0 INTRODUCTION

4.1	Site Location
4.1.1	For the purpose of this report “the wider site” is defined as Brunel Retail Park. However, it should be noted that the ground investigation was limited to the rear of Units 1 to 5. Therefore, this specific area forms “the subject site” within the following sections.
4.1.2	The wider site is centred approximately at National Grid Reference 471420, 171210 and extends to approximately 3.5Ha overall. The approximate elevation of the wider site is between 46m and 49m Above Ordnance Datum (mAOD). Information gathered during the preliminary Delta Simons report is summarised below and a Site Location Plan is provided in Appendix 1.
4.2	General Description and Current Site Use
4.2.1	The wider site is located on the southern side of Rose Kiln Lane, approximately 150 m to the east of the A33 and approximately 2 km to the south of Reading town centre, and is occupied by a retail park, comprising 13 retail units, arranged in an L-shaped layout across the western and southern parts of the demise. Customer car parking located across the central, northern and eastern parts.
4.2.2	The subject site forms the service yard area, which is accessed via an entrance on Gillette Road to the east of the wider site. Specifically, the subject site is to the rear of Units 1 to 5, which are occupied by retail tenants including Pets at Home, Next and Dreams.
4.2.3	The upper sections (above ground level) of the buildings were steel clad with blockwork below. The block work was divided into sections with vertical joints (joined with a flexible sealant).
4.2.4	The external areas of the subject site are predominantly covered by brick pavements within the service yard. There are also some raised areas of minor soft landscaping.
4.2.5	There is block paving forming a path around the perimeter of the building. There are vent grilles periodically spaced around the building in the path. It is understood that these relate to a gas ventilation system for the building. No details of the building’s construction or the design of the gas protection measures has been supplied. However, it is understood that the vent grilles were subject to replacement in 2017.
4.2.6	The subject site is used by tenants for vehicle movements for deliveries and for storage or waste and recycling bins. There is a third-party electricity substation in the west of the subject site, which is likely to be the responsibility of service providers.
4.2.7	Based on a walkover, completed by Paragon on 9 December 2019, no visual evidence of significant ground contamination was noted.
4.2.8	Photographs from the site visit are provided in Appendix 3.

4.3	Observed Evidence of Settlement
4.3.1	Paragon observed that, in the service yard, there has been movement and approximately 100mm of settlement of the pavement to the rear yard which extends along the back of Units 2, 3a and 3b. This is particularly evident to Units 1 to 3b but is also noticeable to the pavement which continues along the rear of Unit 4, albeit to a lesser extent. This is evidenced by rodent boxes fixed to the rear elevation walls, which were previously sat on the pavement that are now suspended above the ground identifying the extent the pavement has sank. Further downward movement and sinking of the block paving to the yard where abuts the rear elevations of Units 1 and 2 was noted and again this continued to Units 3b, 4 and Unit 5.
4.3.2	Significant surface settlement of the block paved areas of the wider and subject site was observed. Whilst manhole covers in the north of the site were level with the paving, in the centre and south of the site, various covers were noted to be elevated relative to the surrounding block paving level. Further to this the block paving was noted to drop down from the footpath by the buildings and the surface of the yard was notably uneven. There is a general fall across the southern block paved area from the building to the fence line. It is not clear whether this fall is as constructed or the result of post construction settlement. This has resulted in several of the manhole / inspection chambers now protruding and being higher than the surrounding block paving up to 100mm in some cases. Several undulations and defects, every few metres or so were observed in the service road area that links to the rear subject site; this is particular noticeable when driving.
4.3.3	Evidence of structural movement was observed along the rear elevation walls to Unit 3a and 3b. This has resulted in sections of the outer skin of wall becoming displaced and pushing outwards. Movement joints along this section of wall are also displaced and no longer vertical providing a further indication of movement. Cracking was also noted internally within Unit 3a where internal walls meet the inner skin of external blockwork indicating the inner skin has also moved. Deflection of the blockwork by c. 50mm from vertical was noted. It is understood that toilets are located within the building behind this section of the wall. Otherwise the blockwork walls were generally in fair to good condition noting the condition of the block paved surfacing – See 5.1.2.
4.3.4	Trees on the off-site slope to the west, also showed signs of slope instability as they were noticeably bent.
4.3.5	Photographs from the site visit are provided in Appendix 3.
4.4	History
4.4.1	Prior to the 1930s, clay and shale below the subject site was excavated and used for the production of bricks and tiles. This excavated area was subsequently subject to landfilling. Although there was no formal license for the landfill, the area was later recorded as an allotment and sometime between 1966 and 1980, this area was used as a scrapyards. Therefore, this area is anticipated to have been filled. A licensed landfill is recorded in the eastern part of the wider site. Local Authority Recorded Landfill information illustrates this was licensed to accept commercial, household and liquid sludge wastes prior to 1994.

4.5	Geology
4.5.1	The geology of the site has been ascertained by reference to the 1:50,000 British Geological Survey sheet 268, solid and drift edition, the BGS website (www.bgs.ac.uk). The site is mapped as being underlain by Infilled and Made Ground, underlain by the Lambeth Group. Alluvium was noted to be associated with the adjacent River Kennet.
4.5.2	British Geological Survey (BGS) data indicates that the subject site is directly underlain by clay, silt and sand of the Lambeth Group; no superficial deposits are indicated to overlie the bedrock, which is anticipated to be due to former brick clay excavation. Made Ground is anticipated due to landfilling.
4.5.3	The Lambeth Group (formerly known as Woolwich and Reading Beds) tend to consist of grey and grey-brown interbedded fine sands silts and clays. There are sometimes shelly beds at the top and bottom of the formation. Some very strong bands of weakly cemented shells and limestone can be encountered, particularly in the area between Lewisham and Bermondsey.
4.5.4	BGS data indicates that boreholes have previously been advanced on the subject site, however, the borehole records are confidential and not available for review. No earlier site investigation reports have been supplied by the client for this assessment. The nearest available BGS borehole records (ref: SU77SW732-34, dated 1977) located approximately 25 m to the north of the wider site identified the following geology: • Made Ground (ash, wire concrete etc.) to depths of between 3.2 and 9.6 metres below ground level (m bgl); • Clay to a maximum depth of 6.5 m bgl; over • Sand proven to a depth of 12.0 m bgl.
4.5.5	The geological survey maps provided on the British Geological Surveys Website also note the site to be underlain by “Infilled Deposits” which are described as “an area where the pre-existing land surface has been excavated and subsequently partially or wholly backfilled” and are usually associated with backfilled quarries.
4.6	Hydrogeology
4.6.1	The Environment Agency (EA) classifies the bedrock (Lambeth Group) as a Secondary (A) Aquifer. EA data indicates that the subject site is not located within a designated groundwater Source Protection Zone.
4.7	Hydrology
4.7.1	The nearest surface water feature is a stream, located near to the south-western boundary of the subject site. During the Paragon walkover, it was observed that the stream runs at the bottom of a slope which forms a slope along the site boundary. This feature appears to flow into the River Kennet, which flows in a generally northerly direction, approximately 60m to the west of the subject site.

4.8	Regulatory Enquiries
4.8.1	Delta-Simons were informed by the local Contaminated Land Officer (CLO) that whilst the subject site is on their list of prioritised sites under Part 2A (due to historical uses), the subject site (given the current commercial use), is considered to be a low priority, and there is no schedule set to investigate it. They also stated that they have no records of previous intrusive investigation for the subject site.
4.8.2	Building Control would not permit the release of construction information relating to the building without the landowner's permission. No 'As Built' information has been supplied by the client. There is a comment in the Delta Simons report regarding piles to Units 12 and 13 within the wider site. Their report states that: <i>"Mason Navarro Pledge provided information regarding piling for the construction to support the discharge of planning conditions for the construction of Units 12 and 13. The letter confirms that piles installed for the foundations of the proposed development would be approximately 7 m in depth and founded in sand beneath the clay layer. As such, the piles would be above the theoretical groundwater level".</i> This is unsubstantiated by As Built information and no such comment is made in relation to the subject site.
4.9	Other Environmental Information
4.9.1	A BGS Recorded Mineral Site, relating to the historical opencast excavation of Lambeth Group clay and shale, associated with Rose Kilns
4.9.2	An Historical Landfill, identified as 'Rose Kiln Lane South' (EA reference: EAHLD13306) is recorded in the east of the wider site as per the comment in Section 4.3.1. In addition, the Groundsure.io website shows an historic landfill in the footprint of the southern run of the Brunel Business Park units and under the distribution centre to the south. The records show that the landfill was referred to as "Gilette Warehouse" and operated between 1930 and 1939. No indication of the source of the fill material was provided.
4.9.3	The client has provided information relating to gas protection at the site. As mentioned above, this information has suggested that vent grilles around the perimeter relate to a gas protection system below the building. However, no detailed specification or As Built information has been supplied. A document was provided that indicated the grilles had all been replaced in 2017. Following this exercise, it is understood that a period of internal gas monitoring was completed by a third-party environmental consultant.
4.9.4	Aviron Associates Limited (Aviron) previously completed a ground gas risk assessment (it is not stated who commissioned it), which was reported within a document referenced 17-142.01 and dated June 2017. The gas risk assessment, reported 2017, comprised the drilling and installation of eight monitoring wells (MW1-MW8). The results / report from 2017 have not been provided by the client. The results of the gas monitoring recorded elevated carbon dioxide, above 5%, being the point, at which point BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings' recommends increasing the Characteristic Situation to CS2.

4.9.5	The level of ground gas protection afforded by the existing ground floor slab and any sub-floor passive venting systems was unknown by Aviron. Hence, it was not possible to determine if existing construction met the criteria of CS2 and provided the necessary ground gas protection to the retail units above. It was concluded that internal gas monitoring should be completed to determine presence of absence of landfill gases within the occupied retail space. It is understood that six rounds were recommended to be completed over a period of 3 months.
4.9.6	These were subsequently completed between February and October 2019 and the internal monitoring data has been provided by the client. These are provided within Appendix 10. Although we have only been provided with five of six data sets, the conclusions of each monitoring round indicated that according to Aviron: <i>“Landfill gas concentrations within the units are considered to be ambient.</i> <i>At this stage it is considered the floor slab is provided adequate ground gas protection to occupants of the retail units.”</i>
4.10	Ground Stability Hazards:
4.10.1	BGS data indicates that the site area is at moderate risk of subsidence hazards as a result of compressible ground hazards and shrinking / swelling clays.
4.10.2	A slope is present to the western part of the subject site, extending off-site. There are crash barriers and a steel palisade fence along the site boundary and so access to the top of the slope at site level is not possible. However, public access is possible at the base of the slope and along the stream from a residential development (Kennett Island) located off-site to the southwest of the subject site.
4.10.3	From Kennet Island, it was possible to see that the slope has a gabion style retaining wall along it along the flank to the south of the service yard where Next is positioned within the subject site. However, moving further northwards along the slope, to the west of the subject site, the gabions stop and the slope becomes slightly steeper. There are some trees displaying evidence of curvature, which can typically provide a visual indication that there has been a degree of movement to the slope. Photographs have been provided in Appendix 3.
4.10.4	The site is not located in a coal affected area.
4.11	Unexploded Ordnance (UXO)
4.11.1	The risk of UXO has been assessed using the online Zetica Bomb Maps, which indicate a low risk onsite.
4.12	Key Risks Requiring Further Investigation
4.12.1	Based on the observations on site, it was recommended that further investigation of the subject site was required due to the settlement observed in the service yard and the structural movement to the rear wall of Units 3a and 3b.

4.12.2	As the subject site has a history of historical landfilling, there is the potential that degradation of landfilled materials could be resulting in ground movement and settlement above. As no specific data has been provided relating to the nature and composition of the ground below the subject site, the only means to assess the ground conditions is by intrusive investigation. This would be supported by geotechnical testing to assess the physical properties of underlying materials.
4.12.3	As landfill can be a source of ground gas generation, and it is known from Aviron that the site was formerly classified as having carbon dioxide concentrations above an acceptable threshold of 5% by volume in air, additional gas monitoring data would also be completed to assess potential risks to the property.
4.12.4	Based on the foregoing, an investigation scope including the preferred location of the trial holes was designated by a Structural Engineer, Bradbrook Consulting. Paragon supplemented the scope with environmental aspects such as gas monitoring. Borehole locations were restricted due to buried services and loading bays/delivery access to each of the units. As such, a GPR and CAT survey was carried out at each investigation location prior to breaking ground. Delivery entrances at the back of the units also had to be kept clear whilst the tenants had their deliveries. The order the boreholes were carried out in was based on the information provided by the tenants during the site walkover and designed to reduce impact on their activities.

5.0 GROUND INVESTIGATION

5.1	Investigation Rationale
5.1.1	The objectives of the investigation were to determine the geochemical and physical properties of the materials below the subject site to assess the nature of landfilled material and assess links (if any) to ground and structural movement observed at the surface. Details of the site methods are presented in Appendix 2.
5.1.2	The intrusive investigation was completed between 6 and 10 January 2020 and comprised of the following: • Three deep boreholes (BH01-BH03) terminated where the natural strata were reached, with monitoring wells for groundwater and ground gas; • Foundation inspection pits (TP01-TP04); • In situ and Ex situ geotechnical laboratory testing; • Geoenvironmental laboratory testing; and • One return groundwater and ground gas monitoring visit.
5.1.3	It was not possible to complete California Bearing Ratio tests at the time of the investigation due to issues with equipment at that time. However, the geotechnical engineer provided an asserted value based upon the material encountered within the borehole as discussed below.

5.1.4 The investigation rationale for the trial holes is summarised below:

Table 1. Rationale for Investigation Locations.

Trial Hole	Rationale	Proposed Depth (m bgl)	Notes
BH01 – BH03	Provide Information on ground conditions and geotechnical parameters	12 (or minimum 2m into the natural strata)	BH3 was terminated at 10.45m as natural was encountered at 8.3m
TP01 – TP03	Provides information on the foundations beneath the building in area of cracked masonry.	To the base of the foundations or 1.2m	Depth of foundations were established using a metal rod probe due to unstable loose gravels.
TP04	Provides information on the foundations at the corner of the building.	To the base of the foundations or 1.2m.	Depth of foundations were established using a metal rod probe due to unstable loose gravels.

5.1.5 The site investigation was undertaken in general accordance and with reference, where relevant to the following documents:

- Specification for Ground Investigation, Site Investigation Steering Group, Thomas Telford, 1994
- British Standard BS10175:2011 (A2) Investigation of potentially contaminated sites – code of practice, as amended;
- Environment Agency (2000) Secondary model procedures for the development of appropriate soil sampling strategies for land contamination. Technical Report P5-066/TR
- DEFRA/Environment Agency Report CLR11 “Model Procedures for the Management of Land Contamination” and Land Contamination: Risk Management (LCRM) 2019.
- BS ISO 5667-22:2010 Water quality. Sampling. Guidance on the design and installation of groundwater monitoring points
- BS EN 1997 Eurocode 7 - Geotechnical Design- Part 1: General rules (2004) Part 2: Ground Investigation and Testing (2007)

5.1.6 The final stage of the geotechnical assessment is the provision of the investigation findings. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in Section 6 of Eurocode7.

5.1.7 A site plan showing the locations of each exploratory hole is provided in Appendix 1.

5.2 Monitoring Wells

5.2.1 Three monitoring wells were installed in the cable percussion boreholes during this investigation. The monitoring wells were constructed of 50mm diameter HDPE pipe. The response zone within BH01 was positioned to intercept the groundwater surface, and BH02 and BH03 were targeted above the groundwater level so readings of the gas generated in the Made Ground could be accurately taken.

5.2.2 The response zone was surrounded by washed filter gravel and the plain zone was surrounded with bentonite to provide a seal. The monitoring wells were finished with bungs with gas taps and flush mounted covers as specified by the client. Monitoring well installations are shown on the borehole logs and summarised in the following table. Full details of the installations are also provided on the borehole logs presented in Appendix 4.

5.2.3 **Table 2. Monitoring Well Installation Details.**

	Plain Well Section (m)	Slotted Well Section (m)	Bentonite Seal (m)
BH1	0.00 – 3.00	3.00 – 12.00	0.50 – 2.50
BH2	0.00 – 1.00	1.00 – 4.00	0.50 – 1.00 and 4.0 – 5.0
BH3	0.00 – 2.00	2.00 – 8.00	0.50 – 2.00 and 8.0 to 8.5

5.3 Sampling and Testing Strategy

5.3.1 Soil samples were collected from each borehole from both the Made Ground and natural strata. Samples were submitted for geotechnical testing at Geolabs Ltd in accordance with relevant versions of BSEN ISO 17892-6:2017, BSEN ISO 14688-1:2002, and BSEN 1997-2:2007. Environmental samples were submitted under controlled conditions with a Chain of Custody to i2 Analytical (i2) a UKAS and MCerts accredited facility.

5.3.2 Due to the poorly consolidated nature of the fill, its composition and its heterogeneity, limited testing could be completed within the Made Ground due to the likely variability of results, which may lead to spurious findings. The material was considered unsuitable for oedometer testing for this reason and also as there was no saturated zone from which to take samples within the fill. Therefore, SPTs were completed in situ throughout the Made Ground to gain information from this unit. Detailed settlement analysis was outside of the scope of this investigation.

5.3.3 Undisturbed conventional U100 sampling techniques have been taken in the cohesive soils. As such, these samples are not suitable for shear strength testing in accordance with Eurocode specification and the results should be used for guidance only.

5.3.4 Geotechnical testing of natural soils identified included:

- Atterberg testing with natural moisture content;
- Particle Size Distribution;
- Undrained Triaxial Test and
- Sulphates and pH (BRE SD1).

5.3.5 The results of the geotechnical testing are presented in Appendix 8.

5.3.6	Environmental soil samples were tested for a suite of testing considered commensurate with the risks identified in the Phase 1 report: • Heavy metals including; arsenic, cadmium, chromium (total and VI), copper, lead, mercury, nickel, selenium, and zinc; • Cyanide; • Phenols; • Petroleum Hydrocarbons (PHC) – Total Petroleum Hydrocarbons Criteria Working Group (TPH-CWG); • Benzene, Toluene, Ethylbenzene and Xylene (BTEX); • Polyaromatic Hydrocarbons (PAH) – Speciated 16; • Asbestos screen and identification; and • Total Organic Carbon (TOC), Sulphates and pH.
5.3.7	A monitoring well was installed through the groundwater within one borehole, BH1. A groundwater samples was recovered using a Waterra bailer on 20th January 2020 and submitted for analysis of the following parameters: • pH, electrical conductivity, total organic carbon, nitrates, sulphates, dissolved oxygen, hardness, turbidity, dissolved solids and suspended solids; • Ammoniacal nitrogen; • Biological Oxygen Demand and Chemical Oxygen Demand; • Heavy metals including; arsenic, cadmium, chromium (total and VI), copper, lead, mercury, nickel, selenium, and zinc; • Cyanide; • Phenols; • Petroleum Hydrocarbons (PHC) – Total Petroleum Hydrocarbons Criteria Working Group (TPH-CWG); • Benzene, Toluene, Ethylbenzene and Xylene (BTEX); • Polyaromatic Hydrocarbons (PAH) – Speciated 16; and • Volatile Organic Compounds, and Semi-Volatile Organic Compounds.
5.3.8	The sample was taken by means of a bailer as it was for indicative purposes.
5.3.9	The results of the environmental laboratory testing are provided in Appendix 7.
5.4	CCTV Drainage Survey
5.4.1	A CCTV drainage survey was completed on 4-5 December 2019 to assess whether there had been any detrimental impact on the drainage system from ground movement. This was completed throughout the whole of the Brunel Retail Park. The full report is provided in Appendix 11.

6.0 BOREHOLES

6.1 General

6.1.1 The intrusive investigations were undertaken between 6th and 10th January 2020. At the time of the investigations, the weather was cold and windy but mostly dry. The weather during the preceding three months recorded higher than average rainfall.

6.1.2 The ground conditions are described in detail in the logs that are presented within Appendix 3. A summary of the ground conditions is also presented in Table 3.

6.1.3 **Table 3. Summary of Ground Conditions**

Depth From (min/max) (m)	Depth To (min/max) (m)	Soil Type	Description
Ground level	0.41 / 0.60	Hardstanding	Hardstanding comprising block paving underlain by sand, a layer of black tarmac and a grey/pink gravelly sandy roadstone.
0.25	1.10	Made Ground	Made Ground. Pale pink and grey/blue very gravelly sand. Gravel is fine to medium and sub-rounded to sub-angular (Roadstone) over yellow orange clayey slightly sandy gravel, of fine to coarse sub-rounded to sub-angular flint with occasional brick fragments.
0.75 / 1.10	8.90 / 10.10	Made Ground	Infilled Material Made Ground. Low strength dark brown and black sandy gravelly clay with red brick fragments, wood, glass, shale, ceramic, rubber and an organic odour. Gravel is fine to medium, sub-angular flint.
8.00 / 10.10	10.45 / 12.20	Clay	Firm to stiff blueish grey silty sandy Clay with occasional gravel of fine sub-rounded to sub-angular chalk.
11.50 / 12.20	12.15 / 12.45	Sand	Very dense blueish grey/ light brown silty sand.

6.1.4 Underlying the hardstanding, the investigation encountered Made Ground formed of low strength, poorly consolidated sandy gravelly clays, with variable proportions of wood and other organic matter. Generally, the Made Ground was similar in composition throughout the boreholes, starting more clayey with a higher ash content with depth. A higher proportion of wood fragments was noted in the Made Ground in BH02 between 4.0m to 9.8m bgl. In BH01, a layer of red brick was noted between 0.6m and 0.7m bgl, and between 7.9m and 8.4m bgl. These soils are thought to represent the infilled and Made Ground identified on the geology maps.

6.1.5 Underlying the Made Ground, boreholes BH01 and BH02 encountered firm to stiff sandy clays overlying medium dense and dense sands to the full depth of investigation. Within borehole BH03 interbedded sands and clays were encountered directly beneath the Made Ground. Within the sand portion of the strata, blueish grey silty sandy clay layers approximately 3-5mm thick were observed interspersed within the sand.

6.2 Olfactory and Visible Evidence of Contamination

6.2.1 During drilling, records of olfactory and visible evidence of contamination were made. These have been summarised in Table 5.

6.2.2 A 'landfill' odour was noted throughout the Made Ground in BH01 and BH03. The odour was slight and became slightly stronger with depth. In BH02 the odour was moderate in the top of the Made Ground and became stronger with depth, particularly between 4.0m and 9.8m bgl where the wood fragments were more prolific. A personal gas detector was used to monitor gases during drilling BH02 and BH03, but no elevated concentrations of hydrogen sulphide were detected during the works.

6.2.3 **Table 4. Summary of Olfactory and Visible Evidence of Contamination**

BH No.	Depth (m bgl)	Comments
BH01	0.00 – 8.90	Areas of black staining within the Made Ground and fragments of tarmac have been noted. Organic odour noted between 0.80 – 4.00m bgl.
BH02	0.75 – 1.20	Black staining noted.
BH02	4.00 – 9.80	Black staining and organic odour noted.
BH03	0.80 – 1.80	Organic odour noted.
BH03	3.40 – 8.00	Black staining with wood fragments and organic odour.

6.3 Groundwater

6.3.1 Groundwater strikes were recorded in the following boreholes during drilling.

Table 5. Summary of Groundwater Strikes

BH No.	Groundwater Level (m bgl)	Borehole Depth (m bgl)
BH01	11.60	12.00
BH02	12.20	12.45
BH03	10.00	10.45

6.3.2 Groundwater levels were recorded during the gas monitoring visit whereby groundwater was only recorded within BH01 at a depth of 10.7mbgl.

7.0 FOUNDATION INSPECTION PITS

7.1	General
7.1.1	Four inspection pits were excavated using hand tools in the area of the displaced blockwork to the rear of Unit 3. In each location a 0.15m thick concrete beam/narrow slab was encountered approximately 0.1m below ground level which was not obviously connected to any other part of the structure. In TP01 and TP03 the concrete beam had rotated away from the blockwork.
7.1.2	In TP01 and TP04 the blockwork appeared to be sat on a horizontal concrete strip 'footing' (articulation slab) which was encountered at a depth of 1.0m bgl and extended out from the blockwork by approximately 750mm.
7.1.3	It was only possible to establish the horizontal extent of the articulation slab within TP04 with a steel probing rod as the gravel surround repeatedly collapsing into the pit.
7.1.4	The foundation pit logs and cross sections are included in Appendix 5.

8.0 CCTV DRAINAGE SURVEY

8.1	General
8.1.1	A CCTV Drainage Survey was completed by WJ Shirley between 4 th and 5 th December 2019 as part of the initial building survey by Paragon. The CCTV Drainage Survey covered the wider retail park and the report is presented in Appendix 11 including a site plan with numbered manholes and defects. The findings would need to be reviewed in connection with this report.
8.2	Summary
8.2.1	The CCTV Drainage Survey has identified defects across the wider retail park and some in the rear yard area. Recommendations were made for de-silting and de-scaling works to clear the accumulations of silt, scale and debris which will help prevent future blockages and restore the system to its full capacity. Further recommendations were made for structural repairs and for the maintenance of the oil interceptor.
8.2.2	The recommendations from the CCTV drainage survey (WJ Shirley, 2019) should be implemented to ensure the drainage network is functioning adequately (full recommendations and costs detailed in the main report). Whilst general settlement is unlikely to continue to occur, damaged drains could discharge water directly to fill which could lead to exacerbated movement (either within the fill or associated with the slope). It is important that this network is regularly inspected, along with a regular general inspection of the rear yard and the following high urgency repairs are completed to prevent inundation of the ground below the site. Whilst some of the following defects are not directly within the area of the subject site, it would be recommended to reduce the potential for inundation by water below ground for the reasons mentioned above. These are set out in the recommendations section below.

9.0 GEOTECHNICAL RESULTS

9.1 Ground Conditions

9.1.1 The site investigation identified Made Ground over clay and sand of the Lambeth Group. The geotechnical site and laboratory testing are presented below. All geotechnical laboratory certificates are presented in Appendix 6.

9.1.2 **Table 6. Summary of Geotechnical Testing**

Test	Number of tests
Moisture Content	2
Atterberg Limit Test	2
Particle Size Distribution Test	2
Sulphate Determination (BRE SD1)	3
Undrained Triaxial Test	1

9.2 Made Ground / Infilled Ground

9.2.1 The site was found to be underlain by Made Ground to between 8.0m and 10.1m below ground level, generally comprising hardstanding over dark brown-black silty sandy gravelly clay with anthropogenic fragments of brick, ceramic, wood, glass and shale.

9.2.2 Made Ground is by nature highly variable in both composition and bearing capacity, and can be subject to large differential settlements when loaded. It is therefore generally unsuitable for use as a bearing stratum. As no obvious evidence for subsidence was noted to the building, it is assumed the foundations of the building are beneath the Made Ground.

9.2.3 **Table 7. Summary of Geotechnical Testing for Made Ground**

Test	Number of tests
SPT 'N' Value	3 – 15
Sulphate Content (g/l)	2.5
pH	7.4 – 8.8

9.2.4 The results of the geotechnical testing for Made Ground have identified that the strength of the infilled material is highly variable. The sulphate design class has been determined to be DS-3 and assuming a mobile groundwater table, the ACEC class would be AC-3.

9.3 Clay (Lambeth Group)

9.3.1 The Made Ground was underlain by silty sandy Clay to between 11.5m and 12.2m bgl. The results of the geotechnical laboratory testing are summarised in Table 8.

9.3.2

Table 8. Summary of Geotechnical Testing for Clay (Lambeth Group)

Test	Number of tests
SPT 'N' Value	13 – 20
Plasticity Index	34
Sulphate Content (g/l)	1.7
pH	7.9
Triaxial Shear Stress Cu (kPa)	17 – 25
Angle of shearing resistance ϕ' (°)	1.5

9.3.3

The results of the testing for the Clay soils indicates that the Clay is classified as firm to stiff and has a medium volume change potential. The sulphate testing indicates the sulphate design class would be DS-3 and assuming a mobile groundwater table, the ACEC class would be AC-3.

9.4

Sand (Lambeth Group)

9.4.1

The silty sandy clays were underlain by dense to very dense silty SAND to between 10.45m and 12.45m bgl at the base of the boreholes. The results of the geotechnical laboratory testing are summarised in Tables 9 and 10.

9.4.2

Table 9. Summary of Geotechnical Testing for Sand (Lambeth Group)

Test	Silt and Clay (%)	Sand (%)	Gravel (%)	Cobbles (%)
BH01 11.7m bgl Sand (Lambeth Group)	11 – 16	84 – 89	0	0

9.4.3

Table 10. Summary of Geotechnical Testing for Sand (Lambeth Group)

Test	Number of tests
SPT 'N' Value	34 – >50
Sulphate Content (g/l)	0.17 – 0.036
pH	8.9 – 9.0

9.4.4

The results from the testing for the Sand soils indicates the Sand is classified as very dense. The sulphate design class would be DS-1 and assuming a mobile groundwater table, the ACEC class would be AC-1d.

10.0 GEOENVIRONMENTAL RESULTS

10.1	Analytical Test Results – Soils
10.2.1	The results of the environmental testing of the soil samples retrieved from the investigation are presented in a screening table in Appendix 5 and summarised below. The laboratory test certificates are also provided in Appendix 5
10.2.2	Chemical testing was completed principally to establish if the site was underlain by landfilled materials. However, following the geochemical laboratory testing, the results have also been compared to industry accepted standards to determine the risks to human health known as Generic Assessment Criteria (GAC). The human health risk assessment uses Category 4 Screening Levels and Suitable 4 Use Levels (C4SLs and S4ULs). The GAC selected is based on a continued commercial use. A detailed methodology for the assessment is presented in Appendix 6.
10.2.3	The results identified Chrysotile Asbestos in the form of 'Loose Fibrous Debris' within BH2 at 4.20m bgl. Currently, there is no GAC for asbestos in soil. Industry guidance produced by CIRIA C7335 (2014) ' <i>Asbestos in soil and made ground: a guide to understanding and managing risks</i> ' states that "in the case of asbestos in soil, there is no published Soil Guideline Value (SGV) or C4SL. Indeed, agreement has yet to be reached in the UK on an appropriate toxicological criterion on which such a GAC could be based". However, asbestos is not considered to be mobile and based on the extensive hardstanding across the site, the risk to site users is minimal.
10.2.4	No other exceedances, above acceptable thresholds for a commercial land use, were identified of the contaminants tested as part of this investigation.
10.2.5	The results for Total Organic Carbon (TOC) ranged between 2.3% and 6.2%.
10.2	Analytical Test Results – Groundwater
10.2.1	The results from the groundwater analysis have been compared with Tier 1 screening values, as for the soils. This has included Environmental Quality Standards (EQS). In addition, water quality parameters from the Water Framework Directive (WFD) (2000) have been used.
10.2.2	Groundwater was recovered from BH01 on 20 January 2020 and results indicated concentrations of Petroleum Hydrocarbons, Polyaromatic Hydrocarbons, Volatile Organic Compounds and Semi-Volatile Organic Compounds were below the limit of detection. Minor levels of heavy metals were identified, however, no exceedances of the EQS were identified.
10.2.3	The results from the water quality parameters including conductivity, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO) and Ammoniacal Nitrogen are summarised in Table 11.

10.2.4

Table 11. Summary of Water Quality Parameters.

Analysis	Result	Threshold
pH	7	>=6 to <=9 = Good
Electrical Conductivity (µS/cm)	4900	1880 (Note this is for a drinking water protected area. No threshold available for areas outside a drinking water protected area)
Phosphorus (µg/l)	45.7	N/A
BOD (mg/l)	15	>7.5 = poor (based on standard for rivers)
COD (mg/l)	50	N/A
Dissolved Oxygen (mg/l)	3.9	<45 = poor (based on standard for rivers)
Ammoniacal Nitrogen as N (µg/l)	5700	290 (general quality of groundwater) < 1100 = Poor

10.2.5

By comparing the above with quality parameters outlined in WFD (2000) for surface water features it is apparent that the groundwater quality is poor, and is likely to be a result of groundwater leaching from the historical landfilled material. However, groundwater was noted at the base of the Made Ground, and the fill was noted to be dry.

10.3

Gas Monitoring Results

10.3.1

Pollutant linkages associated with risks from ground gas and vapour to the property and to human health have been assessed using BS 8485:2015+A1:2019 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

10.3.2

A single gas monitoring visit was undertaken as a result of the short timescales of the investigation for indicative purposes. The monitoring was undertaken on 17th January 2020 and a summary of the results has been presented in Table 12. The gas monitoring records are presented in Appendix 9.

Table 12. Summary of Gas Monitoring Results.

BH No.	Peak Methane (% v/v)	Peak Carbon Dioxide (% v/v)	Minimum Oxygen (% v/v)	Peak Flow Rate (l/hr)	Volatile Organic Compounds (ppm)	Atmospheric Pressure Range (m bars)
BH01	0.0	12.90	7.20	0.00	0.30	1005
BH02	6.40	9.80	3.70	0.00	0.20	1005
BH03	2.50	14.90	0.00	2.70	0.20	1005
MW5 (historical borehole)	0.00	1.50	14.20	0.00	0.30	1005

10.3.3

Carbon monoxide and hydrogen sulphide concentrations were below the limit of detection.

11.0 DISCUSSION

11.1	Ground Conditions
11.1.1	The boreholes advanced at the site found infilled material between depths of 0.75m bgl and 10.10m bgl. The infilled material was of low strength clays and granular sand and gravel with red brick fragments, wood, glass, shale, ceramic, rubber and an organic odour. By drilling boreholes at the site, it has been possible to establish that the site is directly underlain by a thick layer of fill type material. This has been identified by its black organic nature and owing to the anthropogenic materials within it. The fill material also comprised residual contamination within it and was gas producing, suggesting it is of an anthropogenic / fill nature (environmental results are discussed further below).
11.1.2	Made Ground or fill materials are, by nature, highly variable in both composition and bearing capacity and can be subject to large and ongoing differential settlements when loaded. It is therefore generally unsuitable for use as a bearing stratum. The in situ geotechnical testing has identified the strength of the Made Ground is highly variable with SPT 'N' values ranging between 3 and 15. From a review of the uncorrected SPT results carried out in the Made Ground, the material is shown to be variable in density but generally soft and poorly consolidated. Therefore, a material of this nature would typically be susceptible to settlement once subject to loading if structural elements are founded in or on to this material.
11.2	Settlement to the yard area
11.3.1	Due to the poorly consolidated nature of the fill materials described above settlement has occurred since the rear yard area was installed. By excavating hand pits, it has revealed that the brick pavements in the rear yard are situated on a sand layer, over tarmac with a sub-base of roadstone over fill material. It was not possible to carry out in situ CBR testing at the time of the investigation, however, the geotechnical engineer indicated that given the underlying low density and poorly consolidated Made Ground a CBR value of <0.5% would be anticipated. Therefore, owing to the nature of heavy and regular vehicle movements in the rear yard area, this would be considered as insufficient. This is expected to be a contributing factor towards the undulating movement observed within the yard area, which is worse in some areas than others.
11.3	Settlement to the building
11.3.1	Paragon observed approximately 100mm of settlement of the pavement to the rear yard which extends along the back of Units 2, 3a and 3b. This is particularly evident to Units 1 to 3b but is also noticeable to the pavement which continues along the rear of Unit 4, albeit to a lesser extent. This is evidenced by rodent boxes fixed to the rear elevation walls, which were previously sat on the pavement that are now suspended above the ground identifying the extent the pavement has sank. Similar signs of settlement related damage have not been seen within the building footprint or along the western elevation of the structure. This implies that the building itself may be relatively stable compared to the rear yard area. It is anticipated that the existing building is on piled foundations (however, we have not had sight of As Built drawings) whereas the rear yard is situated on a sub-base of roadstone over fill material as per our site observations discussed above.

11.3.2	The infilled material was underlain by sands and clays. The strength of the clay was determined as firm to stiff ('N' values ranged between 13 and 20), and the sand was very dense with 'N' values of 34 to >50. In addition, the clay soils were noted to have a medium volume change potential. A single triaxial test was completed on the Clay which determined a shear stress C_u of 17-25kPa with an angle of shearing resistance of 1.5° .
11.3.3	The soil properties of the sand and clay are deemed to be commensurate with natural strata, asserted to be the Lambeth Group, which is mapped in this area. We have no detailed As Built information to confirm the type of foundations present. Therefore, foundation inspection pits were excavated. The surrounding soils were subject to collapse during excavation and so the findings were inconclusive in this regard although a feature that may have been indicative of a pile cap was noted in two of the pits. Following on-site discussions with a structural engineer, and given the nature of the structure, it is considered likely that the building is piled. With reference to the abovementioned Delta Simons report, other parts of the retail park (Units 12 and 13) were asserted to have been piled to depths of 7m below the sand and clay layer. If the piles in this part of the subject site extend on or into the natural strata through the deep level of fill, this would explain why the building is seemingly less impacted by settlement than the surrounding yard area.
11.4	Visual appraisal - slope
11.4.1	Other factors were considered in relation to the movement observed, such as slope failure. The slope to the west of the site was identified to be very steep and a number of bent trees were present indicating some degree of movement has taken place historically. Visual inspections completed as part of the investigations to date did not identify damage to the building that was definitively attributable to slope failure. The undulation identified to the rear yard area was more consistent with circular depressions rather than a more rigid subsidence effect where large cracks open as a result of lateral movement. As such, settlement is considered to be the more likely cause to the movement observed at the site.
11.5	Potential for future settlement
11.5.1	Detailed settlement analysis was outside of the scope of this investigation. However, testing was completed to assess the composition of the fill. The composition of the fill established by testing has identified that the organic content of the fill is currently low; the frequency of large organic fragments identified was low. This is important as it means that the volume of material capable of degradation in future is low. Furthermore, groundwater was not identified within the Made Ground, it was encountered within the natural soils between depths of 9.50m bgl and 11.50m bgl. Therefore, the fill is considered to be fairly stable going forward as a resting water level / leachate in the fill would be unlikely to contribute to continued settlement subject to completion of recommendations as set out below.
11.5.2	As part of the CCTV survey completed some defects to drainage were noted. Despite the movement visible at the surface within the yard area, the damage to drainage below does not appear to very extensive, which is positive. There are however some urgent defects that should be addressed (as per recommendations below).

11.5.3	It is considered that movement from the slope (if any) would be a long-term consideration and boreholes at the crest and toe of the slope would be required to fully understand potential instability and potential future failure mechanisms. Regular inspections would determine if additional works on the slope are required. However, in the short term to limit the risk of potential slope inundation from damaged drains / pipes, then repairs should be carried out accordingly as discussed below. Limiting water within the fill matrix would also reduce the potential for further ongoing settlement.
11.6	Damage to rear elevation
11.6.1	One section of the blockwork to the rear of Unit 3a was noted to have deflected outward by approximately 50mm from vertical. It was asserted by others that this was due to internal impact damage by a forklift or similar. From an internal inspection by a Paragon Building Surveyor, it is understood that ancillary accommodation in the form of toilets and an office are located within the building behind this section of the wall and there is no obvious sign of impact damage. Therefore, pits were excavated along this elevation to observe whether there was an underlying issue that could be observed.
11.6.2	A structural engineer from Bradbrook Consulting was present when the trial pits were excavated and an articulation slab was identified within the trial pits running parallel to the building wall. Where Made Ground / fill positioned below this feature has settled, it appears that the articulation slab has dropped causing an uplift affect. This uplift has pushed up against a bull nose kerb at the base of the block work wall and caused the rotational effect as the block work wall was pushed outwards. A sketch was prepared by Bradbrook Consulting and is presented as Figure 4 of Appendix 1. Recommendations have been made below for the repair to this wall section, and localised breaking out of the articulation slab to prevent further contact.
11.6.3	In the time and remit of this investigation, it has not been possible to inspect the entire length of the articulation slab to ensure the rotational effect is not being caused elsewhere. If identified, additional areas of the articulation slab will need to be broken out to prevent contact with the bull nose kerb at the base of the blockwork. However, this does not appear to be the case from visual inspections completed to date extensively across the site, with the exception of Unit 3b. It is considered that this process may have also occurred at the rear of this unit as a minor area of blockwork was also slightly pushed out. As these two units (3a and 3b) were the only identified areas where the rotational effect has been observed, it is considered to be a localised defect, specifically at areas where the articulation slab is in contact with the wall.
11.7	Environmental findings
11.7.1	Chemical testing was completed principally to establish if the site was underlain by fill materials. The results of the chemical analysis of soils identified concentrations of contaminants that were indicative of anthropogenic impact.
11.7.2	Made Ground was encountered in all boreholes across the site to a maximum depth of 10.10m bgl. Chemical testing identified asbestos fibres within the Made Ground. This would pose an unacceptable risk to site users if in areas of soft landscaping or at the surface. However, asbestos is not considered to be mobile and based on the extensive hardstanding across the site, the risk to site users is minimal.

11.7.3	In the event that groundworks are undertaken to complete repairs at the site, construction workers are likely to be at risk of exposure to asbestos via inhalation pathways. As such, appropriate Risk Assessments and Method Statements are likely to be required outlining the specific health and safety standards to be followed in accordance with current legislation Control of Asbestos Regulations 2012: Asbestos in Soil (CAR-SOIL). This should include, but not be limited to, an outline for requirements for Personal Protective Equipment and Respiratory Protective Equipment, damping down of excavations and controlled removal of Made Ground arisings to suitably licensed waste receivers.
11.8	Risks to Human Health
11.8.1	The remaining contaminants tested were found to be below the thresholds for a commercial use and are not considered to be a risk to site users. They are greater than the limit of detection which would imply the material is an anthropogenic fill material rather than natural deposits.
11.9	Risks to Controlled Waters
11.9.1	The site is underlain by the Lambeth Group which has been identified as being Clay over Sand. The Lambeth Group is classified by the Environment Agency as a Secondary (A) Aquifer. The site is not situated within a Source Protection Zone and there are no groundwater abstractions within 1km of the site.
11.9.2	The nearest surface water feature is a stream, located near to the south-western boundary of the subject site. During the Paragon walkover, it was observed that the stream runs at the bottom of a slope which forms a slope along the site boundary. This feature appears to flow into the River Kennet, which flows in a generally northerly direction, approximately 60 m to the west of the subject site.
11.9.3	The boreholes encountered Made Ground to a depth on 10.10m bgl over impermeable Clays to 11.50m bgl over permeable Sand. Groundwater was identified within the Sand at 11.50m bgl within BH01 and rose to 10.50m bgl. As such, it is likely that groundwater is trapped beneath the clay.
11.9.4	A groundwater sample was recovered from BH01 and identified concentrations of Petroleum Hydrocarbons, Polyaromatic Hydrocarbons, Volatile Organic Compounds and Semi-Volatile Organic Compounds were below the limit of detection. Minor levels of heavy metals were identified, however, no exceedances of the EQS were identified.
11.9.5	The concentrations of natural water parameters including conductivity, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO) and Ammoniacal Nitrogen found that the water quality was poor. This is likely to be a result of the landfilling within the wider area, rather than from the Made Ground above as it was found to be dry during drilling.
11.10	Gas Risk Assessment
11.10.1	A preliminary Gas Risk Assessment has been carried out in general accordance with 8485:2015+A1:2019 whereby the Characteristic Situation (CS) of the site has been identified. The Characteristic Situation ranges are between 1-6 and determine the gas risk to the property and the level of protection required. The process calculates a Gas Screening Value (GSV) based on gas monitoring which was undertaken based on boreholes within the Made Ground only.

11.10.2	The GSV for the site has been calculated based on the concentration of methane and carbon dioxide monitored and the flow rate recorded in the boreholes using the equation: $GAC = q \left(\frac{Chg}{100} \right)$ Where: • Chg = Concentration of a specific hazardous gas expressed as a percentage of total gas volume (%v/v) • q = Total gas flow from a borehole in litres per hour (l/hr) • Qhg = Calculated flow rate of a specific hazardous gas from a borehole reading The results are then compared to tables set out in the guidance for assessment.
11.10.3	Based on the preliminary test results of the gas monitoring for carbon dioxide the site falls within CS2 (low risk) whereby some degree of gas protection is required.
11.10.4	The Phase 1 investigation identified that the property is not located within a Radon Affected Area and as such, radon gas protection is not considered to be required.
11.10.5	In addition, the internal gas monitoring results from Aviron showed the concentrations within the buildings to mostly be below the limit or in some instances very low. These slight rises in methane and carbon dioxide were attributed to small rooms with less air flow but not considered to be a concern.
11.10.6	The gas data obtained from the recent boreholes shows some methane generation, with some depleted oxygen conditions. Further gas monitoring will be required to make a formal assessment, and the gas protection measures installed within the existing building should be assessed to confirm they are sufficient for the risk identified onsite.

12.0 CONCLUSION

12.1	Based on the findings of the ground investigation completed to date, it is apparent that the site is formed upon a thickness of fill material. This is commensurate with the observations from historical mapping and environmental data base records. There were concerns relating to the quality and composition of the fill material and because no site-specific ground condition data was available for the subject site, a ground investigation was completed. The boreholes have identified fill below the site that is attributed to the settlement issues within the service yard area.
12.2	The settlement experienced below the block paving to the rear yard area of the site does not appear to have had on the same impact / movement to the buildings themselves, which might imply that the foundations of the building are relatively competent. It would also appear that drain chambers (which have not 'dropped' in the same manner as the surrounding block paving) have been more securely founded than the surrounding car park although there are some defects to drainage requiring repair.
12.3	The recommendations from the CCTV drainage survey should be implemented to ensure the drainage network is functioning adequately. Whilst general settlement is unlikely to continue to occur, damaged drains could discharge water directly to the granular Made Ground which could lead to subsidence.

12.4	Despite there appearing to be limited movement to the buildings overall as a result of settlement, there was one area of exception to the rear of Unit 3a where the outer wall was defective. At the time of a Paragon due diligence walkover, it was highlighted by others, that this may have been a result of fork-lift impact damage. However, based upon the internal building layout, a trial pit was excavated to understand the footings and ground conditions local to this part of the building. Based on the information obtained from the ground investigation, it is evident that a rotational failure of the slab in front of the western façade of Unit 3a is likely to be the reason that the block work has pushed up and out. Therefore, this appears to be a localised issue which has been exacerbated by the settlement of materials below and so an appropriate repair and localised remediation of this defect will require consideration. Further assessment along this flank may be prudent to ensure that there is no further area of failure of the articulation slab.
12.5	Based on the odours identified during drilling, and the presence of ground gas in the initial monitoring visit, it is asserted that there are still some residual gases being produced from the fill material.

13.0 RECOMMENDATIONS

13.1	Repairs To Service Yards
13.1.1	Repairs to the settlement in the rear yard area are recommended. As poorly consolidated fill has been identified below the yard area, this would require compaction to create a suitable sub-base with clean down of each paviour prior to relaying. Based on the poorly composed materials below, it is unlikely that a straightforward lift and re-lay approach would be suitable. Therefore, an estimated rate of repair is asserted to be £120/m ² . It is understood that the site's asset managers indicated that there was approximately 55m ² requiring localised repairs. Based on the topographical survey completed and using a Geographical Information System (GIS) to measure the impacted areas, Paragon considers the most currently significant / visually obvious areas to be more in the region of 65m ² . Therefore, the estimated repair costs of these areas would be estimated at £7,800 excluding VAT and professional fees. This estimate covers repair the worst affected areas of the yard only, as opposed to complete replacement.
13.1.2	Note that this rate is subject to survey and agreeing the extent of work required. It would be necessary to ensure that a suitable CBR can be reached for the nature of vehicle movements within the service yard. This is likely to require extensive compaction potentially localised ground improvement which would only be established following site wide specific testing in this regard.
13.1.3	Whilst a localised approach to repair may be acceptable to address areas that have settled more significantly. Under this phased scenario, it would be prudent to undertake regular inspection of the rear yard areas to ensure that if further settlement is identified in future, that it is quickly rectified. Based on the ground conditions encountered, if certain localised areas are remedied / reinforced, then adjacent areas that remain on poorly composed / uncompacted fill may be subject to differential settlement and may drop versus the treated areas particularly where subject to heavy vehicle movements. This could result in further areas needing to be relayed and repair costs could increase significantly.

13.2	Repairs To The Defect Wall And Articulation Slab
13.2.1	It is recommended that an additional request is made for as built drawings and building control records to fully establish the nature of the articulation slab that has been subject to movement. Whilst the movement appears to be localised, it is recommended that repairs to the blockwork are made as soon as possible to prevent further movement.
13.2.2	Repair to this wall section would be required together with localised breaking out of the articulation slab to prevent further contact. Repairs to the external wall, may also include breaking out of the concrete slab. This should be undertaken locally to ensure it does not create a problem elsewhere. Rotation to the wall may also have caused inner skin wall damage that may also need repairs. At the time of the investigation, Paragon were unable to access the inside of the buildings and as such could not make a full assessment.
13.2.3	A budget cost to remove the existing cavity blockwork wall to the rear of Unit 3a, circa 25m ² , and replace with new including internal finishes has been estimated by Paragon between £15,000 and £20,000 excluding VAT and professional fees. Note that this rate is subject to survey and agreeing the extent of work required. For example, it would be recommended to inspect the entire length of the articulation slab (by lifting paving slabs by hand) to ensure the rotational effect is not being caused elsewhere, for example by Unit 3b. If identified, additional areas of the articulation slab will need to be broken out to prevent contact with the bull nose kerb at the base of the blockwork and repairs may need to be extended. However, this does not appear to be the case from visual inspections around the remainder of the structure completed to date.
13.3	Repairs And Maintenance To Drainage
13.3.1	The recommendations from the CCTV drainage survey (WJ Shirley, 2019) should be implemented to ensure the drainage network is functioning adequately (full recommendations and costs detailed in the main report). Whilst general settlement is unlikely to continue to occur, damaged drains could discharge water directly to fill which could lead to exacerbated movement (either within the fill or associated with the slope). It is important that this network is regularly inspected, along with a regular general inspection of the rear yard and the following high urgency repairs are completed to prevent inundation of the ground below the site. Whilst some of the following defects are not directly within the area of the subject site, it would be recommended to reduce the potential for inundation by water below ground for the reasons mentioned above. The key repairs are stated as follows: • There is a collapsed drain near MH13. This will need excavation and renewal to repair. • There are also three displaced joints which we recommend are repaired to prevent further deterioration and possible collapse. These can currently be repaired in-situ by patch lining but have the potential to deteriorate and collapse if not dealt with. • We recommend one of these (D9) within the subject site area is repaired within the next 3 months to prevent likely collapse. • There is a cracked cover slab at inspection chamber MH15. We recommend this is monitored.

13.4	The total cost for the repairs recommended in the drainage report is £48,500 excluding VAT. Specifically, the cost of repairs stated above would be £6,800 excluding VAT, which accounts for repairing displaced joints and collapsed drains – these are considered to be most relevant to reduce risk of inundation of the fill. The report by WJ Shirley is appended to this report. Environmental
13.4.1	As gassing fill material has been identified at the site, ongoing monitoring of the recently installed wells, gas vents, and within the building could be undertaken to verify the adequacy of gas protection measures. This is recommended in the absence of design information about the gas protection measures.
13.4.2	Internal and external gas monitoring around the entire site is estimated at c. £2,000 per visit.

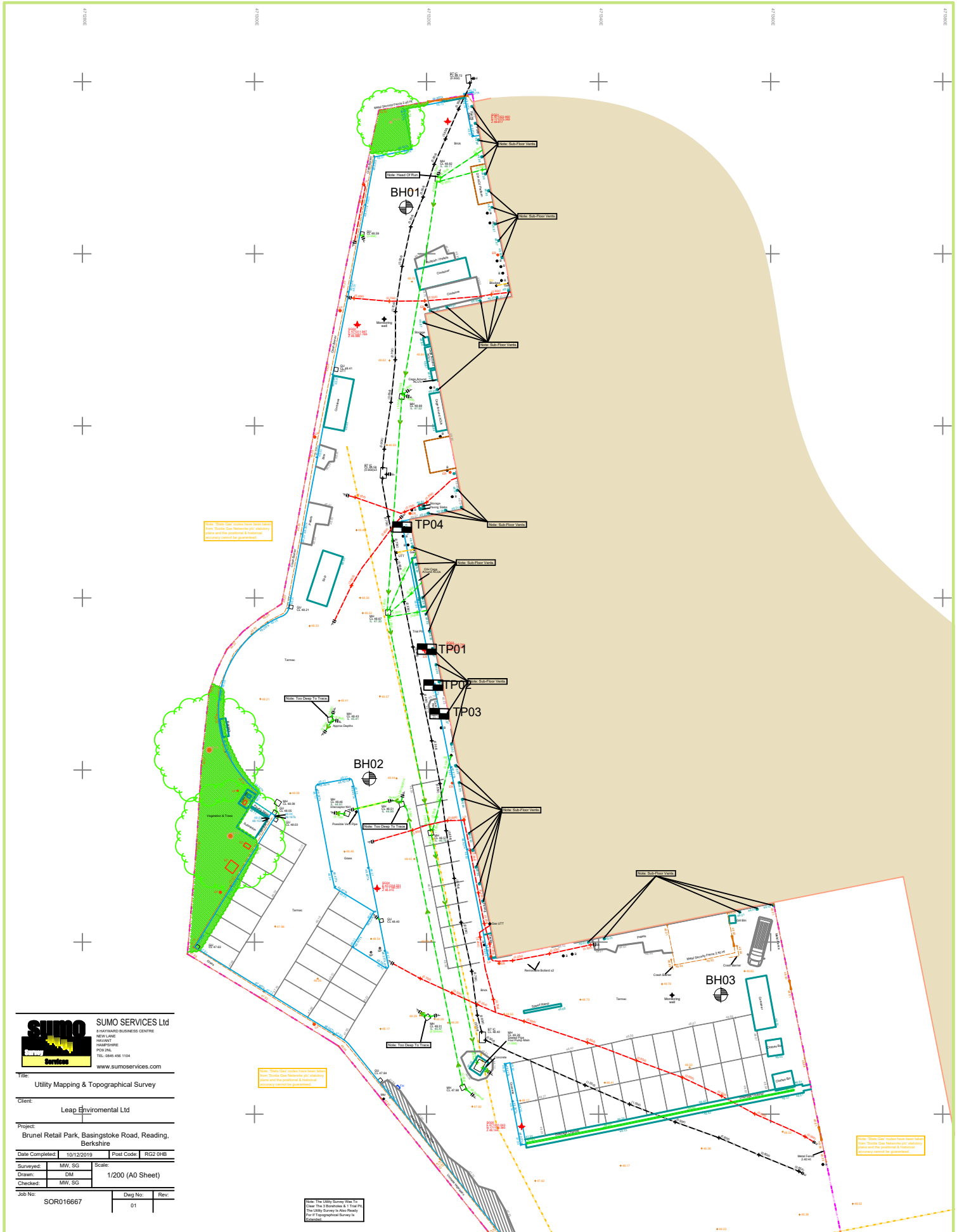
APPENDIX 1: FIGURES



 Site Boundary

Images from Google Maps

	Title:	Site Location Plan			Project:	LP2141
	Project:	Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS	Date:	4th February 2020	Figure No.:	I





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 WINDYBUSH
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 TEL: 0845 438 1104
 www.sumoservices.com

Title: Utility Mapping & Topographical Survey

Client: Leap Environmental Ltd

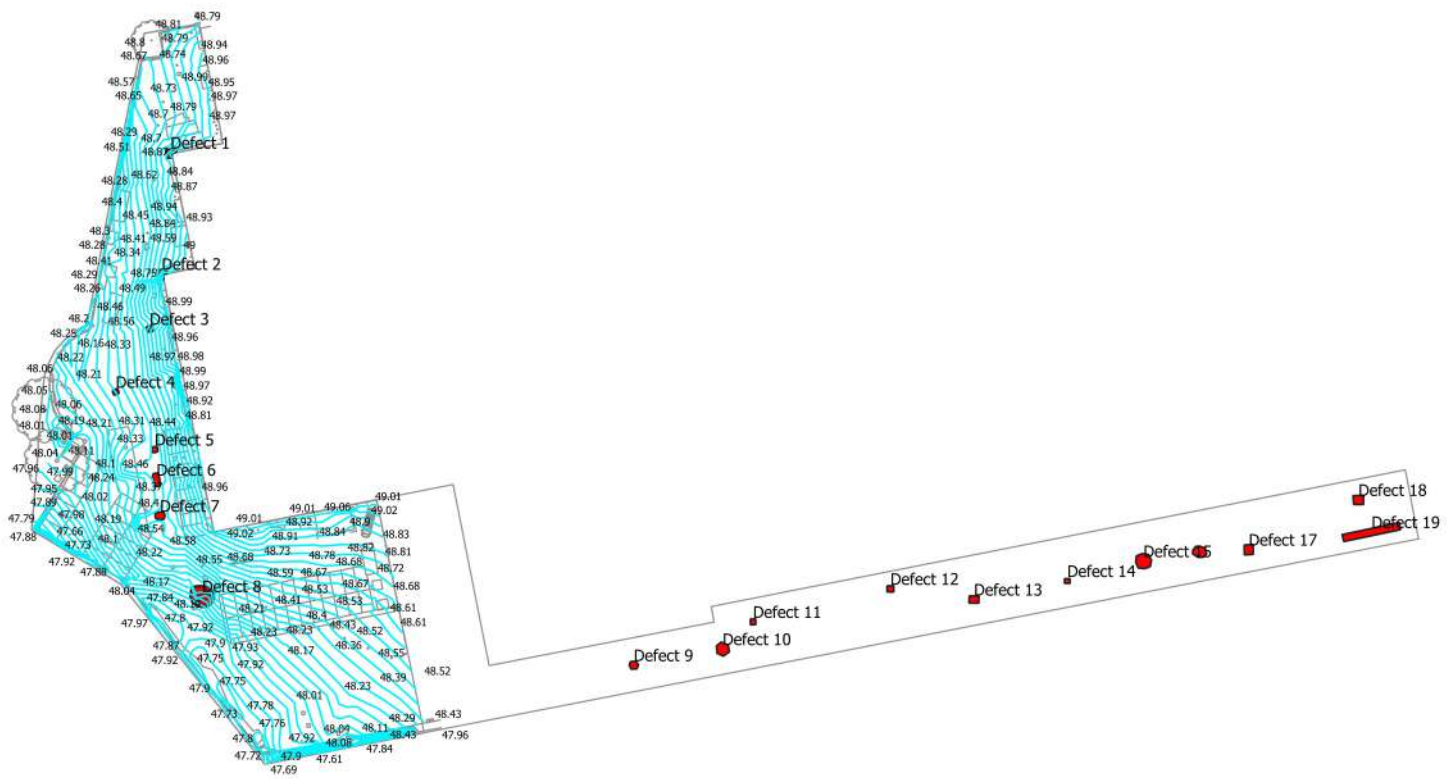
Project: Brunel Retail Park, Basingstoke Road, Reading, Berkshire

Date Completed:	10/12/2019	Post Code:	RG2 0HB
Surveyed:	MW, SG	Scale:	1/200 (A0 Sheet)
Drawn:	DM		
Checked:	MW, SG		
Job No:	SOR016667		
Dwg No:	01	Rev:	

Project	Brunel Business Park	Scale at A4	NTS	Fig No.	2
Title	Site Investigation Plan				
Date	Jan 2020				



Paragon Building Consultancy
The Harlequin Building
65 Southwark Street
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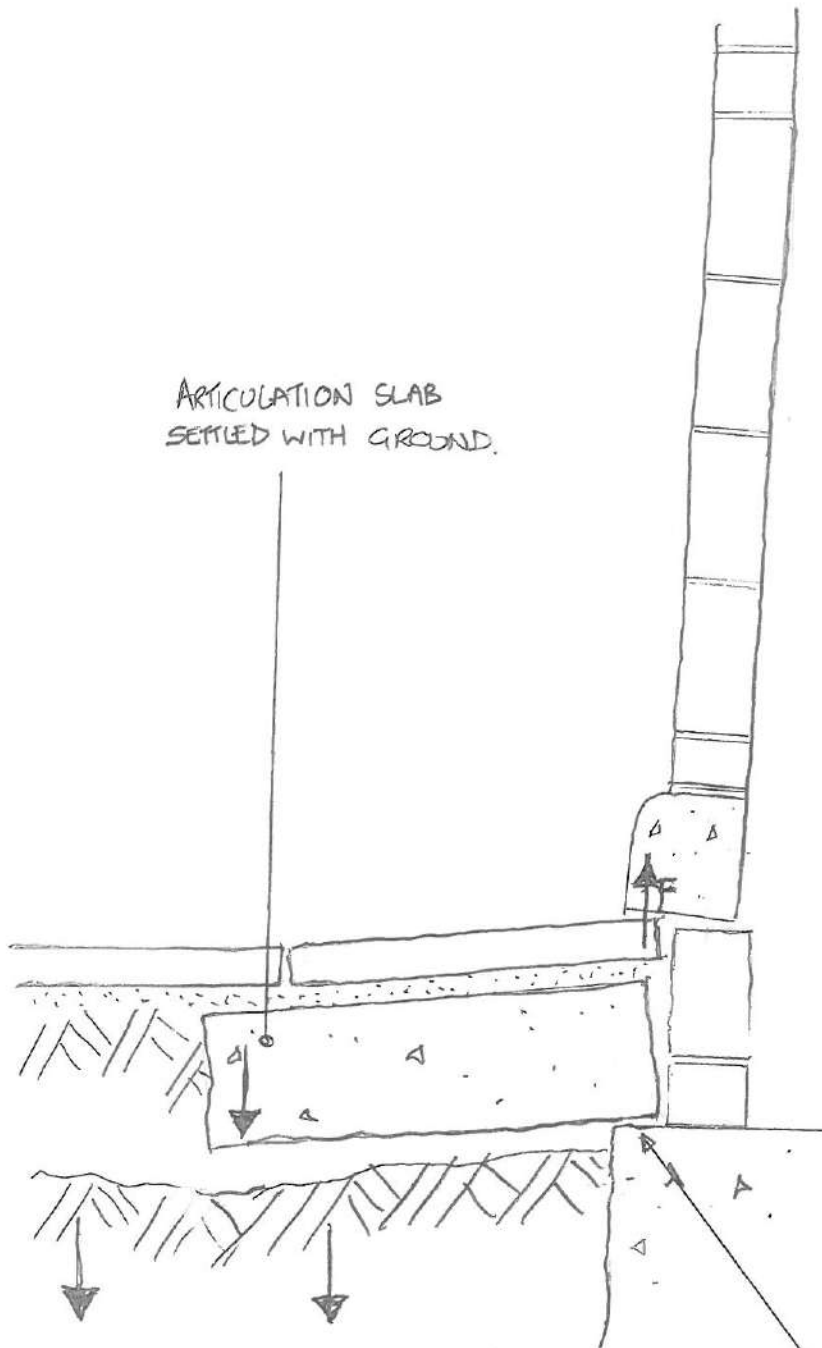


id	Name	Notes	Area (m2)
1	Defect 1	Corner dropped	2.50
2	Defect 2	Corner dropped	3.00
3	Defect 3	Area dropped around drain	2.00
4	Defect 4	Area dropped around drain	1.20
5	Defect 5	Area dropped around drain	1.30
6	Defect 6	Settlement	3.00
7	Defect 7	Area dropped around drain	2.50
8	Defect 8	Area dropped around drain	16.50
9	Defect 9	Settlement	2.00
10	Defect 10	Settlement	3.00
11	Defect 11	Settlement	1.00
12	Defect 12	Settlement	1.00
13	Defect 13	Settlement	3.00
14	Defect 14	Settlement	1.00
15	Defect 15	Settlement	8.00
16	Defect 16	Settlement	3.00
17	Defect 17	Settlement	2.00
18	Defect 18	Settlement	3.00
19	Defect 19	Settlement	6.00

Rev	Description	Date

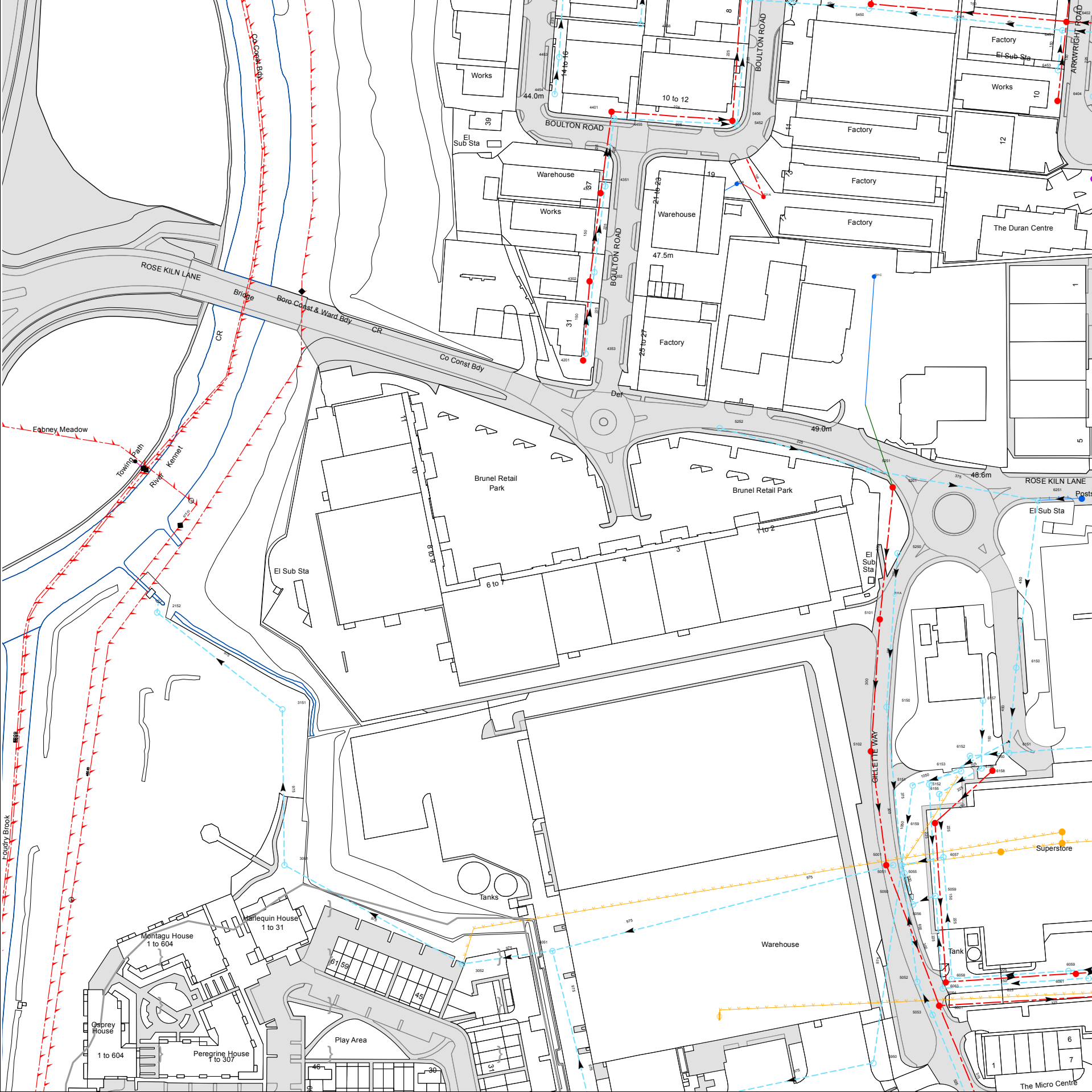
Project Brunel Retail Park	Scale 1:1500
	Drawn by CB
	Approved By CK
Title Defect Location Plan	Drawing Number 3
	Date 10/20/2020

ARTICULATION SLAB
SETTLED WITH GROUND.



ARTICULATION SLAB
ROTATED ON FOOTING.
& APPLIED UPWARD FORCE
IN THE WALL.

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2019 4028677



The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no survey information is available.

Manhole Reference	Manhole Cover Level	Manhole Invert Level
531A	n/a	n/a
531C	n/a	n/a
3151	n/a	n/a
2152	n/a	n/a
5252	49.31	48.03
4201	48.47	46.02
4353	48.38	46.04
4302	47.24	44.94
4352	47.21	45.09
4301	45.57	43.79
4351	45.7	44.13
531B	n/a	n/a
5251	49.12	45.6
5102	47.26	44.52
5101	48.01	44.84
5150	47.49	44.94
5201	48.68	45.16
511A	n/a	n/a
5250	48.46	45.94
5151	46.68	41.29
5152	47.13	45.6
6159	46.75	45.35
6155	47.2	42.5
3051	n/a	n/a
4051	n/a	n/a
5001	46.52	44.3
5051	45.59	n/a
5050	46.71	41.19
5055	46.68	42.05
5056	46.68	44.17
5059	46.28	44.3
6057	46.57	41.87

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Sewer Key - Commercial Drainage and Water Enquiry

Public Sewer Types (Operated & Maintained by Thames Water)

 **Foul:** A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

 **Surface Water:** A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

 **Combined:** A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

 Trunk Surface Water

 Trunk Foul

 Storm Relief

 Trunk Combined

 Vent Pipe

 Bio-solids (Sludge)

 Proposed Thames Surface Water Sewer

 Proposed Thames Water Foul Sewer

 Gallery

 Foul Rising Main

 Surface Water Rising Main

 Combined Rising Main

 Sludge Rising Main

 Proposed Thames Water Rising Main

 Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

 Air Valve

 Dam Chase

 Fitting

 Meter

 Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

 Control Valve

 Drop Pipe

 Ancillary

 Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

 Outfall

 Undefined End

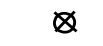
 Inlet

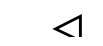
Other Symbols

Symbols used on maps which do not fall under other general categories

 Public/Private Pumping Station

 Change of characteristic indicator (C.O.C.I.)

 Invert Level

 Summit

Areas

Lines denoting areas of underground surveys, etc.

 Agreement

 Operational Site

 Chamber

 Tunnel

 Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

 Foul Sewer

 Surface Water Sewer

 Combined Sewer

 Gully

 Culverted Watercourse

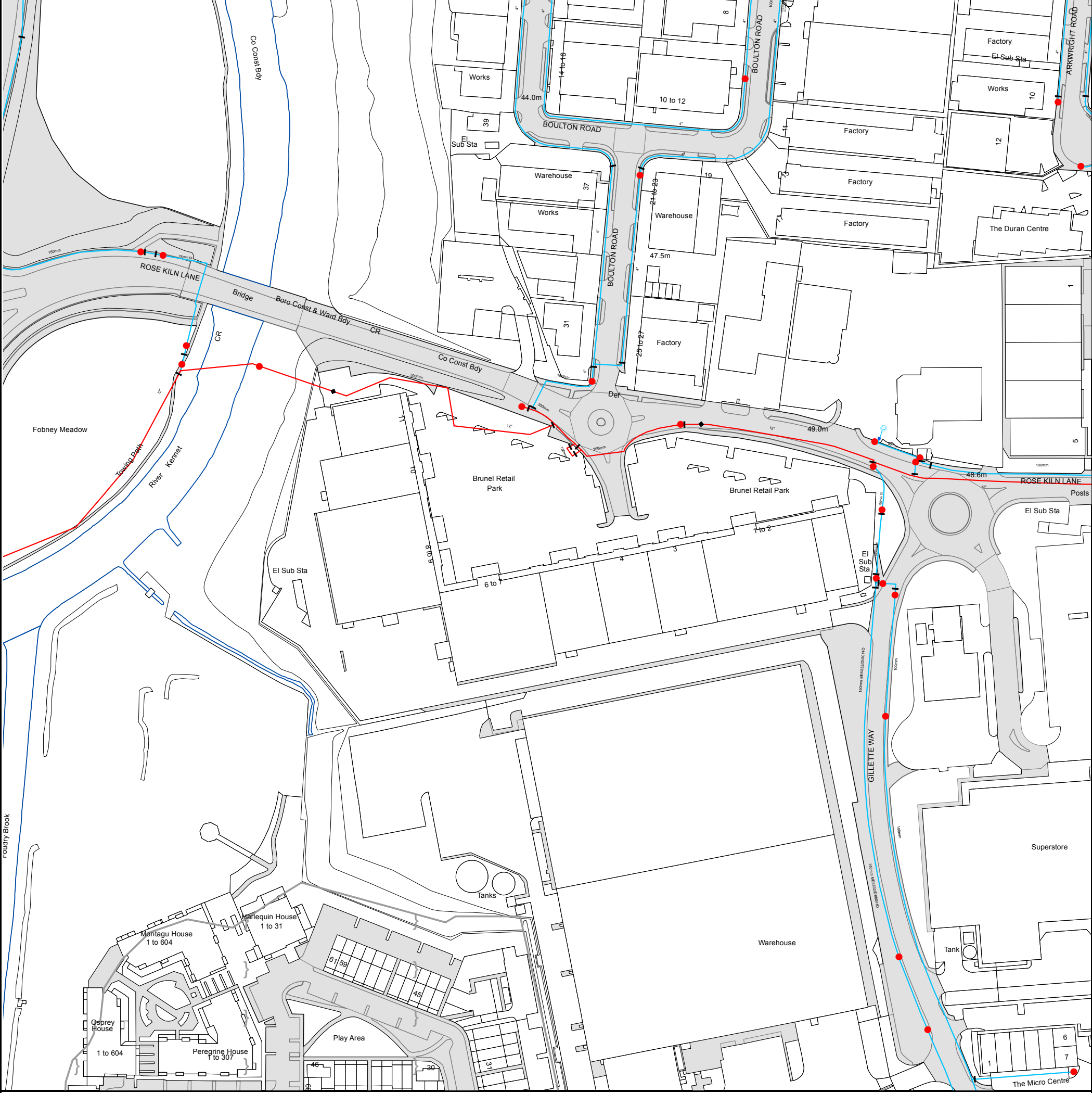
 Proposed

 Abandoned Sewer

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0118 925 1504.



The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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Waterworks Key - Commercial Drainage and Water Enquiry

Water Pipes (Operated & Maintained by Thames Water)

4"	Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
16"	Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.
3" SUPPLY	Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.
3" FIRE	Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
3" METERED	Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.
	Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.
	Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

Valves

	General Purpose Valve
	Air Valve
	Pressure Control Valve
	Customer Valve

Hydrants

	Single Hydrant
--	----------------

Meters

	Meter
--	-------

End Items

Symbol indicating what happens at the end of a water main.

	Blank Flange
	Capped End
	Emptying Pit
	Undefined End
	Manifold
	Customer Supply
	Fire Supply

Operational Sites

	Booster Station
	Other
	Other (Proposed)
	Pumping Station
	Service Reservoir
	Shaft Inspection
	Treatment Works
	Unknown
	Water Tower

Other Symbols

	Data Logger
--	-------------

PIPE DIAMETER

DEPTH BELOW GROUND

Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Other Water Pipes (Not Operated or Maintained by Thames Water)

	Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.
	Private Main: Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

APPENDIX 2: FIELD METHODS

2.0 FIELD METHODS

2.1	Design of Investigation
2.1.1	The site investigation was broadly undertaken in general accordance and with reference, where relevant to the following documents: • Specification for Ground Investigation, Site Investigation Steering Group, Thomas Telford, 1994 • British Standard BS10175:2011+A2:2017 Investigation of potentially contaminated sites – code of practice, as amended; • Eurocode 7: Geotechnical Design BS EN 1997; • Environment Agency (2000) Secondary model procedures for the development of appropriate soil sampling strategies for land contamination. Technical Report P5-066/TR • The Model Procedures for the Management of Land Contamination, CLR 11; and • BS ISO 5667-22:2010 Water quality. Sampling. Guidance on the design and installation of groundwater monitoring points
2.1.2	The works were progressed on site by a subcontractor who have been scrutinised by Paragon and are on Paragon's approved sub-contractor list. The investigation was designed to provide a preliminary assessment of the ground conditions at the subject site. Prior to the progression of the site investigation holes all areas were checked for services.
2.2	Onsite Methods
2.2.1	Boreholes were drilled using a Cable Percussion rig. The block paving was carefully removed and placed to one side and used to reinstate the surface to its previous condition. The boreholes were excavated at 150mm diameter casing. No water flush was used during the drilling works.
2.2.2	Foundation inspection pits were dug using hand tools down the side of Unit 3. The paving slabs at the surface were removed carefully to keep them intact to reinstate the surface to its previous condition. The foundation pits were typically 0.85m wide by 0.85m long and ranged from a depth of 0.5m to 1.25m bgl. Spoil was placed on plastic sheeting to prevent cross- contamination and was replaced in reverse order.
2.2.3	Soil samples were recovered from the boreholes and foundation pits for field screening and logging. Boreholes were logged in general accordance with the requirements of BS 5930:20152 and BS EN ISO 146883.
2.2.4	Standard penetration tests were undertaken in the boreholes at 1m centres in the top 5m and at 1.5m centres thereafter in granular soils alternating with UT100 samples in cohesive soils, in accordance with BS EN ISO 22476-3;2005. Uncorrected blow counts, 'N values', are recorded on the borehole logs in Appendix D.

2.3	Constraints
2.3.1	The ground conditions reported relate only to the point of excavation and do not necessarily guarantee a continuation of the ground conditions throughout the non-inspected area of the site. Whilst such exploratory holes would usually provide a reasonable indication as to the general ground conditions these cannot be determined with complete certainty.
2.4	Monitoring Well Installation
2.4.1	Upon completion of the borehole a monitoring well was installed with 50mm HDPE well pipe to depths presented on the borehole logs. A slotted section of well pipe was surrounded by gravel to provide a 'response zone'. A plain section of pipe was surrounded by bentonite to produce a seal.
2.4.2	Groundwater levels within the gas monitoring wells were recorded during each visit using an electronic dip/interface meter.
2.5	Sampling and Testing Strategy
2.5.1	All the exploratory holes were logged and sampled by a site engineer. Testing and sampling at the site was undertaken to investigate the ground conditions present.
2.5.2	Soil samples were collected from across the site laterally and at different depths within each trail position to provide an even coverage of the site.
2.5.3	Geotechnical bulk disturbed samples were obtained from the strata encountered and were subjected to careful examination.
2.5.4	Environmental soil samples representative of the underlying conditions were collected and submitted for a suite of determinants based on the risks identified in the Phase 1 section of this report and the specific ground conditions identified during the intrusive investigation. The soil samples were transported to an appointed United Kingdom Accreditation Service (UKAS) accredited laboratory.
2.5.5	Groundwater grab samples were recovered using a Waterra bailer and inspected for the presence of water using an electronic dipmeter.
2.6	Quality Control
2.6.1	The samples were despatched under a chain of custody procedure to a UKAS accredited laboratory, for subsequent chemical analysis. Where appropriate, samples were stored within cool boxes containing ice packs. A Chain of Custody is included with all sample consignments.
2.7	Gas Monitoring
2.7.1	The wells were monitored for methane, carbon dioxide, oxygen and hydrogen sulphide using a multi-gas analyser (GA5000/GFM436). The wells screened for the presence of Volatile Organic Compounds using a Photo Ionisation Detector (PID).

2.7.2	Ground gas monitoring was carried out in accordance with the guidelines presented in CIRIA C665 'Assessing risk posed by hazard ground gases to buildings'. Flow was monitored for a period of two minutes where possible; maximum flow was recorded. Ground gases, including concentrations of methane, carbon dioxide, hydrogen sulphide and carbon monoxide were monitored for up to five minutes. During monitoring, ground gas readings were logged every thirty seconds.
2.7.3	Following gas monitoring, water levels are checked using an interface meter, which is also capable of detecting the presence of free product. Where groundwater was present, then water samples were retrieved using a bailer.
2.8	Health and Safety
2.8.1	A site-specific Risk Assessment and Method Statement (RAMS) was produced prior to the works beginning on site; works were completed in accordance with the methodology set up in this assessment. No incidents occurred during this investigation.

APPENDIX 3: PHOTOGRAPHS



01: Rear yard overview



02: Rear yard overview



03: Rear yard overview



04: Rear yard overview



05: Section of damaged wall



06: Section of damaged wall



07: Section of damaged wall



08: Section of damaged wall



09: Section of damaged wall



10: Section of damaged wall



11: Internal Photograph of Unit 4



12: Uneven ground surface



13: Exposed concrete beam



14: Gap between concrete and wall



15: Continuation of concrete beam



16: Broken through concrete beam



17: Cable percussive rig set up



18: Sampled infilled material



19: Sampled natural ground



20: Example of reinstated position



21: Overview of slope



22: Overview of slope



23: Overview of slope



24: Overview of slope

APPENDIX 4: BOREHOLE LOGS

Borehole Log

Borehole No.

BH01

Sheet 1 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 07/01/2020 - 08/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.08			BLOCK PAVING	
					0.18			MADE GROUND: Yellow slightly gravelly fine to coarse sand.	
					0.26			TARMAC	
					0.45			MADE GROUND: Pale pink and grey/blue very gravelly sand. Gravel is fine to medium and sub-rounded to sub-angular (ROADSTONE).	
		0.70	D		0.60			MADE GROUND: Yellow-orange clayey slightly sandy gravel, of fine to coarse sub-rounded to sub-angular flint with occasional brick fragments.	1
		1.10	D		0.70			RED BRICK	
		1.30		N=4 (1,2/1,1,1,1)	1.10			MADE GROUND: Dark brown and black sandy gravelly clay with red brick fragments and a slight organic odour. Gravel is fine to medium sub-angular of flint.	2
		1.30 - 1.75	D					MADE GROUND: Low strength light to medium brown mottled black/dark brown sandy gravelly clay with occasional red brick fragments and rare glass fragments. Gravel is fine to medium sub-rounded to sub-angular of flint and rare sandstone.	
		1.30 - 2.00	B					From 3.0m to 3.8m: Becoming more gravelly.	
		1.50	ES						
		2.00		N=5 (1,0/1,2,1,1)					
		2.00 - 2.45	D						
		2.00 - 2.50	B						
		3.00		N=3 (1,1/1,0,1,1)					
		3.00 - 3.45	D						
		3.00 - 3.50	B						
		4.00		N=2 (1,0/1,0,1,0)	3.80				
		4.00 - 4.45	D						
		4.00 - 4.50	B						
		4.50	ES						
		5.00		N=2 (1,0/1,0,1,0)					
		5.00 - 5.45	D						
		5.00 - 5.50	B						
		6.00	D						
		6.70		N=6 (1,1/1,1,2,2)	6.60				
		6.70 - 7.15	D						
		6.70 - 7.20	B						
		7.20	D						
		7.50	D						
		7.50 - 8.00	B						
		7.95	D		7.90				
								BRICK	8
		8.70	D		8.40				
		9.00		N=14 (1,2/3,3,4,4)	8.90				
		9.00 - 9.45	D						
		9.00 - 9.50	B						
		10.00	ES						

Continued on next sheet

Remarks

Hand dug pit to 0.6m but unable to dig further due to brick. CAT scanned at 0.6m. Water strike at 11.6m, rising to 10.9m after 20 minutes. Well install plain pipe from ground level to 3.0m bgl, slotted pipe from 3.0m to 12.0m bgl. Bentonite seal between 0.5m and 2.5m bgl. Gravel filter medium between 2.5m and 12.0m bgl.

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Borehole Log

Borehole No.

BH01

Sheet 2 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 07/01/2020 - 08/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	D	N=20 (2,3/4,4,6,6)				From 10.5m to 11.5m: red and orange patches.	11
		10.50							
		11.50	D	N=34 (4,6/6,9,9,10)	11.50			From 11.3m to 11.5m: Yellow silty SAND layer.	12
		11.50	D						
		11.70	D					Dense light brownish grey silty SAND.	
		11.70 - 12.15	D						
					12.15			End of borehole at 12.15 m	12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Hand dug pit to 0.6m but unable to dig further due to brick. CAT scanned at 0.6m. Water strike at 11.6m, rising to 10.9m after 20 minutes. Well install plain pipe from ground level to 3.0m bgl, slotted pipe from 3.0m to 12.0m bgl. Bentonite seal between 0.5m and 2.5m bgl. Gravel filter medium between 2.5m and 12.0m bgl.



Borehole Log

Borehole No.

BH02

Sheet 1 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 08/01/2020 - 09/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.08			0.08			BLOCK PAVING	
		0.18			0.18			MADE GROUND: Yellow slightly gravelly fine to coarse sand.	
		0.22			0.22			TARMAC	
		0.41			0.41			MADE GROUND: Pale pink and grey/blue very gravelly sand. Gravel is fine to medium and sub-rounded to sub-angular (ROADSTONE).	
		0.75			0.75			MADE GROUND: Yellow-orange clayey slightly sandy gravel, of fine to coarse sub-rounded to sub-angular flint with occasional brick fragments.	1
		1.20		N=15 (1,2/3,4,4,4)				MADE GROUND: Extremely low to very low strength dark grey mottled black, grey and green slightly clayey gravelly sand with occasional lumps of green sand, brick fragments and an organic odour. Gravel is fine to medium and sub-angular.	2
		1.20 - 1.65	D					Between 0.75m and 1.2m: Soils are black and brown in colour.	
		1.20 - 2.00	B					At 1.2m: Soils are medium strength.	
		2.00		N=4 (2,1/1,1,1,1)				At 2.5m: Lumps of greyish blue and brown sandy clay.	
		2.00 - 2.45	D					From 3.0m to 4.0m: Occasional fragments of glass, ceramic and tarmac.	3
		2.00 - 2.50	B						
		3.00		N=2 (2,1/0,1,0,1)					
		3.00 - 3.45	D						
		3.00 - 3.50	B						
		4.00		N=4 (1,0/1,1,1,1)	4.00				
		4.00 - 4.45	D					MADE GROUND: Very low strength black clayey gravelly sand with occasional fragments of brick, glass and ceramic, and pieces of rubber and wood/twigs, and a strong organic odour. Gravel is fine and occasional medium sized, and sub-rounded to sub-angular.	4
		4.00 - 4.50	B						
		4.20	ES						
		5.00		N=4 (1,1/1,1,1,1)					5
		5.00 - 5.45	D						
		5.00 - 5.50	B						
		6.60		N=4 (2,1/1,1,1,1)					6
		6.60 - 7.05	D						
		6.60 - 7.10	B						
		8.00		N=4 (1,1/1,1,1,1)					7
		8.00 - 8.50	B						
		9.50		N=4 (1,1/1,1,1,1)					8
		9.50 - 9.95	D						
		9.50 - 10.00	B						
					9.80				9
								MADE GROUND: Dark grey with black silty	10

Continued on next sheet

Remarks

Hand dug pit to 1.2m. Water strike at 12.2m, rising to 11.2m after 20 minutes. Well install plain pipe from ground level to 1.0m bgl, slotted pipe from 1.0m to 4.0m bgl. Bentonite seal between 0.5m and 1.0m bgl and 4.0m and 5.0m bgl. Gravel filter medium between 1.0m and 4.0m bgl.

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Borehole Log

Borehole No.

BH02

Sheet 2 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 08/01/2020 - 09/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	ES		10.10			sandy gravelly clay with brick and ceramic fragments and fibrous roots, and occasional lumps of grey silty clay. Gravel is fine and sub-angular	
		11.00 - 11.45	U					Medium strength blueish grey with occasional brown patches silty sandy CLAY with occasional gravels of fine sub-rounded to sub-angular chalk.	11
		11.25	ES						
		11.45	D						
		12.00		N=13 (2,3/2,3,4,4)					
		12.00 - 12.45	D		12.20			Medium dense bluish grey silty SAND.	12
					12.45			End of borehole at 12.45 m	
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Hand dug pit to 1.2m. Water strike at 12.2m, rising to 11.2m after 20 minutes. Well install plain pipe from ground level to 1.0m bgl, slotted pipe from 1.0m to 4.0m bgl. Bentonite seal between 0.5m and 1.0m bgl and 4.0m and 5.0m bgl. Gravel filter medium between 1.0m and 4.0m bgl.



Borehole Log

Borehole No.

BH03

Sheet 1 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

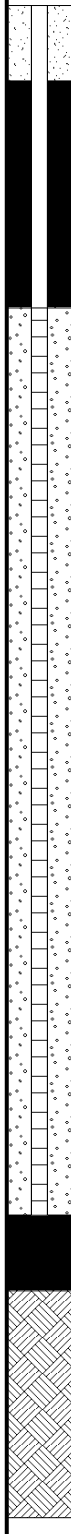
Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 09/01/2020 - 10/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.08			0.08			BLOCK PAVING	
		0.18			0.18			MADE GROUND: Yellow slightly gravelly fine to coarse sand.	
		0.23			0.23			TARMAC	
		0.40	D		0.40			MADE GROUND: Pale pink and grey/blue very gravelly sand. Gravel is fine to medium and sub-rounded to sub-angular (ROADSTONE).	
		0.50	D		0.50			MADE GROUND: Yellow-orange clayey slightly sandy gravel, of fine to coarse sub-rounded to sub-angular flint with occasional brick fragments.	1
		0.70	D		0.70			MADE GROUND: Medium strength black sandy gravelly clay with a slight organic odour. Gravel is fine to medium sub-rounded to sub-angular.	
		1.20		N=12 (2,3/2,3,3,4)	1.20			MADE GROUND: Extremely low to low strength dark brown very sandy gravelly clay with occasional fragments of glass and a slight organic odour. Gravel is fine to medium and sub-rounded to sub-angular.	2
		1.20 - 1.65	D		1.20 - 1.65				
		1.20 - 2.00	B		1.20 - 2.00				
		1.50	ES		1.50				
		2.00		N=3 (1,1/0,1,0,1,1)	2.00				
		2.00 - 2.45	D		2.00 - 2.45				
		2.00 - 2.50	B		2.00 - 2.50				
		3.00		N=2 (1,1/0,1,0,1)	3.00				
		3.00 - 3.45	D		3.00 - 3.45				
		3.00 - 3.50	B		3.00 - 3.50				
		4.00		N=2 (2,1/0,1,0,1)	4.00				
		4.00 - 4.45	D		4.00 - 4.45				
		4.00 - 4.50	B		4.00 - 4.50				
		5.00		N=2 (1,1/0,1,0,1)	5.00				
		5.00 - 5.45	D		5.00 - 5.45				
		5.00 - 5.50	B		5.00 - 5.50				
		6.00	ES		6.00				
		6.50		N=4 (2,1/1,1,1,1)	6.50				
		6.50 - 6.95	D		6.50 - 6.95				
		6.50 - 7.00	B		6.50 - 7.00				
		8.00			8.00				
		8.10 - 8.55	D		8.10 - 8.55			Very dense light brown SAND with bands of bluish grey silty sandy CLAY.	8
		8.55	D		8.55				
		9.00	ES		9.00				
		9.50		N=50 (3,4/50 for 285mm)	9.50				
		9.50 - 9.95	D		9.50 - 9.95				
		9.50 - 10.00	B		9.50 - 10.00				

Continued on next sheet

Remarks

Hand dug pit to 1.2m. Water strike at 10.0m, rising to 9.0m after 20 minutes. Well install plain pipe from ground level to 2.0m bgl, slotted pipe from 2.0m to 8.0m bgl. Bentonite seal between 0.5m and 2m bgl, and 8.0m and 8.5m bgl. Gravel filter medium between 2.0m and 8.0m bgl.

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Borehole Log

Borehole No.

BH03

Sheet 2 of 2

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -

Hole Type
CP

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Level:

Scale
1:50

Client: Paragon Building Consultancy

Dates: 09/01/2020 - 10/01/2020

Logged By
LS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00		N=50 (4,9/50 for 205mm)					
		10.00 - 10.45	D		10.45			End of borehole at 10.45 m	
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Hand dug pit to 1.2m. Water strike at 10.0m, rising to 9.0m after 20 minutes. Well install plain pipe from ground level to 2.0m bgl, slotted pipe from 2.0m to 8.0m bgl. Bentonite seal between 0.5m and 2m bgl, and 8.0m and 8.5m bgl. Gravel filter medium between 2.0m and 8.0m bgl.



APPENDIX 5: FOUNDATION INSPECTION PIT LOGS



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Trial Pit Log

Trialpit No

TP01

Sheet 1 of 1

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -
Level:

Date
06/01/2020

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Dimensions (m):

0.85

Depth
1.07

0.85

Scale
1:25

Logged
LS

Client: Paragon Building Consultancy

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05			PAVING SLAB
				0.15			MADE GROUND: Yellow slightly gravelly sand. Gravel is fine sub-angular of flint.
							CONCRETE
				0.50			MADE GROUND: Loose greyish brown very gravelly sand.
				1.07			End of pit at 1.07 m

1

2

3

4

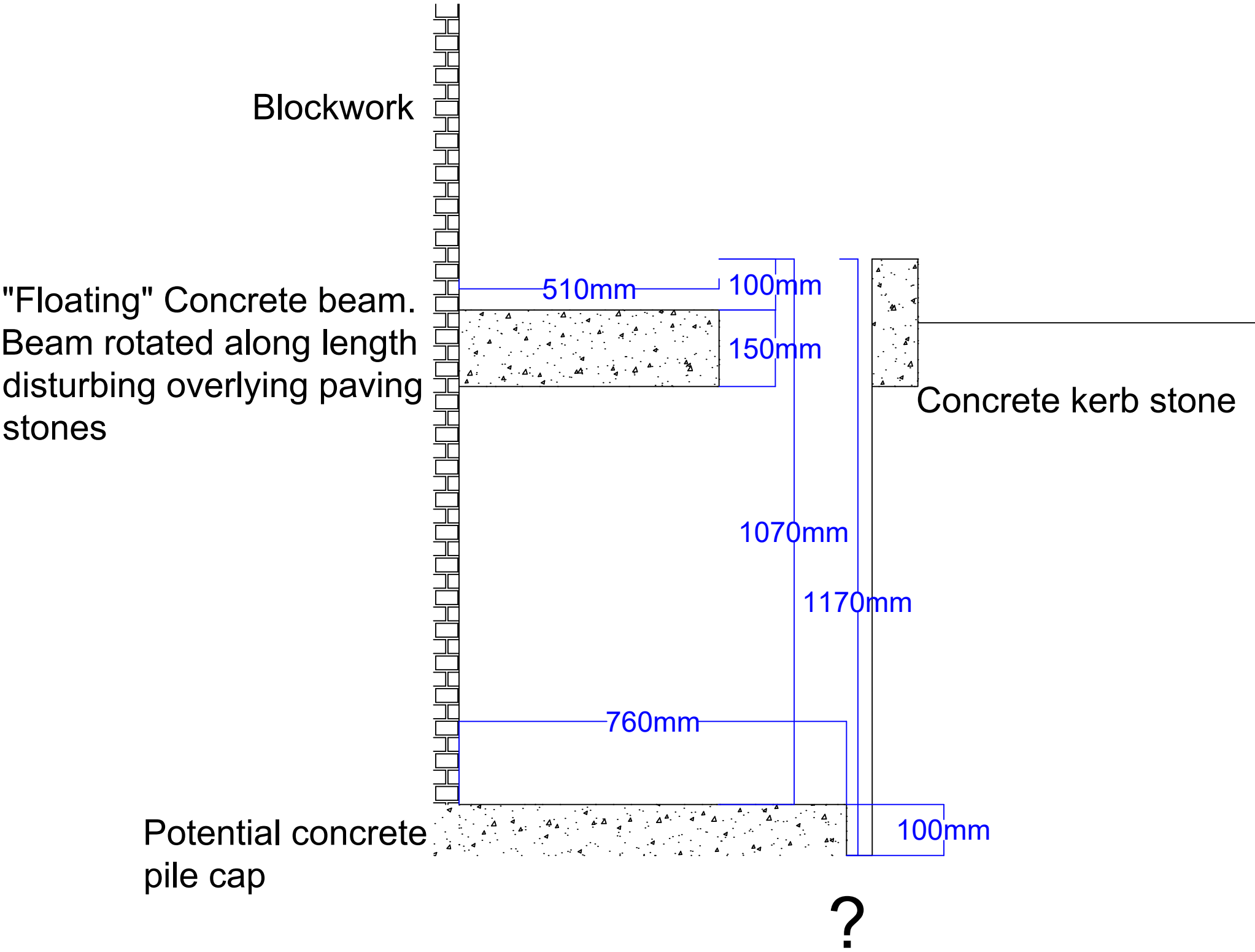
5

Remarks: Depths at base proven using rod due to loose material. No water encountered.

Stability: Unstable

AGS

TP1



leap environmental	Client	Paragon Building Consultancy	Date	Jan '20	Project Ref.	LP2141
	Project	Brunel Business Park, Reading		Scale at A4	Fig No.	3
	Title	Foundation Section		NTS		

Trial Pit Log

Trialpit No

TP02

Sheet 1 of 1

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords:	-
Level:	

Date
06/01/2020

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Dimensions
(m):

0.85

Depth
0.50

0.45

Scale
1:25

Logged
LS

Client: Paragon Building Consultancy

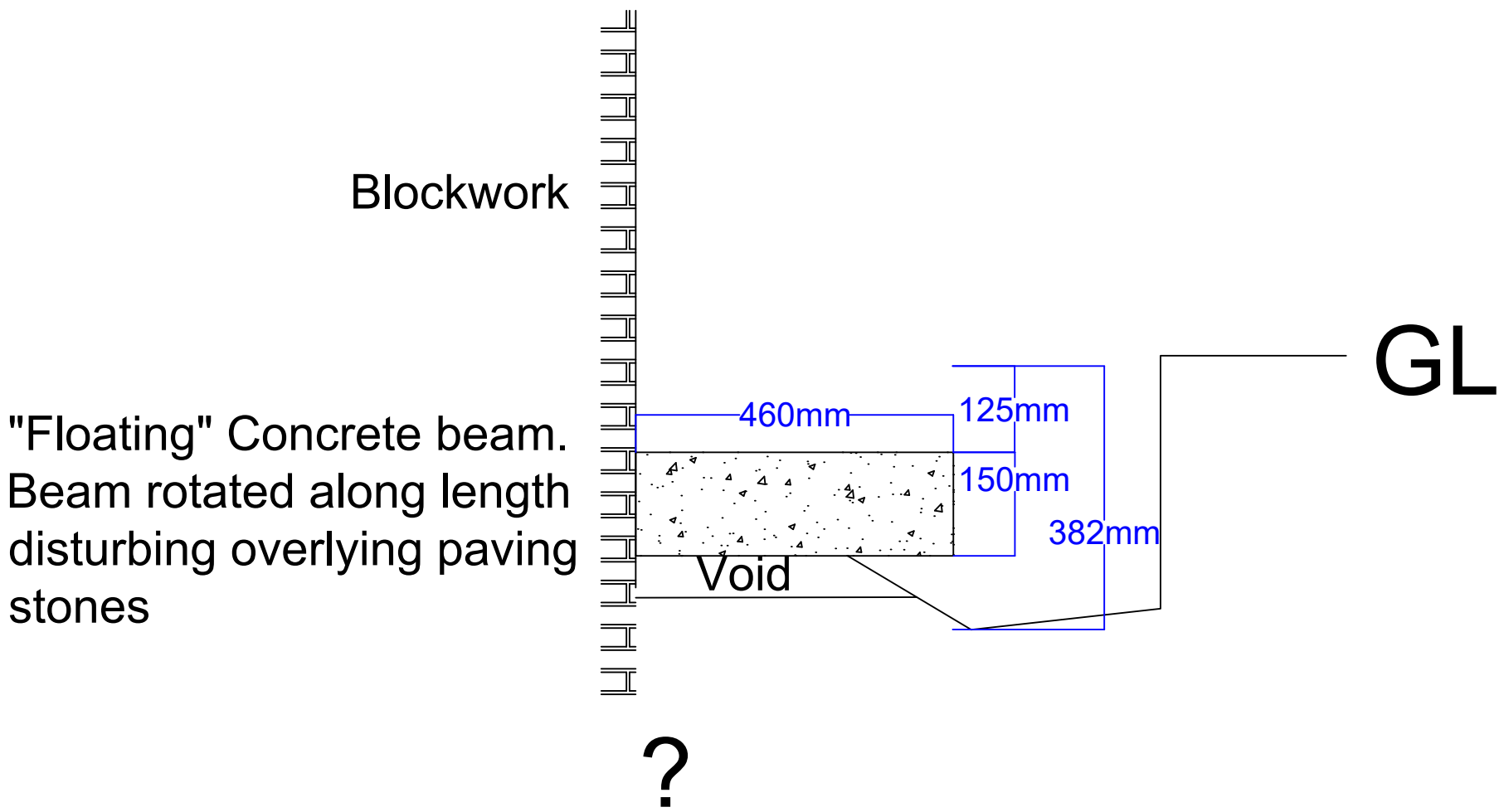
[illegible]

Remarks:	Depths at base proven using rod due to loose material. No water encountered.
----------	--

Stability: Unstable

AGS

TP2



leap environmental	Client	Northfield Cottages, Fontwell	Date	Jan '20	Project Ref.	LP2141
	Project	Paragon Building Consultancy		Scale at A4	Fig No.	4
	Title	Foundation Section		NTS		

Trial Pit Log

Trialpit No

TP03

Sheet 1 of 1

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords:	-
Level:	

Date
06/01/2020

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Dimensions
(m):

0.85

Scale
1:25

Client: Paragon Building Consultancy

Depth
0.50

0.85

Logged
LS

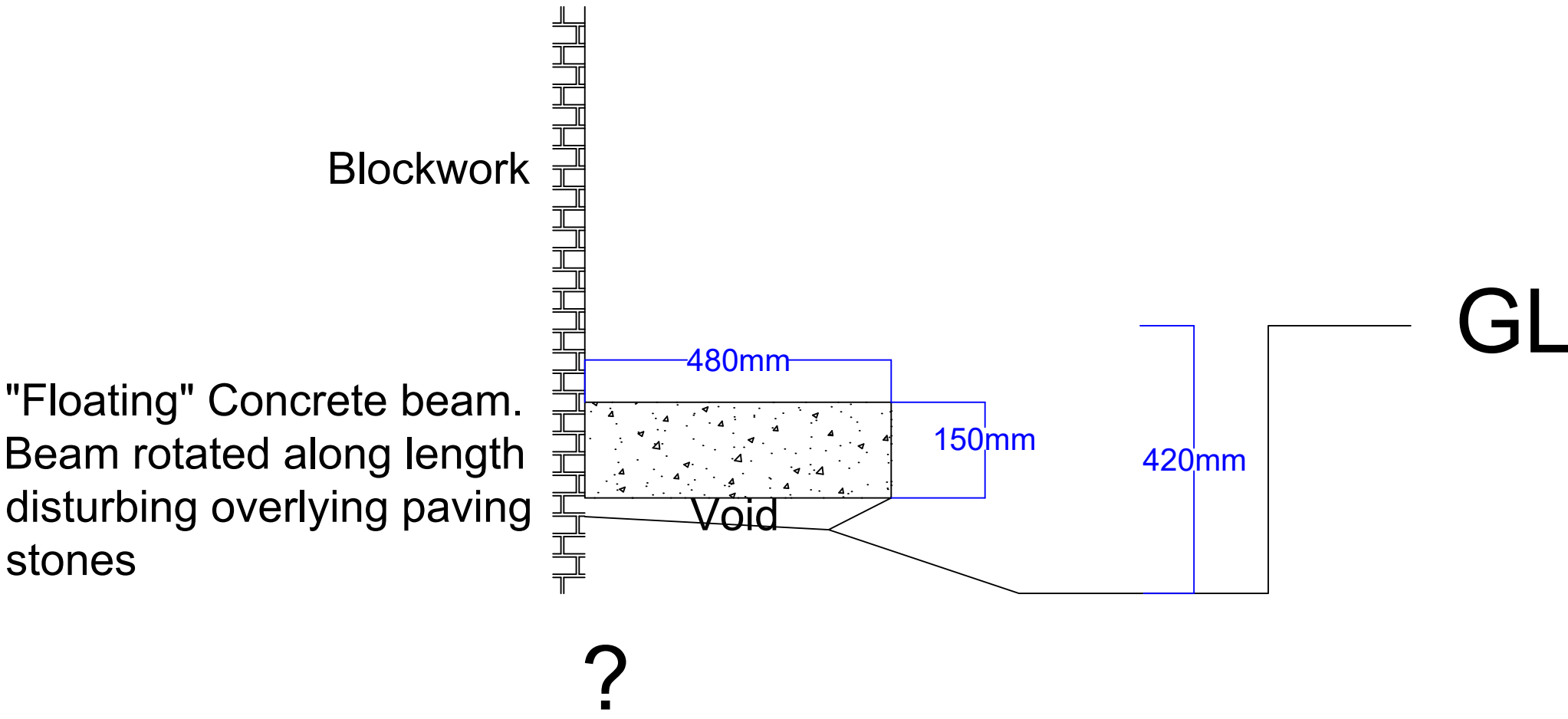
[illegible]

Remarks:	Depths at base proven using rod due to loose material. No water encountered.
----------	--

Stability: Unstable

AGS

TP3



leap environmental	Client	Paragon Building Consultancy	Date	Jan '20	Project Ref.	LP2141
	Project	Brunel Business Park		Scale at A4	Fig No.	5
	Title	Foundation Section		NTS		



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Trial Pit Log

Trialpit No

TP04

Sheet 1 of 1

Project Name: Brunel Retail Park

Project No.
LP2141

Co-ords: -
Level:

Date
06/01/2020

Location: Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

Dimensions (m):

0.85

Depth
1.25

0.85

Scale
1:25

Logged
LS

Client: Paragon Building Consultancy

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05			PAVING SLAB
				0.10			MADE GROUND: Yellow slightly gravelly sand. Gravel is fine sub-angular of flint.
				0.31			CONCRETE
							MADE GROUND: Loose greyish brown very gravelly sand.
				1.25			End of pit at 1.25 m

1

2

3

4

5

Remarks: Depths at base proven using rod due to loose material. No water encountered.

Stability: Unstable

AGS

TP4

Blockwork

"Floating" Concrete beam.
Beam rotated along length
disturbing overlying paving
stones

GL

Potential concrete
pile cap

Width not visually confirmed
due to collapsing gravels but
probed with steel rod and
estimated to be between
750 and 850mm

?

leap environmental	Client	Paragon Building Consultancy	Date	Jan '20	Project Ref.	LP2141
	Project	Brunel Business Park		Scale at A4	Fig No.	6
	Title	Foundation Section		NTS		

APPENDIX 6: GENERIC ENVIRONMENTAL RISK ASSESSMENT

6.0 GENERIC ENVIRONMENTAL ASSESSMENT

6.1	Introduction
6.1.1	This appendix provides additional background information on certain approaches and methods used by Paragon in the preparation of this report.
6.1.2	The geoenvironmental investigation has been completed in general accordance with BS10175:2011+A1:2017.
6.1.3	The geotechnical aspects of the report have been broadly written in general accordance with Eurocode 7 (BS EN 1997-2:2007).
6.2	Preliminary Risk Assessment and Conceptual Site Model
6.2.1	The preliminary risk assessment is made of both geotechnical and geoenvironmental hazards identified at the desk study stage. This is then updated based on the findings of the Phase 2 Investigation. The risk associated with hazards uses a matrix of probability of occurrence vs the consequence. Geotechnical risks are assessed using a ground model.
6.2.2	In the context of geoenvironmental risks, in order for there to be a risk there must be a viable pollutant linkage, which means there must be a source of contaminations, a potential receptor and a pathway linking the two. The purpose of the Preliminary Conceptual Site Model is to identify all of the potential contaminant linkages and qualitatively assess the potential risks associated with these linkages. Contaminant linkages are potentially unacceptable risks in terms of current contaminated land regime legal framework and require either further assessment through the ground investigation. Should one of the three linkages be absent then there is no linkage and no further action is required.
6.2.3	Geoenvironmental risks are also outlined within Environmental Protection Act 1990, Part 2A which uses the term 'significant harm or significant possibility of significant harm (SPOSH)'.
6.2.4	Paragon has adopted a classification level based on definitions within CIRIA Report C552 and professional judgement. Paragon's Rationale for Risk Ratings is presented in Table 1. The classification for the probability of harm is presented in Table 2.

6.2.5

Table 1. Rationale for Risk Ratings

Risk Rating	Risk Rating	Rationale	Examples
High		Contaminants very likely or known to represent an unacceptable risk, SPOSH. Equivalent to EA Category 1 pollution incident including persistent and/or extensive detrimental effects on water quality, closure of a potable abstraction point. Site not suitable for proposed use Enforcement action possible Urgent action required	Significant short-term effects to humans is defined as serious injury, defects or death. Die-back of plants in landscaped areas. Short term pollution of controlled waters, major fish kill. Elevated contaminants close to potable abstraction. Major damage to buildings i.e. explosion
Medium to High		Contaminants likely or known to represent an unacceptable risk Action required.	Possible short-term effects and likely long-term effects to humans is defined as serious injury, defects or death. Buildings unsafe to occupy. Ingress of contaminants through plastic pipes. Stress or dead plants in landscaped areas. Pollution of sensitive water resources
Medium		Contaminants likely to exceed assessment criteria and may to represent an unacceptable risk. Some damage to property (crops, buildings etc). Some action required.	Significant long-term effects to humans is defined as serious injury, defects or death. Buildings unsafe to occupy. Potential ingress of contaminants through plastic pipes. Stress or dead plants in landscaped areas. Pollution of sensitive water resources
Low to Medium		Contaminants may exceed assessment criteria but no harm as no unacceptable intake or contact. Minor or short-lived damage to property, ecosystems. Site likely to be suitable for proposed use Action unlikely whilst in current use	Harm not significant, pollutant linkage broken. Minor damage to plants in landscaped areas. Minor damage to buildings.
Low		Contaminants likely or known to have no risk of harm. Site likely to be suitable for proposed use Repairable effects to damage to property etc. No further action required	No measurable effects. No significant impact to property, plants, ecosystems.

6.2.6

Table 2. Classification of Probability of Geoenvironmental Risks

Classification	Risk Rating
High Likelihood	There is a contaminant 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.
Likely	There is a contaminant linkage and all the elements are present, which means that it is probable that an event will occur.
Low Likelihood	There is a contaminant 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	There is a contaminant linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

6.2.7

Table 3. Probability / Consequence Graphic

		Consequence				
		High	Moderate to High	Moderate	Low to Moderate	Low
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Low / Moderate Risk	Low Risk
	Likely	High Risk	Moderate Risk	Low / Moderate Risk	Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Low / Moderate Risk	Low Risk	Low Risk	Very Low Risk
	Unlikely	Low / Moderate Risk	Low Risk	Very Low Risk	Very Low Risk	Very Low Risk
	No Linkage	No Risk				

6.3

Contaminant Analysis

6.3.1

The procedures set out in Land Contamination: Risk Management 2019 and the DoE Industry Profiles provide good summaries of priority pollutants for UK sites. These have been used during the Phase 1 assessment to scope the analysis of chemicals of concern.

6.4	Generic Tier 1 Human Health Risk Assessment
6.4.1	Generic Assessment Criteria (GAC) are used as the limit at which exceedances would cause harm. GAC are developed based on assumptions of characteristics and behaviours or sources, pathways and receptors. These are largely conservative and are calculated using the Contaminated Land Exposure Assessment (CLEA) model, which uses exposure to the receptor and toxicology data of the contaminant in the assessment. Published and industry recognised GACs have been produced for a range of environments: • Residential with homegrown produce • Residential without homegrown produce • Commercial • Allotments • Public Open Space – Park (POS_{park}) • Public Open Space – Residential (POS_{Resi}).
6.4.2	The results of the chemical laboratory testing were screened using GACs based on a range of sources: • Atkins ATRISK SOIL SSV Values (2011) • Category 4 Screening Levels (C4SLs) including cadmium, Benzo(a)pyrene, benzene, arsenic, lead and chromium VI, produced by LQM CIEH. • Suitable 4 Use Levels (S4UL) produced by LQM CIEH (2015).
6.4.3	Category 4 Screening Levels were developed to screen out land affected by contamination under Part 2A of the EPA 1990. They represent a low level of risk whilst still being protective of human health.
6.4.4	In accordance with Health Protection Agency (HPA) guidance for the risk assessment approaches for Polycyclic Aromatic Hydrocarbons (PAH), 2010, benzo(a)pyrene has been used as a surrogate marker for carcinogenic PAHs. The threshold PAHs have been assessed individually.
6.4.5	Statistical analysis has been carried out on populations of greater than six results. Where the population is less than six, statistical analysis has been deemed inappropriate. Therefore, the maximum concentration of each contaminant has been recorded. The Upper Confidence Level or U ₉₅ has been calculated to present the level at which we would be 95% confident that the true mean is less than the GAC. All non-detect values have been treated as being equal to half the limit of detection.
6.4.6	These results have been used to carry out a Level 1: Quantitative Human Health Assessment for the ground contamination present against standards for the commercial use of the property. These results can also be used for a preliminary assessment for off-site disposal classification.

6.5	Controlled Waters Risk Assessment
6.5.1	The Environment Agency Groundwater Protection Policy (GP3) outlines the legal framework, detailed policies, technical background and the tools to be used in the protection of groundwater. The Water Framework Directive (2000/60/EC) set out the protocol for controlling water quality of the whole water environment. During Groundwater Risk Assessments the impact on controlled waters is outlined. Controlled waters include groundwater, surface water, coastal waters, inland waters and reservoirs.
6.5.2	Aquifers are classified based on their sensitivity. The following aquifer definitions are adopted. - Principal Aquifers - These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer. - Secondary Aquifers - These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types: - Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers; and - Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. - Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type - Unproductive Strata - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
6.5.3	To determine the impact of contaminants on groundwater and surface water Environmental Quality Standards (EQS) and Drinking Water Standards (DWS) are used as screening criteria.
6.6	Gas Risk Assessment
6.6.1	The pragmatic approach to ground gas risk assessment by Card et al 2012 has been followed to determine the gas risk of the site. This method compares the Total Organic Content (TOC) of the Made Ground, and the age and depth of the fill to provide a basis to determine the Characteristic Situation of the site.
6.6.2	The risks associated with methane and carbon dioxide are assessed using BS8485:2015 and guidelines from CIRIA (Wilson et al 2007), the NHBC (Boyle and Witherington 2007) and CL:AIRE RB17 (Card et al 2012).

6.6.3	These methods use the gas monitoring results to produce a Gas Screening Value, which is compared to Tables set out within the guidance. Information on the proposed development is then used to determine the level of gas protection required via a scoring system. Each gas protection measure is assigned a score and combinations of the measures are used to meet the score required.
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APPENDIX 7: ENVIRONMENTAL LABORATORY TESTING



Brunel Retail Park Soil Results

Analytical Parameter	Sample Reference			BH1	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH3	BH3
	Depth (m)			1.50	4.50	10.00	0.80	4.20	10.50	11.25	1.50	6.00	9.00
	Lab Report Number			20-81114	20-81114	20-81114	20-81114	20-81114	20-81114	20-81114	20-81114	20-81114	20-81114
	Lab Sample Number			1412254	1412255	1412256	1412257	1412258	1412259	1412260	1412261	1412262	1412263
	Date Sampled			07/01/2020	07/01/2020	07/01/2020	08/01/2020	08/01/2020	08/01/2020	08/01/2020	09/01/2020	10/01/2020	10/01/2020
Units	Limit of detection	GAC											
Stone Content	%	0.1	N/A	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	N/A	12	21	17	14	29	18	16	19	27	14
Total mass of sample received	kg	0.001	N/A	1.5	1.3	1.5	1.5	1.6	1.6	2	1.6	1.2	1.6
Asbestos in Soil	Type	N/A	Detection	-	-	-	-	Chrysotile - Loose Fibrous Debris	-	-	-	-	-
General Inorganics													
pH - Automated	pH Units	N/A	N/A	8.2	7.4	7.8	7.9	7.4	8.5	8.5	7.5	7.4	8.8
Total Cyanide	mg/kg	1	N/A	-	-	-	-	2	-	-	-	-	-
Total Sulphate as SO ₄	mg/kg	50	N/A	-	-	-	-	22000	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	N/A	-	-	-	-	2.5	-	-	-	-	-
Sulphide	mg/kg	1	N/A	-	-	-	-	48	-	-	-	-	-
Total Organic Carbon (TOC)	%	0.1	N/A	2.3	5.1	0.3	2.4	6.2	1.3	0.4	3.8	5.7	0.2
Total Phenols													
Total Phenols (monohydric)	mg/kg	1	N/A	-	-	-	-	< 1.0	-	-	-	-	-
Speciated PAHs													
Naphthalene	mg/kg	0.05	190	-	-	-	-	0.38	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	83000	-	-	-	-	< 0.05	-	-	-	-	-
Acenaphthene	mg/kg	0.05	84000	-	-	-	-	0.13	-	-	-	-	-
Fluorene	mg/kg	0.05	63000	-	-	-	-	0.16	-	-	-	-	-
Phenanthrene	mg/kg	0.05	22000	-	-	-	-	1.6	-	-	-	-	-
Anthracene	mg/kg	0.05	520000	-	-	-	-	0.3	-	-	-	-	-
Fluoranthene	mg/kg	0.05	23000	-	-	-	-	2.5	-	-	-	-	-
Pyrene	mg/kg	0.05	54000	-	-	-	-	2.3	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	N/A	-	-	-	-	1.7	-	-	-	-	-
Chrysene	mg/kg	0.05	N/A	-	-	-	-	1.2	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	N/A	-	-	-	-	1.6	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	N/A	-	-	-	-	0.79	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	76	-	-	-	-	1.2	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	N/A	-	-	-	-	0.77	-	-	-	-	-
Dibenzo(a,h)anthracene	mg/kg	0.05	N/A	-	-	-	-	0.21	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	N/A	-	-	-	-	0.79	-	-	-	-	-
Total PAH													
Speciated Total EPA-16 PAHs	mg/kg	0.8	N/A	-	-	-	-	15.6	-	-	-	-	-
Heavy Metals / Metalloids													
Arsenic (aqua regia extractable)	mg/kg	1	640	-	82	-	20	82	-	-	-	70	-
Cadmium (aqua regia extractable)	mg/kg	0.2	410	-	6.5	-	5.2	29	-	-	-	15	-
Chromium (hexavalent)	mg/kg	4	49	-	< 0.2	-	1.1	2.7	-	-	-	< 0.2	-
Chromium (aqua regia extractable)	mg/kg	1	8600	-	48	-	28	48	-	-	-	42	-
Copper (aqua regia extractable)	mg/kg	1	68000	-	400	-	170	1200	-	-	-	290	-
Lead (aqua regia extractable)	mg/kg	1	2330	-	1100	-	320	1900	-	-	-	860	-
Mercury (aqua regia extractable)	mg/kg	0.3	58	-	< 0.3	-	1.6	3.3	-	-	-	13	-
Nickel (aqua regia extractable)	mg/kg	1	980	-	120	-	35	120	-	-	-	110	-
Selenium (aqua regia extractable)	mg/kg	1	12000	-	< 1.0	-	< 1.0	< 1.0	-	-	-	< 1.0	-
Zinc (aqua regia extractable)	mg/kg	1	730000	-	1100	-	620	1400	-	-	-	640	-
Monoaromatics & Oxygenates													
Benzene	µg/kg	1	98	-	-	-	-	< 1.0	-	-	-	-	-
Toluene	µg/kg	1	56000	-	-	-	-	< 1.0	-	-	-	-	-
Ethylbenzene	µg/kg	1	2700	-	-	-	-	< 1.0	-	-	-	-	-
p & m-xylene	µg/kg	1	5900	-	-	-	-	< 1.0	-	-	-	-	-
o-xylene	µg/kg	1	6600	-	-	-	-	< 1.0	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	N/A	-	-	-	-	< 1.0	-	-	-	-	-
Petroleum Hydrocarbons													
TPH C10 - C40	mg/kg	10	N/A	-	-	-	-	720	-	-	-	-	-
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	3200	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	7800	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	2000	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	9700	-	-	-	-	5	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	59000	-	-	-	-	13	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	160000	-	-	-	-	42	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	1600000	-	-	-	-	280	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	N/A	-	-	-	-	340	-	-	-	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	26000	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	56000	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	3500	-	-	-	-	< 0.001	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	16000	-	-	-	-	4.2	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	36000	-	-	-	-	13	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	28000	-	-	-	-	40	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	28000	-	-	-	-	280	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	N/A	-	-	-	-	330	-	-	-	-	-

Brunel Retail Park Water Results

Sample Reference				
Depth (m)				
Lab Report Number				
Lab Sample Number				
Date Sampled				
Analytical Parameter	Units	Limit of detection	GAC Freshwater EQS	
General Inorganics				
pH	pH Units	N/A	6.0-9.0	7
Electrical Conductivity at 20 °C	µS/cm	10		4900
Turbidity	NTU	1		< 1
Total Cyanide	µg/l	10	1	< 10
Complex Cyanide	µg/l	10	1	< 10
Free Cyanide	µg/l	10	1	< 10
Sulphate as SO ₄	µg/l	45		2290000
Sulphate as SO ₄	mg/l	0.045		2290
Sulphide	µg/l	5		< 5.0
Chloride	mg/l	0.15		190
Ammoniacal Nitrogen as N	µg/l	15		5700
Ammonium as NH ₄	µg/l	15		7300
Total Organic Carbon (TOC)	mg/l	0.1		16.8
Nitrate as N	mg/l	0.01		36.7
Alkalinity	mgCaCO ₃ /l	3		1000
Chemical Oxygen Demand (Total)	mg/l	2		50
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1		15
Total Suspended Solids	mg/l	2		13000
Total Dissolved Solids (Gravimetric)	mg/l	4		2600
Hardness - Total	mgCaCO ₃ /l	1		1760
Dissolved Oxygen	mg/l	1		3.9
Total Phenols				
Total Phenols (monohydric)	µg/l	10	7.7	< 10
Speciated PAHs				
Naphthalene	µg/l	0.01	2	< 0.01
Acenaphthylene	µg/l	0.01		< 0.01
Acenaphthene	µg/l	0.01		< 0.01
Fluorene	µg/l	0.01		< 0.01
Phenanthrene	µg/l	0.01		< 0.01
Anthracene	µg/l	0.01	0.1	< 0.01
Fluoranthene	µg/l	0.01	0.1	< 0.01
Pyrene	µg/l	0.01		< 0.01
Benzo(a)anthracene	µg/l	0.01		< 0.01
Chrysene	µg/l	0.01		< 0.01
Benzo(b)fluoranthene	µg/l	0.01		< 0.01
Benzo(k)fluoranthene	µg/l	0.01		< 0.01
Benzo(a)pyrene	µg/l	0.01	0.02	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01		< 0.01
Dibenzo(a,h)anthracene	µg/l	0.01		< 0.01
Benzo(ghi)perylene	µg/l	0.01		< 0.01
Total PAH				
Total EPA-16 PAHs	µg/l	0.16		< 0.16



		Sample Reference		BH1
		Depth (m)		10
		Lab Report Number		20-81873
		Lab Sample Number		1416074
		Date Sampled		20/01/2020
	Units	Limit of detection	GAC Freshwater EQS	
Heavy Metals / Metalloids				
Antimony (dissolved)	µg/l	0.4		< 0.4
Arsenic (dissolved)	µg/l	0.15	50	0.48
Barium (dissolved)	µg/l	0.06		69
Beryllium (dissolved)	µg/l	0.1	15	< 0.1
Boron (dissolved)	µg/l	10		20000
Cadmium (dissolved)	µg/l	0.02	5	0.07
Calcium (dissolved)	mg/l	0.012		470
Chromium (hexavalent)	µg/l	5		< 5.0
Chromium (dissolved)	µg/l	0.2	50	0.2
Cobalt (dissolved)	µg/l	0.2		5.1
Copper (dissolved)	µg/l	0.5	5	1.5
Iron (dissolved)	mg/l	0.004		< 0.004
Lead (dissolved)	µg/l	0.2	1.2	< 0.2
Magnesium (dissolved)	mg/l	0.005		140
Manganese (dissolved)	µg/l	0.05		4100
Mercury (dissolved)	µg/l	0.05	1	< 0.05
Molybdenum (dissolved)	µg/l	0.05		0.91
Nickel (dissolved)	µg/l	0.5	200	5.5
Phosphorus (dissolved)	µg/l	20		45.7
Potassium (dissolved)	mg/l	0.025		110
Selenium (dissolved)	µg/l	0.6		4.8
Sodium (dissolved)	mg/l	0.01		610
Tin (dissolved)	µg/l	0.2		< 0.20
Vanadium (dissolved)	µg/l	0.2		< 0.2
Zinc (dissolved)	µg/l	0.5	30	9
Monoaromatics & Oxygenates				
Benzene	µg/l	1	10	< 1.0
Toluene	µg/l	1	74	< 1.0
Ethylbenzene	µg/l	1		< 1.0
p & m-xylene	µg/l	1		< 1.0
o-xylene	µg/l	1		< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1		< 1.0
Petroleum Hydrocarbons				
Mineral Oil (C10 - C40)	µg/l	10		< 10.0
Diesel Range Organics (C10 - C25)	µg/l	10		< 10
TPH1 (C10 - C40)	µg/l	10		< 10
TPH2 (C6 - C10)	µg/l	10		< 10
TPH-CWG - Aliphatic >C5 - C6	µg/l	1		< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1		< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1		< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10		< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10		< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10		< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10		< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	10	< 10
TPH-CWG - Aromatic >C5 - C7	µg/l	1		< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1		< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1		< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10		< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10		< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10		< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10		< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	10	< 10



Sample Reference		BH1	
Depth (m)		10	
Lab Report Number		20-81873	
Lab Sample Number		1416074	
Date Sampled		20/01/2020	
Units	Limit of detection	GAC Freshwater EQS	
VOCs			
Chloromethane	µg/l	1	< 1.0
Chloroethane	µg/l	1	< 1.0
Bromomethane	µg/l	1	< 1.0
Vinyl Chloride	µg/l	1	< 1.0
Trichlorofluoromethane	µg/l	1	< 1.0
1,1-Dichloroethene	µg/l	1	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	< 1.0
Cis-1,2-dichloroethene	µg/l	1	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	< 1.0
1,1-Dichloroethane	µg/l	1	< 1.0
2,2-Dichloropropane	µg/l	1	< 1.0
Trichloromethane	µg/l	1	< 1.0
1,1,1-Trichloroethane	µg/l	1	< 1.0
1,2-Dichloroethane	µg/l	1	< 1.0
1,1-Dichloropropene	µg/l	1	< 1.0
Trans-1,2-dichloroethene	µg/l	1	< 1.0
Benzene	µg/l	1	< 1.0
Tetrachloromethane	µg/l	1	< 1.0
1,2-Dichloropropane	µg/l	1	< 1.0
Trichloroethene	µg/l	1	< 1.0
Dibromomethane	µg/l	1	< 1.0
Bromodichloromethane	µg/l	1	< 1.0
Cis-1,3-dichloropropene	µg/l	1	< 1.0
Trans-1,3-dichloropropene	µg/l	1	< 1.0
Toluene	µg/l	1	< 1.0
1,1,2-Trichloroethane	µg/l	1	< 1.0
1,3-Dichloropropane	µg/l	1	< 1.0
Dibromochloromethane	µg/l	1	< 1.0
Tetrachloroethene	µg/l	1	< 1.0
1,2-Dibromoethane	µg/l	1	< 1.0
Chlorobenzene	µg/l	1	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	< 1.0
Ethylbenzene	µg/l	1	< 1.0
p & m-Xylene	µg/l	1	< 1.0
Styrene	µg/l	1	< 1.0
Tribromomethane	µg/l	1	< 1.0
o-Xylene	µg/l	1	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	< 1.0
Isopropylbenzene	µg/l	1	< 1.0
Bromobenzene	µg/l	1	< 1.0
n-Propylbenzene	µg/l	1	< 1.0
2-Chlorotoluene	µg/l	1	< 1.0
4-Chlorotoluene	µg/l	1	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	< 1.0
tert-Butylbenzene	µg/l	1	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	< 1.0
sec-Butylbenzene	µg/l	1	< 1.0
1,3-Dichlorobenzene	µg/l	1	< 1.0
p-Isopropyltoluene	µg/l	1	< 1.0
1,2-Dichlorobenzene	µg/l	1	< 1.0
1,4-Dichlorobenzene	µg/l	1	< 1.0
Butylbenzene	µg/l	1	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	< 1.0
Hexachlorobutadiene	µg/l	1	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	< 1.0

	Sample Reference		BH1	
	Depth (m)		10	
	Lab Report Number		20-81873	
	Lab Sample Number		1416074	
	Date Sampled		20/01/2020	
	Units	Limit of detection	GAC Freshwater EQS	
SVOCs				
Aniline	µg/l	0.05		< 0.05
Phenol	µg/l	0.05		< 0.05
2-Chlorophenol	µg/l	0.05		< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05		< 0.05
1,3-Dichlorobenzene	µg/l	0.05		< 0.05
1,2-Dichlorobenzene	µg/l	0.05		< 0.05
1,4-Dichlorobenzene	µg/l	0.05		< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05		< 0.05
2-Methylphenol	µg/l	0.05		< 0.05
Hexachloroethane	µg/l	0.05		< 0.05
Nitrobenzene	µg/l	0.05		< 0.05
4-Methylphenol	µg/l	0.05	40	< 0.05
Isophorone	µg/l	0.05		< 0.05
2-Nitrophenol	µg/l	0.05		< 0.05
2,4-Dimethylphenol	µg/l	0.05		< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05		< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05		< 0.05
Naphthalene	µg/l	0.01		< 0.01
2,4-Dichlorophenol	µg/l	0.05		< 0.05
4-Chloroaniline	µg/l	0.05		< 0.05
Hexachlorobutadiene	µg/l	0.05		< 0.05
4-Chloro-3-methylphenol	µg/l	0.05		< 0.05
2,4,6-Trichlorophenol	µg/l	0.05		< 0.05
2,4,5-Trichlorophenol	µg/l	0.05		< 0.05
2-Methylnaphthalene	µg/l	0.05		< 0.05
2-Chloronaphthalene	µg/l	0.05		< 0.05
Dimethylphthalate	µg/l	0.05		< 0.05
2,6-Dinitrotoluene	µg/l	0.05		< 0.05
Acenaphthylene	µg/l	0.01		< 0.01
Acenaphthene	µg/l	0.01		< 0.01
2,4-Dinitrotoluene	µg/l	0.05		< 0.05
Dibenzofuran	µg/l	0.05		< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05		< 0.05
Diethyl phthalate	µg/l	0.05		< 0.05
4-Nitroaniline	µg/l	0.05		< 0.05
Fluorene	µg/l	0.01		< 0.01
Azobenzene	µg/l	0.05		< 0.05
Bromophenyl phenyl ether	µg/l	0.05		< 0.05
Hexachlorobenzene	µg/l	0.05		< 0.05
Phenanthrene	µg/l	0.01		< 0.01
Anthracene	µg/l	0.01		< 0.01
Carbazole	µg/l	0.05		< 0.05
Dibutyl phthalate	µg/l	0.05		< 0.05
Anthraquinone	µg/l	0.05		< 0.05
Fluoranthene	µg/l	0.01		< 0.01
Pyrene	µg/l	0.01		< 0.01
Butyl benzyl phthalate	µg/l	0.05		< 0.05
Benzo(a)anthracene	µg/l	0.01		< 0.01
Chrysene	µg/l	0.01		< 0.01
Benzo(b)fluoranthene	µg/l	0.01		< 0.01
Benzo(k)fluoranthene	µg/l	0.01		< 0.01
Benzo(a)pyrene	µg/l	0.01		< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01		< 0.01
Dibenz(a,h)anthracene	µg/l	0.01		< 0.01
Benzo(ghi)perylene	µg/l	0.01		< 0.01



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Analytical Report Number : 20-81114

Project / Site name:	Brunel Retail Park	Samples received on:	10/01/2020
Your job number:	191247	Samples instructed on:	15/01/2020
Your order number:	BRUNEL-CB	Analysis completed by:	24/01/2020
Report Issue Number:	1	Report issued on:	24/01/2020
Samples Analysed:	10 soil samples		

Signed: 

Zina Abdul Razzak
Senior Quality 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

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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.

Iss No 20-81114-1 Brunel Retail Park 191247

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The results included within the report are representative of the samples submitted for analysis.

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Analytical Report Number: 20-81114
Project / Site name: Brunel Retail Park
Your Order No: BRUNEL-CB

Lab Sample Number	1412254	1412255	1412256	1412257	1412258
Sample Reference	BH1	BH1	BH1	BH2	BH2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.50	4.50	10.00	0.80	4.20
Date Sampled	07/01/2020	07/01/2020	07/01/2020	08/01/2020	08/01/2020
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
Moisture Content	%	N/A	NONE	12	29
Total mass of sample received	kg	0.001	NONE	1.5	1.6

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	Chrysotile - Loose Fibrous Debris
Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	Detected

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2	7.4	7.8	7.9	7.4
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-	2
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	22000
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	2.5
Sulphide	mg/kg	1	MCERTS	-	-	-	-	48
Total Organic Carbon (TOC)	%	0.1	MCERTS	2.3	5.1	0.3	2.4	6.2

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	-	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	0.38
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	0.13
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	0.16
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	1.6
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	0.30
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	2.5
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	2.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	1.7
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	1.2
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	1.6
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	0.79
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	1.2
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	0.77
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	0.21
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	0.79

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-	-	15.6
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Analytical Report Number: 20-81114

Project / Site name: Brunel Retail Park

Your Order No: BRUNEL-CB

Lab Sample Number	1412254	1412255	1412256	1412257	1412258
Sample Reference	BH1	BH1	BH1	BH2	BH2
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.50	4.50	10.00	0.80	4.20
Date Sampled	07/01/2020	07/01/2020	07/01/2020	08/01/2020	08/01/2020
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	82	-	20	82
Boron (water soluble)	mg/kg	0.2	MCERTS	-	6.5	-	5.2	29
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	-	1.1	2.7
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	48	-	28	48
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	400	-	170	1200
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	1100	-	320	1900
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	< 0.3	-	1.6	3.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	120	-	35	120
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	1100	-	620	1400

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
o-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	< 1.0

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	-	-	-	-	720
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TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	5.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	13
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	42
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	280
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	340

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	4.2
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	13
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	40
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	280
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	330

Analytical Report Number: 20-81114
Project / Site name: Brunel Retail Park
Your Order No: BRUNEL-CB

Lab Sample Number				1412259	1412260	1412261	1412262	1412263
Sample Reference				BH2	BH2	BH3	BH3	BH3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				10.50	11.25	1.50	6.00	9.00
Date Sampled				08/01/2020	08/01/2020	09/01/2020	10/01/2020	10/01/2020
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	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	18	16	19	27	14
Total mass of sample received	kg	0.001	NONE	1.6	2.0	1.6	1.2	1.6

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.5	8.5	7.5	7.4	8.8
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	-
Sulphide	mg/kg	1	MCERTS	-	-	-	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.3	0.4	3.8	5.7	0.2

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-	-	-
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Analytical Report Number: 20-81114

Project / Site name: Brunel Retail Park

Your Order No: BRUNEL-CB

Lab Sample Number				1412259	1412260	1412261	1412262	1412263
Sample Reference				BH2	BH2	BH3	BH3	BH3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				10.50	11.25	1.50	6.00	9.00
Date Sampled				08/01/2020	08/01/2020	09/01/2020	10/01/2020	10/01/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	70	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	15	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	42	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	290	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	860	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	13	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	110	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	< 1.0	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	640	-

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	-
o-xylene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-

Analytical Report Number : 20-81114

Project / Site name: Brunel Retail Park

* 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 *
1412254	BH1	None Supplied	1.50	Brown loam and clay with gravel.
1412255	BH1	None Supplied	4.50	Brown loam and clay with gravel.
1412256	BH1	None Supplied	10.00	Light brown sandy clay with gravel.
1412257	BH2	None Supplied	0.80	Brown loam and clay with gravel.
1412258	BH2	None Supplied	4.20	Brown loam and clay with gravel.
1412259	BH2	None Supplied	10.50	Brown loam and clay with stones and vegetation.
1412260	BH2	None Supplied	11.25	Light grey clay and sand.
1412261	BH3	None Supplied	1.50	Brown loam and clay with gravel.
1412262	BH3	None Supplied	6.00	Brown loam and sand with gravel.
1412263	BH3	None Supplied	9.00	Light brown sand with gravel.

Analytical Report Number : 20-81114

Project / Site name: Brunel Retail Park

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L0738-PL	W	MCERTS
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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed 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
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
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	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
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
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
Total organic carbon (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
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH2		S	20-81114	1412258	c	Total cyanide in soil	L080-PL	c



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Analytical Report Number : 20-81115

Project / Site name:	Brunel Retail Park	Samples received on:	10/01/2020
Your job number:	191247	Samples instructed on:	15/01/2020
Your order number:	BRUNEL-CB	Analysis completed by:	27/01/2020
Report Issue Number:	1	Report issued on:	27/01/2020
Samples Analysed:	10:1 WAC sample		

Signed: *A. Czerwińska*

Agnieszka Czerwińska

Technical Reviewer (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

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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Waste Acceptance Criteria Analytical Results								
Report No:	20-81115							
					Client: PARAGONBC			
Location	Brunel Retail Park							
Lab Reference (Sample Number)	1412264 / 1412265				Landfill Waste Acceptance Criteria			
Sampling Date	08/01/2020				Limits			
Sample ID	BH2				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	
Depth (m)	4.20							
Solid Waste Analysis								
TOC (%)**	6.3				3%	5%	6%	
Loss on Ignition (%) **	27.8				--	--	10%	
BTEX (µg/kg) **	< 10				6000	--	--	
Sum of PCBs (mg/kg) **	< 0.007				1	--	--	
Mineral Oil (mg/kg)	110				500	--	--	
Total PAH (WAC-17) (mg/kg)	23				100	--	--	
pH (units)**	7.3				--	>6	--	
Acid Neutralisation Capacity (mol / kg)	2.3				--	To be evaluated	To be evaluated	
Eluate Analysis								
	10:1			10:1	Limit values for compliance leaching test			
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)			
Arsenic *	0.0035			0.0266	0.5	2	25	
Barium *	0.0521			0.390	20	100	300	
Cadmium *	< 0.0001			< 0.0008	0.04	1	5	
Chromium *	0.0014			0.011	0.5	10	70	
Copper *	0.018			0.13	2	50	100	
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2	
Molybdenum *	0.0236			0.177	0.5	10	30	
Nickel *	0.043			0.32	0.4	10	40	
Lead *	0.0068			0.051	0.5	10	50	
Antimony *	0.031			0.23	0.06	0.7	5	
Selenium *	< 0.0040			< 0.040	0.1	0.5	7	
Zinc *	0.62			4.7	4	50	200	
Chloride *	9.9			74	800	4000	25000	
Fluoride	0.077			0.58	10	150	500	
Sulphate *	1200			9200	1000	20000	50000	
TDS*	1100			8100	4000	60000	100000	
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-	
DOC	7.31			54.8	500	800	1000	
Leach Test Information								
Stone Content (%)	< 0.1							
Sample Mass (kg)	1.6							
Dry Matter (%)	71							
Moisture (%)	29							
Results are expressed on a dry weight basis, after correction for moisture content where applicable.								
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation								
Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.								
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.								



Analytical Report Number : 20-81115

Project / Site name: Brunel Retail Park

* 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 *
1412264	BH2	None Supplied	4.20	Brown loam and clay with gravel.

Analytical Report Number : 20-81115

Project / Site name: Brunel Retail Park

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance"	L046-PL	W	NONE
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
BTEX in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L0738-PL	W	MCERTS
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L0338-PL	W	ISO 17025
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In house method.	L047-PL	D	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil"	L039-PL	W	ISO 17025
Mineral Oil (Soil) C10 - C40	Determination of mineral oil fraction extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L076-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In house method.	L005-PL	W	MCERTS
Speciated WAC-17 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. MCERTS accredited except Coronene.	L064-PL	D	NONE
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
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil"	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by electrometric measurement.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	ISO 17025

Iss No 20-81115-1 Brunel Retail Park 191247

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The results included within the report are representative of the samples submitted for analysis.

Page 4 of 5

Analytical Report Number : 20-81115

Project / Site name: Brunel Retail Park

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total organic carbon (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

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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 30°C.



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Analytical Report Number : 20-81873

Project / Site name:	Brunel Retail Park, Reading	Samples received on:	20/01/2020
Your job number:	191247	Samples instructed on:	20/01/2020
Your order number:	BRUNEL-GW-CB	Analysis completed by:	31/01/2020
Report Issue Number:	1	Report issued on:	31/01/2020
Samples Analysed:	1 water sample		

Signed:

Rachel Bradley

Deputy Quality Manager
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.



Analytical Report Number: 20-81873

Project / Site name: Brunel Retail Park, Reading

Your Order No: BRUNEL-GW-CB

Lab Sample Number	1416074						
Sample Reference	BH1						
Sample Number	None Supplied						
Depth (m)	10.00						
Date Sampled	20/01/2020						
Time Taken	None Supplied						
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

General Inorganics

pH	pH Units	N/A	ISO 17025	7.0				
Electrical Conductivity at 20 °C	µS/cm	10	ISO 17025	4900				
Turbidity	NTU	1	NONE	< 1				
Total Cyanide	µg/l	10	ISO 17025	< 10				
Complex Cyanide	µg/l	10	ISO 17025	< 10				
Free Cyanide	µg/l	10	ISO 17025	< 10				
Sulphate as SO ₄	µg/l	45	ISO 17025	2290000				
Sulphate as SO ₄	mg/l	0.045	ISO 17025	2290				
Sulphide	µg/l	5	NONE	< 5.0				
Chloride	mg/l	0.15	ISO 17025	190				
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	5700				
Ammonium as NH ₄	µg/l	15	ISO 17025	7300				
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	16.8				
Nitrate as N	mg/l	0.01	ISO 17025	36.7				
Alkalinity	mgCaCO ₃ /l	3	ISO 17025	1000				
Chemical Oxygen Demand (Total)	mg/l	2	ISO 17025	50				
BOD (Biochemical Oxygen Demand) (Total) - PL	mg/l	1	ISO 17025	15				
Total Suspended Solids	mg/l	2	ISO 17025	13000				
Total Dissolved Solids (Gravimetric)	mg/l	4	ISO 17025	2600				
Hardness - Total	mgCaCO ₃ /l	1	ISO 17025	1760				
Dissolved Oxygen	mg/l	1	NONE	3.9				

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10				
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01				
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01				
Fluorene	µg/l	0.01	ISO 17025	< 0.01				
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01				
Anthracene	µg/l	0.01	ISO 17025	< 0.01				
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Pyrene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Chrysene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01				
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01				
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01				

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16				
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Analytical Report Number: 20-81873

Project / Site name: Brunel Retail Park, Reading

Your Order No: BRUNEL-GW-CB

Lab Sample Number				1416074				
Sample Reference				BH1				
Sample Number				None Supplied				
Depth (m)				10.00				
Date Sampled				20/01/2020				
Time Taken				None Supplied				
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Antimony (dissolved)	µg/l	0.4	ISO 17025	< 0.4				
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.48				
Barium (dissolved)	µg/l	0.06	ISO 17025	69				
Beryllium (dissolved)	µg/l	0.1	ISO 17025	< 0.1				
Boron (dissolved)	µg/l	10	ISO 17025	20000				
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.07				
Calcium (dissolved)	mg/l	0.012	ISO 17025	470				
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0				
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.2				
Cobalt (dissolved)	µg/l	0.2	ISO 17025	5.1				
Copper (dissolved)	µg/l	0.5	ISO 17025	1.5				
Iron (dissolved)	mg/l	0.004	ISO 17025	< 0.004				
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2				
Magnesium (dissolved)	mg/l	0.005	ISO 17025	140				
Manganese (dissolved)	µg/l	0.05	ISO 17025	4100				
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05				
Molybdenum (dissolved)	µg/l	0.05	ISO 17025	0.91				
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.5				
Phosphorus (dissolved)	µg/l	20	ISO 17025	45.7				
Potassium (dissolved)	mg/l	0.025	ISO 17025	110				
Selenium (dissolved)	µg/l	0.6	ISO 17025	4.8				
Sodium (dissolved)	mg/l	0.01	ISO 17025	610				
Tin (dissolved)	µg/l	0.2	ISO 17025	< 0.20				
Vanadium (dissolved)	µg/l	0.2	ISO 17025	< 0.2				
Zinc (dissolved)	µg/l	0.5	ISO 17025	9.0				



Analytical Report Number: 20-81873

Project / Site name: Brunel Retail Park, Reading

Your Order No: BRUNEL-GW-CB

Lab Sample Number	1416074						
Sample Reference	BH1						
Sample Number	None Supplied						
Depth (m)	10.00						
Date Sampled	20/01/2020						
Time Taken	None Supplied						
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0			
Toluene	µg/l	1	ISO 17025	< 1.0			
Ethylbenzene	µg/l	1	ISO 17025	< 1.0			
p & m-xylene	µg/l	1	ISO 17025	< 1.0			
o-xylene	µg/l	1	ISO 17025	< 1.0			
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0			

Petroleum Hydrocarbons

Mineral Oil (C10 - C40)	µg/l	10	NONE	< 10.0			
Diesel Range Organics (C10 - C25)	µg/l	10	NONE	< 10			

TPH1 (C10 - C40)	µg/l	10	NONE	< 10			
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TPH2 (C6 - C10)	µg/l	10	ISO 17025	< 10			
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TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10			
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10			
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10			
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10			
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10			

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0			
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10			
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10			
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10			
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10			
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10			



Analytical Report Number: 20-81873

Project / Site name: Brunel Retail Park, Reading

Your Order No: BRUNEL-GW-CB

Lab Sample Number	1416074					
Sample Reference	BH1					
Sample Number	None Supplied					
Depth (m)	10.00					
Date Sampled	20/01/2020					
Time Taken	None Supplied					
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0				
Chloroethane	µg/l	1	ISO 17025	< 1.0				
Bromomethane	µg/l	1	ISO 17025	< 1.0				
Vinyl Chloride	µg/l	1	NONE	< 1.0				
Trichlorofluoromethane	µg/l	1	NONE	< 1.0				
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0				
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0				
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0				
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0				
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0				
Trichloromethane	µg/l	1	ISO 17025	< 1.0				
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0				
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0				
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0				
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0				
Benzene	µg/l	1	ISO 17025	< 1.0				
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0				
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0				
Trichloroethene	µg/l	1	ISO 17025	< 1.0				
Dibromomethane	µg/l	1	ISO 17025	< 1.0				
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0				
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0				
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0				
Toluene	µg/l	1	ISO 17025	< 1.0				
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0				
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0				
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0				
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0				
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0				
Chlorobenzene	µg/l	1	ISO 17025	< 1.0				
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0				
Ethylbenzene	µg/l	1	ISO 17025	< 1.0				
p & m-Xylene	µg/l	1	ISO 17025	< 1.0				
Styrene	µg/l	1	ISO 17025	< 1.0				
Tribromomethane	µg/l	1	ISO 17025	< 1.0				
o-Xylene	µg/l	1	ISO 17025	< 1.0				
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0				
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0				
Bromobenzene	µg/l	1	ISO 17025	< 1.0				
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0				
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0				
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0				
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0				
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0				
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0				
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0				
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0				
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0				
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0				
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0				
Butylbenzene	µg/l	1	ISO 17025	< 1.0				
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0				
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0				
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0				
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0				



Analytical Report Number: 20-81873

Project / Site name: Brunel Retail Park, Reading

Your Order No: BRUNEL-GW-CB

Lab Sample Number	1416074						
Sample Reference	BH1						
Sample Number	None Supplied						
Depth (m)	10.00						
Date Sampled	20/01/2020						
Time Taken	None Supplied						
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05			
Phenol	µg/l	0.05	NONE	< 0.05			
2-Chlorophenol	µg/l	0.05	NONE	< 0.05			
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05			
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05			
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05			
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05			
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05			
2-Methylphenol	µg/l	0.05	NONE	< 0.05			
Hexachloroethane	µg/l	0.05	NONE	< 0.05			
Nitrobenzene	µg/l	0.05	NONE	< 0.05			
4-Methylphenol	µg/l	0.05	NONE	< 0.05			
Isophorone	µg/l	0.05	NONE	< 0.05			
2-Nitrophenol	µg/l	0.05	NONE	< 0.05			
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05			
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05			
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05			
Naphthalene	µg/l	0.01	ISO 17025	< 0.01			
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05			
4-Chloroaniline	µg/l	0.05	NONE	< 0.05			
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05			
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05			
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05			
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05			
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05			
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05			
Dimethylphthalate	µg/l	0.05	NONE	< 0.05			
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05			
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01			
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01			
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05			
Dibenzofuran	µg/l	0.05	NONE	< 0.05			
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05			
Diethyl phthalate	µg/l	0.05	NONE	< 0.05			
4-Nitroaniline	µg/l	0.05	NONE	< 0.05			
Fluorene	µg/l	0.01	ISO 17025	< 0.01			
Azobenzene	µg/l	0.05	NONE	< 0.05			
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05			
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05			
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01			
Anthracene	µg/l	0.01	ISO 17025	< 0.01			
Carbazole	µg/l	0.05	NONE	< 0.05			
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05			
Anthraquinone	µg/l	0.05	NONE	< 0.05			
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01			
Pyrene	µg/l	0.01	ISO 17025	< 0.01			
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05			
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01			
Chrysene	µg/l	0.01	ISO 17025	< 0.01			
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01			
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01			
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01			
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01			
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01			
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01			

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 20-81873

Project / Site name: Brunel Retail Park, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Alkalinity in Water (by discrete analyser)	Determination of Alkalinity by discrete analyser (colorimetry). Accredited matrices: SW, PW, GW.	In house method based on MEWAM & USEPA Method 310.2.	L082-PL	W	ISO 17025
Ammoniacal Nitrogen as N in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (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
Ammonium as NH ₄ 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
Biological oxygen demand (total) of water	Determination of biochemical oxygen demand in water (5 days). Accredited matrices: SW, PW, GW.	In-house method based on standard method 5210B.	L086-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
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Chemical Oxygen Demand in Water (Total)	Determination of total COD in water by reflux oxidation with acidified K ₂ Cr ₂ O ₇ followed by colorimetry. Accredited matrices: SW, PW, GW.	HACH DR/890 Colorimeter Procedures Manual (48470-22) (Ref 0170.2)	L065-PL	W	ISO 17025
Chloride in water	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025
Complex cyanide in water	Determination of complex cyanide by calculation. 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
Dissolved Oxygen in water	Determination of dissolved oxygen.	In-house method	L086-PL	W	NONE
DRO (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
Electrical conductivity at 20°C of water	Determination of electrical conductivity in water by electrometric measurement. Accredited Matrices SW, GW, PW	In-house method	L031-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
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-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
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
Mineral Oil (Waters) C10 - C40	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE

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The results included within the report are representative of the samples submitted for analysis.

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Analytical Report Number : 20-81873

Project / Site name: Brunel Retail Park, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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 Wastewater & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
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
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	NONE
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 by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Sulphide in water	Determination of sulphide in water by ion selective electrode.	In-house method	L029-PL	W	NONE
Suspended solids in water	Determined gravimetrically with GFC filtration papers.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-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
Total dissolved solids in water (Gravimetric)	Determination of total dissolved solids in water by gravimetry.	In house method based on BSEN 15216:2007	L004-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
Total organic carbon in water	Determination of dissolved organic carbon in water by TOC/DOC NDIR analyser. Accredited matrices: SW PW GW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
TPH2 (Waters)	Determination of hydrocarbons C6-C10 by headspace GC-MS. Accredited Matrices SW, PW, GW.	In-house method based on USEPA8260	L088-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Turbidity of in water	Determination of sample turbidity by colorimeter and comparison with standard reference samples.	In-house method based on Standard Method 8237	L083-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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.

APPENDIX 8: GEOTECHNICAL LABORATORY TESTING

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Location	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH01	9.00		B	Mottled light grey, yellowish brown and brown slightly fine sandy silty CLAY.	28.0	57	23	34	100										
BH01	10.50		D																Chemical
BH01	11.70		D	Yellowish brown mottled grey clayey SAND. Sand is mainly fine.															Particle Size Distribution
BH02	11.00-11.45		U	Soft mottled dark grey, grey and brown sandy CLAY with rare medium gravel.	20.3					2.12	1.76	Undisturbed	110 220 440	34 45 50	22				
BH02	11.45		D	Dark grey mottled greyish brown clayey sandy SILT with rare gravel.	19.0		NP		97										
BH02	12.00		D																Chemical
BH03	9.50		B	Yellowish brown mottled grey SAND. Sand is mainly fine.															Particle Size Distribution
BH03	9.50		D																Chemical

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

NP=Non Plastic

Checked and Approved by  S Burke - Senior Technician 04/02/2020	Project Number: Project Name: GEO / 30486 BRUNEL RETAIL PARK LP2141	
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Tested by Chemtest Ltd : MCERTS / UKAS No 2183

GEOLABSPage 1 of 1
(Ref 1580824863)

PARTICLE SIZE DISTRIBUTION

BH / TP No.
Depth (m)
Sample Type

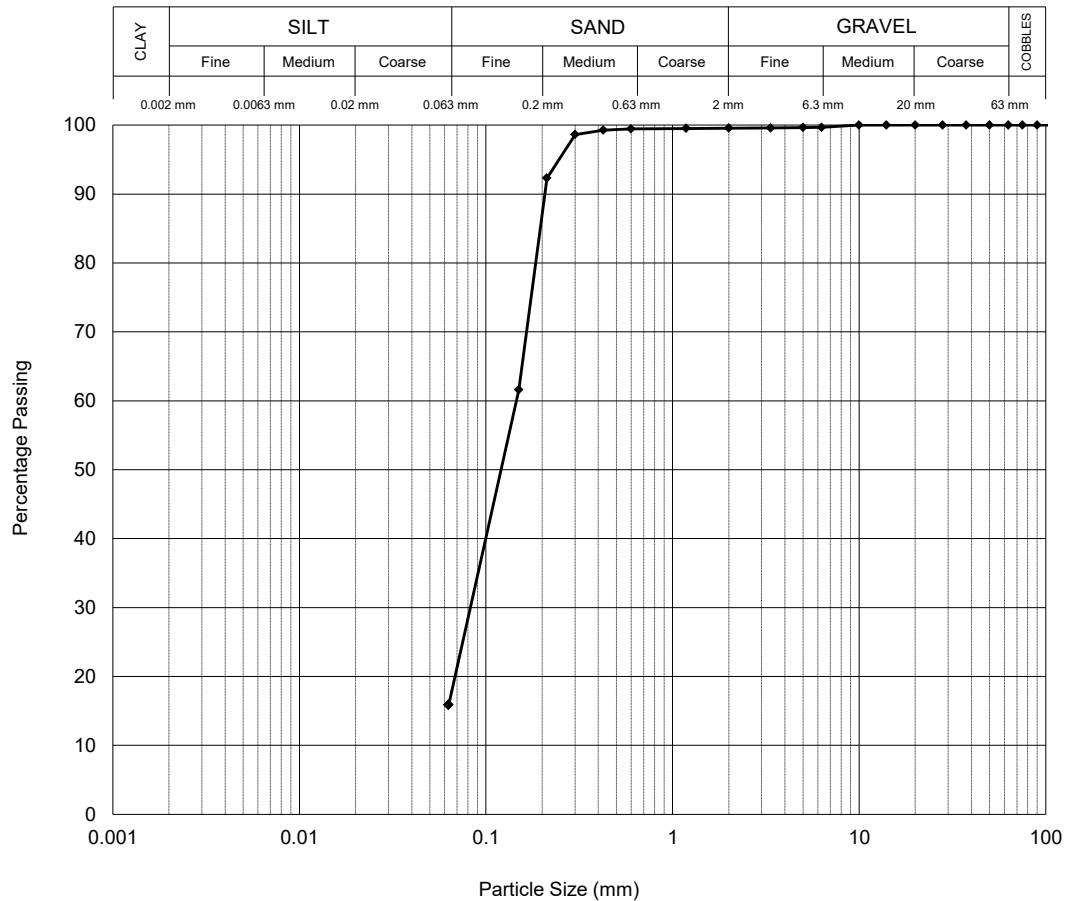
BH01
11.70
D

Description

Yellowish brown mottled grey clayey SAND. Sand is mainly fine.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	100
600 µm	99
425 µm	99
300 µm	99
212 µm	92
150 µm	62
63 µm	16



Particle Proportions	
Cobbles	0
Gravel	0
Sand	84
Silt & Clay	16

Checked and Approved by

S Burke

S Burke - Senior Technician
04/02/2020

Project Number:

GEO / 30486

Project Name:

BRUNEL RETAIL PARK
LP2141

GEOLABS

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PARTICLE SIZE DISTRIBUTION

BH / TP No.
Depth (m)
Sample Type

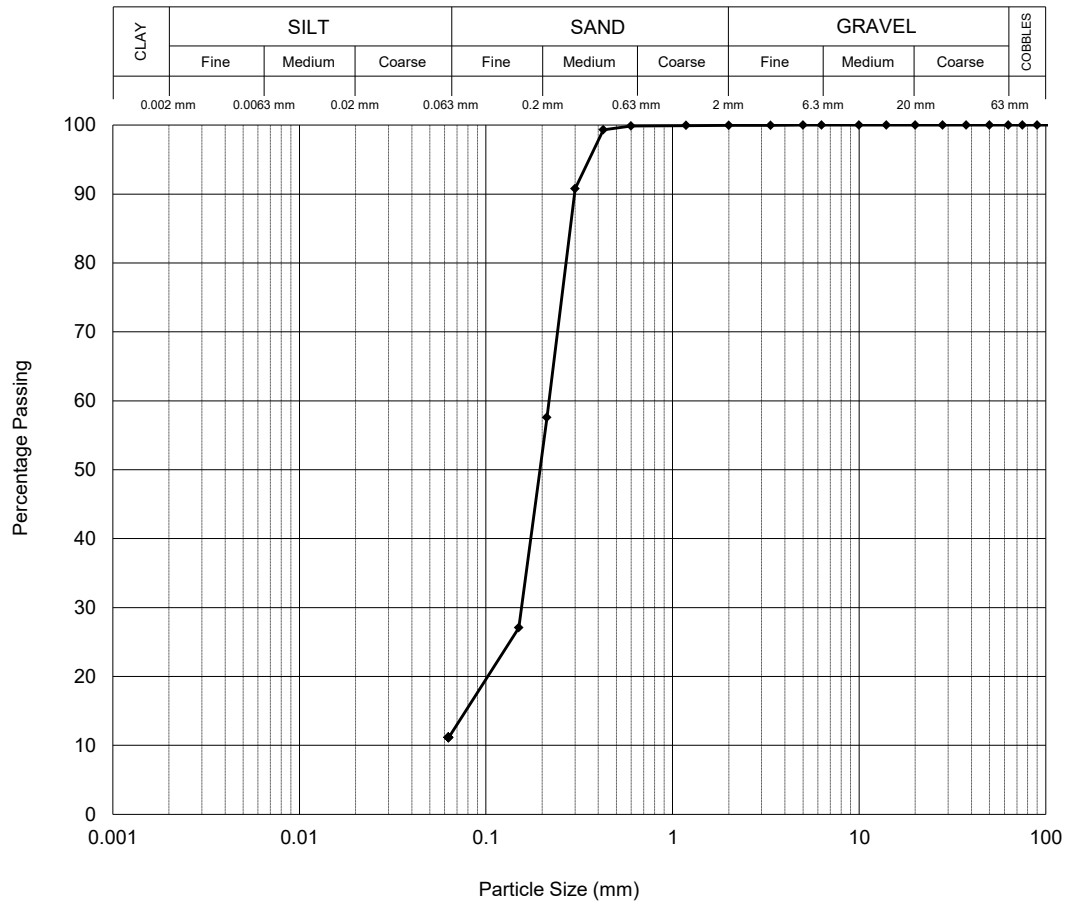
BH03
9.50
B

Description

Yellowish brown mottled grey SAND. Sand is mainly fine.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	100
6.30 mm	100
5.00 mm	100
3.35 mm	100
2.00 mm	100
1.18 mm	100
600 µm	100
425 µm	99
300 µm	91
212 µm	58
150 µm	27
63 µm	11



Particle Proportions	
Cobbles	0
Gravel	0
Sand	89
Silt & Clay	11

Checked and Approved by

S Burke

S Burke - Senior Technician
04/02/2020

Project Number:

GEO / 30486

Project Name:

BRUNEL RETAIL PARK
LP2141

GEOLABS

Page 1 of 1

Test Report By: GEOLABS Limited, Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX

Client: Leap Environmental, Wyvols Court, Swallowfield, Reading, RG7 1WY

(Ref 1580824875)

UNCONSOLIDATED UNDRAINED MULTISTAGE TRIAXIAL COMPRESSION

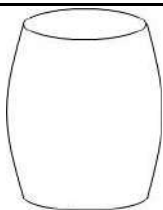
Location BH02
Depth (m) 11.00-11.45
Sample Type U

Description:

Soft mottled dark grey, grey and brown sandy CLAY with rare medium gravel.

Specimen Details

Specimen conditions	Undisturbed		
Length (mm)	199.5		
Diameter (mm)	103.1		
Moisture content (%)	20.3		
Bulk density (Mg/m ³)	2.12		
Dry density (Mg/m ³)	1.76		
Test Details	1	2	3
Latex membrane thickness (mm)	0.3	0.3	0.3
Specimen height prior to shearing (mm)	199.5	-	-
Membrane correction (kPa)	0.3	0.6	0.9
Mean rate of shear (%/min)	1.0	1.0	1.0
Cell pressure (kPa)	110	220	440
Strain at failure (%)	4.0	8.5	15.0
Maximum deviator stress (kPa)	34	45	50
Shear Stress Cu (kPa)	17	23	25

Mode of failure

Orientation of the sample

Vertical

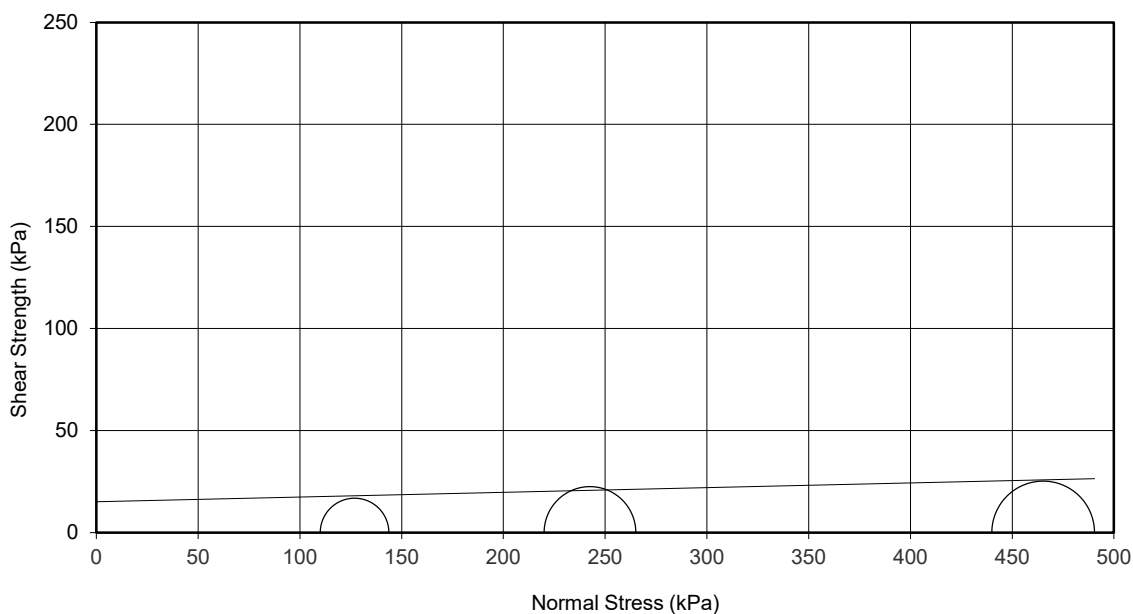
Distance from top of tube mm

95

Shear Strength Parameters

Cohesion (kPa) 15

Angle of Shear Resistance (°) 1.5



Processed by DD

Checked and Approved by

S Burke - Senior Technician
04/02/2020

Project Number:

GEO / 30486

Project Name:

BRUNEL RETAIL PARK
LP2141

GEOLABS

APPENDIX 9: MONITORING RESULTS

Continuous Gas Monitoring Record								
Date	17/01/2020	Engineer	LS					
Project No	LP2141	Temp °C	8					
Site	Brunel Retail Park	Ambient Pressure	1005					
BH01 Hole ID		Time	Flow (f/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.00	0.00	0.30	20.90	0.00	0.00
		00:15	0.00	0.00	12.10	18.80	0.00	0.00
VOC peak (ppm)	0.30	00:30	0.00	0.00	12.70	16.40	0.00	0.00
		01:00	0.00	0.00	12.80	13.30	0.00	0.00
VOC steady (ppm)	0.20	01:30	0.00	0.00	12.90	11.20	0.00	0.00
		02:00	0.00	0.00	12.90	9.40	0.00	0.00
Borehole Depth (mbgl)	11.39	02:30	0.00	0.00	12.90	8.60	0.00	0.00
		03:00	-	0.00	12.90	8.20	0.00	0.00
Water level (mbgl)	10.07	03:30	-	0.00	12.90	7.70	0.00	0.00
		04:00	-	0.00	12.90	7.50	0.00	0.00
Borehole Pressure (mb)	0.00	04:30	-	0.00	12.90	7.30	0.00	0.00
		05:00	-	0.00	12.90	7.20	0.00	0.00
MW5 Hole ID		Time	Flow (f/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.00	0.00	6.70	14.20	0.00	0.00
		00:15	0.00	0.00	1.10	14.70	0.00	0.00
VOC peak (ppm)	0.30	00:30	0.00	0.00	0.90	15.30	0.00	0.00
		01:00	0.00	0.00	0.90	16.20	0.00	0.00
VOC steady (ppm)	0.20	01:30	0.00	0.00	0.90	16.80	0.00	0.00
		02:00	0.00	0.00	1.00	17.10	0.00	0.00
Borehole Depth (mbgl)	2.13	02:30	0.00	0.00	1.00	17.20	0.00	0.00
		03:00	0.00	0.00	1.10	17.30	0.00	0.00
Water level (mbgl)	-	03:30	0.00	0.00	1.20	17.40	0.00	0.00
		04:00	0.00	0.00	1.30	17.40	0.00	0.00
Borehole Pressure (mb)	0.00	04:30	0.00	0.00	1.40	17.40	0.00	0.00
		05:00	0.00	0.00	1.50	17.40	0.00	0.00

Borehole to south of site (no bung) GW= 9.65 Base = 15.01

Continuous Gas Monitoring Record								
Date	17/01/2020	Engineer	LS					
Project No	LP2141	Temp °C	8					
Site	Brunel Retail Park	1005						
BH02 Hole ID		Time	Flow (f/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.00	0.00	1.50	17.40	0.00	0.00
		00:15	0.00	5.70	9.40	15.40	0.00	0.00
		00:30	0.00	6.20	9.60	13.50	0.00	0.00
VOC peak (ppm)	0.20	01:00	0.00	6.40	9.80	9.60	0.00	0.00
VOC steady (ppm)	0.20	01:30	0.00	6.40	9.80	8.90	0.00	0.00
		02:00	0.00	6.50	9.80	6.40	0.00	0.00
Borehole Depth (mbgl)	4.16	02:30	-	6.40	9.80	5.30	0.00	0.00
		03:00	-	6.40	9.80	4.40	0.00	0.00
Water level (mbgl)	-	03:30	-	6.40	9.80	4.20	0.00	0.00
		04:00	-	6.40	9.80	3.90	0.00	0.00
Borehole Pressure (mb)	0.00	04:30	-	6.40	9.80	3.80	0.00	0.00
		05:00	-	6.30	9.80	3.70	0.00	0.00
BH03 Hole ID		Time	Flow (f/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.00	2.50	11.60	9.30	0.00	0.00
		00:15	0.00	1.40	13.10	8.40	0.00	0.00
		00:30	-1.50	1.00	13.90	7.00	0.00	0.00
VOC peak (ppm)	0.20	01:00	-0.40	1.00	14.60	6.10	0.00	0.00
VOC steady (ppm)	0.20	01:30	-0.10	0.90	14.90	3.00	0.00	0.00
		02:00	-2.70	0.90	14.90	1.90	0.00	0.00
Borehole Depth (mbgl)	8.03	02:30	0.00	0.80	14.90	0.80	0.00	0.00
		03:00	0.00	0.80	14.80	0.30	0.00	0.00
Water level (mbgl)	-	03:30	0.00	0.80	14.80	0.10	0.00	0.00
		04:00	0.00	0.80	14.80	0.00	0.00	0.00
Borehole Pressure (mb)	between 0 and -12.4	04:30	0.00	0.70	14.80	-0.10	0.00	0.00
		05:00	0.00	0.70	14.80	-0.20	0.00	0.00

APPENDIX 10: INTERNAL GAS MONITORING RESULTS



INTERNAL GAS RISK ASSESSMENT VISIT 1

BRUNEL RETAIL PARK, ROSE KILN LANE, READING, RG2 0HS

**ON BEHALF OF
ABERDEEN ASSETT MANAGEMENT
C/O JLL
REPORT 17-142.02-1
FEBRUARY 2019**

1.0 Introduction

Aviron Associates Limited (Aviron) previously completed a ground gas risk assessment, which is reported within our report referenced 17-142.01 and dated June 2017.

The gas risk assessment, reported 2017, comprised the drilling and installation of eight monitoring wells (MW1-MW8).

The presence of soil vapours was determined prior to bulk ground gas monitoring on six occasions using a MiniRAE Photon Ionisation Detector (PID) from RAEs Systems.

The presence of hazardous bio-gases including methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) was determined on six occasions using a GA2000 Infra-Red Gas Analyser from Geotechnical Instruments Ltd. The flow rate and atmospheric pressure, in millibars (mB), was also measured during the monitoring process.

Depth to groundwater was measured using an electronic dip meter.

The results of the gas monitoring recorded elevated carbon dioxide, above 5%, being the point at which point BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings' recommends increasing the Characteristic Situation to CS2.

The level of ground gas protection afforded by the existing ground floor slab and any sub-floor passive venting systems was unknown. Hence, it was not possible to determine if existing construction met the criteria of CS2 and provided the necessary ground gas protection to the retail units above.

It was concluded that internal gas monitoring should be completed to determine presence or absence of landfill gases within the occupied retail space.

2.0 Monitoring Method

CIRIA C665 "Assessing risks posed by hazardous ground gas to buildings" provides guidance for internal gas surveys.

Section 5.3.4 states "*Internal gas surveys are generally undertaken within existing buildings, structures and service ducts where there is potential for soil gas ingress*".

The above is considered appropriate for the existing retail units.

Methane and carbon dioxide can be detected using the GA2000 Gas analyser and volatiles can be detected using a PID; for example the same instruments as the assessment reported June 2017.

Aviron Associates Limited - Head Office

Badgemore House - Badgemore Park - Gravel Hill - Henley on Thames - RG9 4NR

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Registered Office

Herschel House, 58 Herschel Street, Slough, Berkshire, SL1 1PG

Company no. 06471259 - VAT no. 929 5083 96

Example 5.2 of C665 provides a recommendation for an internal survey.

The following methodology is recommended which replicates the recommendations of C665;

1. Switch on monitoring equipment and 'run-through' clean to 'zero' equipment. Complete in location away from suspected gas/vapour source; that being out-door air the in the car park of by the front door of the retail unit.
2. Record weather, air temperature and ground conditions.
3. Walk around the perimeter of the building noting airbricks, manhole covers, service entries and shallow excavations. These will assist with location potential gas/vapour entry points into the ground floor.
4. Ensure no cooking, cleaning, smoking etc is occurring within the property as this can influence readings.
5. Attend site with existing ground floor layout plans, if not make a record of rooms.
6. Survey one room at a time and repeat items 6 to 9 for all ground floor rooms.
7. Start in the centre of the room with the monitoring probe at head height, measure the 'ambient' concentration and record. Complete with all both instruments (PID & GA2000).
8. Next measure soil gases/vapours which could ingress through the ground floor. Place probe at floor level where floor meets walls. Where skirting boards are present monitor above and below the skirting. Walk very slowly around the room, holding the probe at the correct level and record any reading which are above 'ambient'. Make a record.
9. Soil vapours/gases can accumulate in cupboards. Locate cupboards and monitor with probe recording any reading above ambient.
10. Do similar for any service entries which can be located at the ground floor and record any reading above ambient.

3.0 Frequency of Monitoring

CIRIA document C665 was also consulted to gain advice on the frequency and number of monitoring events to complete a ground gas risk assessment. The typical number of visits, which is often the industry norm is six, as per the external monitoring assessment.

It is known the site is underlain by a landfill (in places). This would typically indicate a HIGH gas risk hazard. However, given the results of the 'June 2017' monitoring a Characteristic Situation CS2 was determined which equates the LOW.

For the purpose of moving this assessment forward with a level of internal monitoring it is considered that a 'best practice' bench mark of CS3 (MODERATE risk) should be applied to determine the frequency and duration of further monitoring events.

Section 5.5 of C665 suggests the number of monitoring rounds and provides table matrices based on risk and sensitivity (use) of the building.

For a LOW sensitivity (commercial) use building of MODERATE risk a monitoring period of three months is suggested incorporated six monitoring events.

CIRIA C665 highlights the importance of monitoring during worst-case conditions. This is typically during a low pressure front when barometric pressure rapidly falls below 1000mB. Hence, the period of monitoring may need to be extended should worst-case conditions not be encountered.

Therefore, the proposal is to completed **six monitoring visits** over a period of **circa 3 months**.

Furthermore, upon completion of the initial six rounds of monitoring, bi-annual monitoring visits should be completed to confirm the on-going level of risk and enable suitable actions to be taken, if necessary.



4.0 Units to be Monitored

The units to be monitored are as follows:

 Costa	Opens 6:30am, first member of staff around 6am.
 Subway	Opens 7am, first member of staff around 6:30am.
 Pets at Home	Opens 9am, first member of staff around 7am Tues-Thurs, otherwise 8am.
 B&M	Opens 9am, first member of staff around 8:30am.
 Laura Ashley	Opens 9:30am, first member of staff around 9am.
 SCS	Opens 10am, first member of staff around 9:30am
 Shoezone	Opens 9am, first member of staff around 8:30am.
 Dreams	Opens 9am, first member of staff around 8:30am.
 Go Outdoors	Opens 9am, first member of staff around 8:30am.
 Halfords	Opens 9am, first member of staff around 8:30am.
 Next	Opens 9:30am, first member of staff around 9am.
 'Vacant'	CLOSED. Access TBC.
 Brantano	CLOSED. Access TBC.

Prior to each monitoring event a timetable of monitoring was proposed.

The order of monitoring is designed to gain access to units upon staff opening-up such that back-offices can be air monitored prior to staff occupancy. The purpose being to 'as close as possible' evaluate air quality in rooms with closed doors where the air exchange is limited; when compared to rooms with open doors.

Where stores have similar 'opening times' the order of 'access' shall vary from store to store during the progress of the six monitoring visits. It is expected this will apply to B&M, Laura Ashley, SCS, Shoezone, Dreams, Go Outdoors, Halfords and Next.

5.0 Hazardous Ground Gas Monitoring

Monitoring was completed within the aforementioned occupied units using a GA2000 and PID on the dates shown within table 5, which also summarises weather conditions and atmosphere pressure. To determine rising or falling pressures local 'online' weather trends from the Met Office were consulted and the on-site measured barometric pressures v's time were also considered.

Table 5 : Background Gas Monitoring Data

Date	Atmospheric Pressure	Rising/Falling Pressure?	Weather Conditions
30/01/2019	989mB - 987mB	Falling	Cold, icy, -5 rising to -2°C

Monitoring was completed by an Aviron field technician initially trained by RAE Systems (and subsequently/periodically in-house) to use the RID and Geotechnical Instruments Limited (and subsequently/periodically in-house to operate the GA2000.

Note 2 of C665 indicates 'worst-case' conditions occur during (rapidly) falling and sub-1000mB atmospheric pressures. Section 5.5.1 of C665 indicates 'worst-case' conditions are likely to occur during weather conditions such as rainfall, frost or dry weather.

'Worst-case' conditions were encountered on 30 January 2019.



6.0 Summary of Results

Results obtained during the monitoring process are **appended** to this report. Table 6 summaries the results obtained.

Table 6 : Summary of Monitoring Results

Gas	Measured Conc. Range (% v/v)		Comments
	Low	High	
CH ₄	0.0	0.1	Methane has been recorded in a very low range. It is noted methane is detected later in the morning of monitoring once stores have been occupied. The early monitoring events have recorded methane at 0.0%. It is considered the records of methane at 0.1%, later in the morning/day, are resultant of human activity. All concentrations are below the trigger value of 1%.
CO ₂	0.0	0.3	Generally carbon dioxide was recorded around 0.1% with notable rises to 0.2% and 0.3% with rooms such as toilets, training rooms, canteens and shop floors. The presence of carbon dioxide between 0.2% and 0.3% is likely a result of human activity or possible stagnant air within closed rooms. All concentrations are below the trigger value of 5%.
O ₂	20.7	20.9	Oxygen has been ambiently recorded between 20.7% and 20.9% on all occasions. The slightly lower oxygen concentrations reflective of corresponding oxygen and methane concentrations. All concentrations are above the trigger value of 18%.
Vapour*	0.0	0.0	No vapour (PID) concentrations have been recorded indicating the absence of volatile organic compounds.

*vapour concentration in parts per million (ppm)

7.0 Conclusions and Recommendations

Landfill gas concentrations within the units are considered to be ambient.

At this stage it is considered the floor slab is provided adequate ground gas protection to occupants of the retail units.

A further five monitoring visits should be completed.

Prepared by **James Burkitt** BEng (Hons) CEnv MRICS
Managing Director
Date 28 February 2019
Encs Monitoring Results



VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Pets at Home

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 31/01/2019

TIME 08:15

WEATHER/TEMP Cold, icy, -5

VISIT NUMBER

1

EQUIPMENT

GA2000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration							Location of Max. Value	Notes
Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)		
Outside / front door	n/a	0	0	20.9	989	0		
Main shop floor - left	n/a	0	0.1	20.8	989	0		
Main shop floor - right	n/a	0	0.1	20.8	989	0		
Main shop floor - front	n/a	0	0.1	20.8	989	0		
Main shop floor - rear	n/a	0	0.1	20.8	989	0		
Gents w/c	No	0	0.1	20.8	989	0		
Ladies w/c	No	0	0.1	20.8	989	0		
Store room	No	0	0.1	20.8	989	0		
Staff room	No	0	0.2	20.8	989	0		
Groom room	No	0	0.1	20.8	989	0		
Prep room	No	0	0.1	20.8	989	0		
Vets Theatre	No	0	0.2	20.7	989	0		
Cats Kennel	No	0	0.1	20.8	989	0		
Dog kennel	No	0	0.1	20.8	989	0		
Prep room 2	No	0	0.1	20.8	989	0		
Consult 1	No	0	0.1	20.8	989	0		
Consult 2	No	0	0.1	20.8	989	0		
Consult 3	No	0	0.1	20.8	989	0		
Storage/isolation	No	0	0.1	20.8	989	0		
Office	No	0	0.1	20.8	989	0		

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	1
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Next

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 31/01/2019

TIME 10:02

WEATHER/TEMP Cold, icy, -4

VISIT NUMBER

1

EQUIPMENT

GA2000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration							Location of Max. Value	Notes
Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)		
Outside / front door	n/a	0	0	20.9	989	0		
Main shop floor - left	n/a	0	0.1	20.8	989	0		
Main shop floor - right	n/a	0	0.1	20.8	989	0		
Main shop floor - front	n/a	0	0.1	20.8	989	0		
Main shop floor - rear	n/a	0	0.1	20.8	989	0		
Mens w/c	No	0	0.2	20.7	989	0		
Ladies W/c	No	0	0.1	20.8	989	0		
Stockroom clothes	No	0.1	0.1	20.7	989	0		
Main stockroom	No	0	0.1	20.8	989	0		
Admin office	No	0.1	0.1	20.8	989	0		
Cash office	No	0.1	0.1	20.7	989	0		
Managers office	No	0	0.1	20.8	989	0		
Stationary	No	0	0.1	20.8	989	0		
Cleaners cupboard	No	0	0.1	20.8	989	0		
Disabaled w/c	No	0	0.1	20.8	989	0		
Deliveries	No	0.1	0.1	20.8	989	0		
Shoe room	No	0.1	0.1	20.7	989	0		
Electrical cupboard	No	0.1	0	20.8	989	0		
Staff room	No	0.1	0.1	20.8	989	0		



INTERNAL GAS RISK ASSESSMENT VISIT 2

BRUNEL RETAIL PARK, ROSE KILN LANE, READING, RG2 0HS

**ON BEHALF OF
ABERDEEN ASSETT MANAGEMENT
C/O JLL
REPORT 17-142.02-2
MARCH 2019**

1.0 Introduction

Aviron Associates Limited (Aviron) previously completed a ground gas risk assessment, which is reported within our report referenced 17-142.01 and dated June 2017.

The gas risk assessment, reported 2017, comprised the drilling and installation of eight monitoring wells (MW1-MW8).

The presence of soil vapours was determined prior to bulk ground gas monitoring on six occasions using a MiniRAE Photon Ionisation Detector (PID) from RAEs Systems.

The presence of hazardous bio-gases including methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) was determined on six occasions using a GA2000 Infra-Red Gas Analyser from Geotechnical Instruments Ltd. The flow rate and atmospheric pressure, in millibars (mB), was also measured during the monitoring process.

Depth to groundwater was measured using an electronic dip meter.

The results of the gas monitoring recorded elevated carbon dioxide, above 5%, being the point at which point BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings' recommends increasing the Characteristic Situation to CS2.

The level of ground gas protection afforded by the existing ground floor slab and any sub-floor passive venting systems was unknown. Hence, it was not possible to determine if existing construction met the criteria of CS2 and provided the necessary ground gas protection to the retail units above.

It was concluded that internal gas monitoring should be completed to determine presence or absence of landfill gases within the occupied retail space.

2.0 Monitoring Method

CIRIA C665 "Assessing risks posed by hazardous ground gas to buildings" provides guidance for internal gas surveys.

Section 5.3.4 states "*Internal gas surveys are generally undertaken within existing buildings, structures and service ducts where there is potential for soil gas ingress*".

The above is considered appropriate for the existing retail units.

Methane and carbon dioxide can be detected using the GA2000 (and GA5000) Gas analyser and volatiles can be detected using a PID; for example the same instruments as the assessment reported June 2017.

Aviron Associates Limited - Head Office

Badgemore House - Badgemore Park - Gravel Hill - Henley on Thames - RG9 4NR

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Registered Office

Herschel House, 58 Herschel Street, Slough, Berkshire, SL1 1PG

Company no. 06471259 - VAT no. 929 5083 96

Example 5.2 of C665 provides a recommendation for an internal survey.

The following methodology is recommended which replicates the recommendations of C665:

1. Switch on monitoring equipment and 'run-through' clean to 'zero' equipment. Complete in location away from suspected gas/vapour source; that being out-door air the in the car park of by the front door of the retail unit.
2. Record weather, air temperature and ground conditions.
3. Walk around the perimeter of the building noting airbricks, manhole covers, service entries and shallow excavations. These will assist with location potential gas/vapour entry points into the ground floor.
4. Ensure no cooking, cleaning, smoking etc is occurring within the property as this can influence readings.
5. Attend site with existing ground floor layout plans, if not make a record of rooms.
6. Survey one room at a time and repeat items 6 to 9 for all ground floor rooms.
7. Start in the centre of the room with the monitoring probe at head height, measure the 'ambient' concentration and record. Complete with all both instruments (PID & GA2000).
8. Next measure soil gases/vapours which could ingress through the ground floor. Place probe at floor level where floor meets walls. Where skirting boards are present monitor above and below the skirting. Walk very slowly around the room, holding the probe at the correct level and record any reading which are above 'ambient'. Make a record.
9. Soil vapours/gases can accumulate in cupboards. Locate cupboards and monitor with probe recording any reading above ambient.
10. Do similar for any service entries which can be located at the ground floor and record any reading above ambient.

3.0 Frequency of Monitoring

CIRIA document C665 was also consulted to gain advice on the frequency and number of monitoring events to complete a ground gas risk assessment. The typical number of visits, which is often the industry norm is six, as per the external monitoring assessment.

It is known the site is underlain by a landfill (in places). This would typically indicate a HIGH gas risk hazard. However, given the results of the 'June 2017' monitoring a Characteristic Situation CS2 was determined which equates the LOW.

For the purpose of moving this assessment forward with a level of internal monitoring it is considered that a 'best practice' bench mark of CS3 (MODERATE risk) should be applied to determine the frequency and duration of further monitoring events.

Section 5.5 of C665 suggests the number of monitoring rounds and provides table matrices based on risk and sensitivity (use) of the building.

For a LOW sensitivity (commercial) use building of MODERATE risk a monitoring period of three months is suggested incorporated six monitoring events.

CIRIA C665 highlights the importance of monitoring during worst-case conditions. This is typically during a low pressure front when barometric pressure rapidly falls below 1000mB. Hence, the period of monitoring may need to be extended should worst-case conditions not be encountered.

Therefore, the proposal is to completed **six monitoring visits** over a period of **circa 3 months**.

Furthermore, upon completion of the initial six rounds of monitoring, bi-annual monitoring visits should be completed to confirm the on-going level of risk and enable suitable actions to be taken, if necessary.



4.0 Units to be Monitored

The units to be monitored are as follows:

 Costa	Opens 6:30am, first member of staff around 6am.
 Subway	Opens 7am, first member of staff around 6:30am.
 Pets at Home	Opens 9am, first member of staff around 7am Tues-Thurs, otherwise 8am.
 Shoezone	Opens 9am, first member of staff around 8:30am.
 Laura Ashley	Opens 9:30am, first member of staff around 9am.
 SCS	Opens 10am, first member of staff around 9:30am.
 B&M	Opens 9am, first member of staff around 8:30am.
 Next	Opens 9:30am, first member of staff around 9am.
 Halfords	Opens 9am, first member of staff around 8:30am.
 Go Outdoors	Opens 9am, first member of staff around 8:30am.
 Dreams	Opens 9am, first member of staff around 8:30am.
 'Vacant'	CLOSED. Access TBC.
 Brantano	CLOSED. Access TBC.

The order of monitoring is designed to gain access to units upon staff opening-up such that back-offices can be air monitored prior to staff occupancy. The purpose being to 'as close as possible' evaluate air quality in rooms with closed doors where the air exchange is limited; when compared to rooms with open doors.

Where stores have similar 'opening times' the order of 'access' shall vary from store to store during the progress of the six monitoring visits. It is expected this will apply to B&M, Laura Ashley, SCS, Shoezone, Dreams, Go Outdoors, Halfords and Next.

5.0 Hazardous Ground Gas Monitoring

Monitoring was completed within the aforementioned occupied units using a GA5000 and PID on the dates shown within table 5, which also summarises weather conditions and atmosphere pressure. To determine rising or falling pressures local 'online' weather trends from the Met Office were consulted and the on-site measured barometric pressures v's time were also considered.

Table 5 : Background Gas Monitoring Data

Date	Atmospheric Pressure	Rising/Falling Pressure?	Weather Conditions
15/03/2019	1000mB - 1003mB	Rising	Over-cast, 12 rising to 13°C

Monitoring was completed by an Aviron field technician initially trained by RAE Systems (and subsequently/periodically in-house) to use the RID and Geotechnical Instruments Limited (and subsequently/periodically in-house to operate the GA5000.

Note 2 of C665 indicates 'worst-case' conditions occur during (rapidly) falling and sub-1000mB atmospheric pressures. Section 5.5.1 of C665 indicates 'worst-case' conditions are likely to occur during weather conditions such as rainfall, frost or dry weather.

'Worst-case' conditions were not encountered on 15 March 2019.



6.0 Summary of Results

Results obtained during the monitoring process are **appended** to this report. Table 6 summaries the results obtained.

Table 6 : Summary of Monitoring Results

Gas	Measured Conc. Range (% v/v)		Comments
	Low	High	
CH ₄	0.0	0.1	Methane as been recorded in a very low range. It is noted methane is detected later in the morning of monitoring once stores have been occupied. The early monitoring events have recorded methane at 0.0%. It is considered the records of methane at 0.1%, later in the morning/day, are resultant of human activity. All concentrations are below the trigger value of 1%.
CO ₂	0.0	0.1	Generally carbon dioxide was recorded between 0.0% and 0.1% with no notable rises in occupied areas. All concentrations are below the trigger value of 5%.
O ₂	19.3	20.3	Oxygen has been ambiently recorded between 19.3% and 20.3% on all occasions. The slightly lower oxygen concentrations perhaps reflective of earlier monitoring of the units prior to ambient air exchange within. Nonetheless all concentrations are above the trigger value of 18%.
Vapour*	0.0	0.0	No vapour (PID) concentrations have been recorded indicating the absence of volatile organic compounds.

*vapour concentration in parts per million (ppm)

7.0 Conclusions and Recommendations

Landfill gas concentrations within the units are considered to be ambient.

At this stage it is considered the floor slab is provided adequate ground gas protection to occupants of the retail units.

A further five monitoring visits should be completed.

Prepared by **James Burkitt** BEng (Hons) CEnv MRICS
Managing Director
Date 26 March 2019
Encs Monitoring Results



VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Pets at Home

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 15/03/2019

TIME 08:23

WEATHER/TEMP Overcast/13°

VISIT NUMBER

2

EQUIPMENT

GA5000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	19.7	1001	0		
Main shop floor - left	n/a	0	0.1	19.6	1001	0		
Main shop floor - right	n/a	0	0.1	19.6	1001	0		
Main shop floor - front	n/a	0	0.1	19.6	1001	0		
Main shop floor - rear	n/a	0	0.1	19.6	1001	0		
Gents w/c	No	0	0.1	19.6	1001	0		
Ladies w/c	No	0	0.1	19.6	1001	0		
Store room	No	0	0.1	19.6	1001	0		
Staff room	No	0	0.2	19.6	1001	0		
Groom room	No	0	0.1	19.6	1001	0		
Prep room	No	0	0.1	19.6	1001	0		
Vets Theatre	No	0	0.2	19.6	1001	0		
Cats Kennel	No	0	0.1	19.6	1001	0		
Dog kennel	No	0	0.1	19.8	1001	0		
Prep room 2	No	0	0.1	19.8	1001	0		
Consult 1	No	0	0.1	19.8	1001	0		
Consult 2	No	0	0.1	19.8	1001	0		
Consult 3	No	0	0.1	19.8	1001	0		
Storage/isolation	No	0	0.1	19.8	1001	0		
Office	Yes	0	0.1	19.6	1001	0		

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

WEATHER/TEMP Overcast/13°

COMPLETED BY

GR

[illegible]

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	2
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Next

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 31/01/2019

TIME 10:02

WEATHER/TEMP Overcast/13°

VISIT NUMBER

2

EQUIPMENT

GA5000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	20.4	1002	0		
Main shop floor - left	n/a	0	0	20.3	1002	0		
Main shop floor - right	n/a	0	0	20.3	1002	0		
Main shop floor - front	n/a	0	0	20.3	1002	0		
Main shop floor - rear	n/a	0	0	20.3	1002	0		
Mens w/c	No	0	0.1	20.3	1002	0		
Ladies W/c	No	0	0.1	20.3	1002	0		
Stockroom clothes	No	0	0	20.3	1002	0		
Main stockroom	No	0	0	20.3	1002	0		
Admin office	No	0.1	0	20.3	1002	0		
Cash office	No	0.1	0	20.3	1002	0		
Managers office	No	0	0.1	20.3	1002	0		
Stationary	No	0	0	20.3	1002	0		
Cleaners cupboard	No	0	0	20.3	1002	0		
Disabaled w/c	No	0	0	20.3	1002	0		
Deliveries	No	0.1	0	20.3	1002	0		
Shoe room	No	0.1	0	20.3	1002	0		
Electrical cupboard	No	0	0	20.3	1002	0		
Staff room	No	0	0	20.3	1002	0		



INTERNAL GAS RISK ASSESSMENT VISIT 3

BRUNEL RETAIL PARK, ROSE KILN LANE, READING, RG2 0HS

**ON BEHALF OF
ABERDEEN ASSETT MANAGEMENT
C/O JLL
REPORT 17-142.02-3
MARCH 2019**

1.0 Introduction

Aviron Associates Limited (Aviron) previously completed a ground gas risk assessment, which is reported within our report referenced 17-142.01 and dated June 2017.

The gas risk assessment, reported 2017, comprised the drilling and installation of eight monitoring wells (MW1-MW8).

The presence of soil vapours was determined prior to bulk ground gas monitoring on six occasions using a MiniRAE Photon Ionisation Detector (PID) from RAEs Systems.

The presence of hazardous bio-gases including methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) was determined on six occasions using a GA2000 Infra-Red Gas Analyser from Geotechnical Instruments Ltd. The flow rate and atmospheric pressure, in millibars (mB), was also measured during the monitoring process.

Depth to groundwater was measured using an electronic dip meter.

The results of the gas monitoring recorded elevated carbon dioxide, above 5%, being the point at which point BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings' recommends increasing the Characteristic Situation to CS2.

The level of ground gas protection afforded by the existing ground floor slab and any sub-floor passive venting systems was unknown. Hence, it was not possible to determine if existing construction met the criteria of CS2 and provided the necessary ground gas protection to the retail units above.

It was concluded that internal gas monitoring should be completed to determine presence or absence of landfill gases within the occupied retail space.

2.0 Monitoring Method

CIRIA C665 "Assessing risks posed by hazardous ground gas to buildings" provides guidance for internal gas surveys.

Section 5.3.4 states "*Internal gas surveys are generally undertaken within existing buildings, structures and service ducts where there is potential for soil gas ingress*".

The above is considered appropriate for the existing retail units.

Methane and carbon dioxide can be detected using the GA2000 (and GA5000) Gas analyser and volatiles can be detected using a PID; for example the same instruments as the assessment reported June 2017.

Aviron Associates Limited - Head Office

Badgemore House - Badgemore Park - Gravel Hill - Henley on Thames - RG9 4NR

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Registered Office

Herschel House, 58 Herschel Street, Slough, Berkshire, SL1 1PG

Company no. 06471259 - VAT no. 929 5083 96

Example 5.2 of C665 provides a recommendation for an internal survey.

The following methodology is recommended which replicates the recommendations of C665:

1. Switch on monitoring equipment and 'run-through' clean to 'zero' equipment. Complete in location away from suspected gas/vapour source; that being out-door air the in the car park of by the front door of the retail unit.
2. Record weather, air temperature and ground conditions.
3. Walk around the perimeter of the building noting airbricks, manhole covers, service entries and shallow excavations. These will assist with location potential gas/vapour entry points into the ground floor.
4. Ensure no cooking, cleaning, smoking etc is occurring within the property as this can influence readings.
5. Attend site with existing ground floor layout plans, if not make a record of rooms.
6. Survey one room at a time and repeat items 6 to 9 for all ground floor rooms.
7. Start in the centre of the room with the monitoring probe at head height, measure the 'ambient' concentration and record. Complete with all both instruments (PID & GA2000).
8. Next measure soil gases/vapours which could ingress through the ground floor. Place probe at floor level where floor meets walls. Where skirting boards are present monitor above and below the skirting. Walk very slowly around the room, holding the probe at the correct level and record any reading which are above 'ambient'. Make a record.
9. Soil vapours/gases can accumulate in cupboards. Locate cupboards and monitor with probe recording any reading above ambient.
10. Do similar for any service entries which can be located at the ground floor and record any reading above ambient.

3.0 Frequency of Monitoring

CIRIA document C665 was also consulted to gain advice on the frequency and number of monitoring events to complete a ground gas risk assessment. The typical number of visits, which is often the industry norm is six, as per the external monitoring assessment.

It is known the site is underlain by a landfill (in places). This would typically indicate a HIGH gas risk hazard. However, given the results of the 'June 2017' monitoring a Characteristic Situation CS2 was determined which equates the LOW.

For the purpose of moving this assessment forward with a level of internal monitoring it is considered that a 'best practice' bench mark of CS3 (MODERATE risk) should be applied to determine the frequency and duration of further monitoring events.

Section 5.5 of C665 suggests the number of monitoring rounds and provides table matrices based on risk and sensitivity (use) of the building.

For a LOW sensitivity (commercial) use building of MODERATE risk a monitoring period of three months is suggested incorporated six monitoring events.

CIRIA C665 highlights the importance of monitoring during worst-case conditions. This is typically during a low pressure front when barometric pressure rapidly falls below 1000mB. Hence, the period of monitoring may need to be extended should worst-case conditions not be encountered.

Therefore, the proposal is to completed **six monitoring visits** over a period of **circa 3 months**.

Furthermore, upon completion of the initial six rounds of monitoring, bi-annual monitoring visits should be completed to confirm the on-going level of risk and enable suitable actions to be taken, if necessary.



4.0 Units to be Monitored

The units to be monitored are as follows:

 Costa	Opens 6:30am, first member of staff around 6am.
 Subway	Opens 7am, first member of staff around 6:30am.
 Pets at Home	Opens 9am, first member of staff around 7am Tues-Thurs, otherwise 8am.
 Dreams	Opens 9am, first member of staff around 8:30am.
 Next	Opens 9:30am, first member of staff around 9am.
 SCS	Opens 10am, first member of staff around 9:30am
 Laura Ashley	Opens 9:30am, first member of staff around 9am.
 Go Outdoors	Opens 9am, first member of staff around 8:30am.
 B&M	Opens 9am, first member of staff around 8:30am.
 Halfords	Opens 9am, first member of staff around 8:30am.
 Shoezone	Opens 9am, first member of staff around 8:30am.
 Go Outdoors	Opens 9am, first member of staff around 8:30am.
 'Vacant'	CLOSED. Access TBC.
 Brantano	Access gained.

The order of monitoring is designed to gain access to units upon staff opening-up such that back-offices can be air monitored prior to staff occupancy. The purpose being to 'as close as possible' evaluate air quality in rooms with closed doors where the air exchange is limited; when compared to rooms with open doors.

Where stores have similar 'opening times' the order of 'access' shall vary from store to store during the progress of the six monitoring visits. It is expected this will apply to B&M, Laura Ashley, SCS, Shoezone, Dreams, Go Outdoors, Halfords and Next.

5.0 Hazardous Ground Gas Monitoring

Monitoring was completed within the aforementioned occupied units using a GA5000 and PID on the dates shown within table 5, which also summarises weather conditions and atmosphere pressure. To determine rising or falling pressures local 'online' weather trends from the Met Office were consulted and the on-site measured barometric pressures v's time were also considered.

Table 5 : Background Gas Monitoring Data

Date	Atmospheric Pressure	Rising/Falling Pressure?	Weather Conditions
29/03/2019	10023mB - 1023mB	Rising	Sunny, 7°C to 10°C

Monitoring was completed by an Aviron field technician initially trained by RAE Systems (and subsequently/periodically in-house) to use the RID and Geotechnical Instruments Limited (and subsequently/periodically in-house to operate the GA5000.

Note 2 of C665 indicates 'worst-case' conditions occur during (rapidly) falling and sub-1000mB atmospheric pressures. Section 5.5.1 of C665 indicates 'worst-case' conditions are likely to occur during weather conditions such as rainfall, frost or dry weather.

'Worst-case' conditions were not encountered on 29 March 2019.



6.0 Summary of Results

Results obtained during the monitoring process are **appended** to this report. Table 6 summaries the results obtained.

Table 6 : Summary of Monitoring Results

Gas	Measured Conc. Range (% v/v)		Comments
	Low	High	
CH ₄	0.0	0.1	Methane as been recorded in a very low range. It is noted methane is detected later in the morning of monitoring once stores have been occupied. The early monitoring events have recorded methane at 0.0%. It is considered the records of methane at 0.1%, later in the morning/day, are resultant of human activity. All concentrations are below the trigger value of 1%.
CO ₂	0.1	0.2	Generally carbon dioxide was recorded between 0.1% and 0.2% with no notable rises in occupied areas. All concentrations are below the trigger value of 5%.
O ₂	19.2	20.4	Oxygen has been ambiently recorded between 19.3% and 20.3% on all occasions. The slightly lower oxygen concentrations perhaps reflective of earlier monitoring of the units prior to ambient air exchange within. Nonetheless all concentrations are above the trigger value of 18%.
Vapour*	0.0	0.0	No vapour (PID) concentrations have been recorded indicating the absence of volatile organic compounds.

*vapour concentration in parts per million (ppm)

7.0 Conclusions and Recommendations

Landfill gas concentrations within the units are considered to be ambient.

At this stage it is considered the floor slab is provided adequate ground gas protection to occupants of the retail units.

A further three monitoring visits should be completed.

Prepared by **James Burkitt** BEng (Hons) CEnv MRICS
Managing Director
Date 29 March 2019
Encs Monitoring Results



VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Pets at Home

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 29/03/2019

TIME 08:09

WEATHER/TEMP Sunny/7°

VISIT NUMBER

3

EQUIPMENT

GA5000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	19.3	1023	0		
Main shop floor - left	n/a	0	0.1	19.2	1023	0		
Main shop floor - right	n/a	0	0.1	19.2	1023	0		
Main shop floor - front	n/a	0	0.1	19.2	1023	0		
Main shop floor - rear	n/a	0	0.1	19.2	1023	0		
Gents w/c	No	0	0.1	19.4	1023	0		
Ladies w/c	No	0	0.1	19.4	1023	0		
Store room	No	0	0.1	19.3	1023	0		
Staff room	No	0	0.1	19.4	1023	0		
Groom room	No	0	0.1	19.3	1023	0		
Prep room	No	0	0.2	19.6	1023	0		
Vets Theatre	No	0	0.1	19.6	1023	0		
Cats Kennel	No	0	0.1	19.6	1023	0		
Dog kennel	No	0	0.2	19.6	1023	0		
Prep room 2	No	0	0.1	19.4	1023	0		
Consult 1	No	0	0.2	19.5	1023	0		
Consult 2	No	0	0.2	19.5	1023	0		
Consult 3	No	0	0.1	19.5	1023	0		
Storage/isolation	No	0	0.1	19.5	1023	0		
Office	Yes	0	0.1	19.5	1023	0		

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

WEATHER/TEMP Sunny/9°

GR

[illegible]

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	3
EQUIPMENT	GA5000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Next

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 29/03/2019

TIME 11:48

WEATHER/TEMP Sunny/10°

VISIT NUMBER

3

EQUIPMENT

GA5000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0.1	20.5	1025	0		
Main shop floor - left	n/a	0	0.1	20.3	1025	0		
Main shop floor - right	n/a	0	0.1	20.3	1025	0		
Main shop floor - front	n/a	0	0.1	20.3	1025	0		
Main shop floor - rear	n/a	0	0.1	20.3	1025	0		
Mens w/c	No	0	0.1	20.3	1025	0		
Ladies W/c	No	0	0.1	20.3	1025	0		
Stockroom clothes	No	0.1	0.1	20.3	1025	0		
Main stockroom	No	0	0.1	20.4	1025	0		
Admin office	No	0	0.2	20.3	1025	0		
Cash office	No	0	0.2	20.3	1025	0		
Managers office	No	0	0.1	20.3	1025	0		
Stationary	No	0.1	0.1	20.4	1025	0		
Cleaners cupboard	No	0.1	0.1	20.3	1025	0		
Disabaled w/c	No	0	0.1	20.3	1025	0		
Deliveries	No	0	0.2	20.3	1025	0		
Shoe room	No	0	0.1	20.4	1025	0		
Electrical cupboard	No	0.1	0.1	20.2	1025	0		
Staff room	No	0.1	0.1	20.4	1025	0		

WEATHER/TEMP Sunny/7⁰

COMPLETED BY

GR

[illegible]

WEATHER/TEMP Sunny/7⁰

COMPLETED BY

GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Pets at Home

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 23/08/2019

TIME 08:33

WEATHER/TEMP Sunny

VISIT NUMBER

4

EQUIPMENT

GA2000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	20.8	1021	0		
Main shop floor - left	n/a	0	0	20.6	1021	0		
Main shop floor - right	n/a	0	0	20.6	1021	0		
Main shop floor - front	n/a	0	0	20.6	1021	0		
Main shop floor - rear	n/a	0	0	20.5	1021	0		
Gents w/c	No	0	0	20.6	1021	0		
Ladies w/c	No	0	0	20.6	1021	0		
Store room	No	0	0	20.5	1021	0		
Staff room	No	0	0	20.6	1021	0		
Groom room	No	0	0	20.5	1021	0		
Prep room	No	0	0.1	20.5	1021	0		
Vets Theatre	No	0.1	0	20.5	1021	0		
Cats Kennel	No	0	0	20.5	1021	0		
Dog kennel	No	0	0	20.4	1021	0		
Prep room 2	No	0	0	20.5	1021	0		
Consult 1	No	0	0	20.5	1021	0		
Consult 2	No	0	0	20.6	1021	0		
Consult 3	No	0	0	20.6	1021	0		
Storage/isolation	No	0	0	20.6	1021	0		
Office	Yes	0	0	20.6	1021	0		

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Next

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 23/08/2019

TIME 10:04

WEATHER/TEMP Sunny

VISIT NUMBER

4

EQUIPMENT

GA2000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	20.9	1021	0		
Main shop floor - left	n/a	0	0	20.7	1021	0		
Main shop floor - right	n/a	0	0	20.7	1021	0		
Main shop floor - front	n/a	0	0	20.7	1021	0		
Main shop floor - rear	n/a	0	0.1	20.7	1021	0		
Mens w/c	No	0	0	20.8	1021	0		
Ladies W/c	No	0	0	20.7	1021	0		
Stockroom clothes	No	0	0	20.8	1021	0		
Main stockroom	No	0	0	20.7	1021	0		
Admin office	No	0	0.1	20.7	1021	0		
Cash office	No	0	0	20.7	1021	0		
Managers office	No	0	0	20.7	1021	0		
Stationary	No	0	0	20.8	1021	0		
Cleaners cupboard	No	0	0	20.7	1021	0		
Disabaled w/c	No	0	0	20.7	1021	0		
Deliveries	No	0	0.1	20.7	1021	0		
Shoe room	No	0	0.1	20.7	1021	0		
Electrical cupboard	No	0	0.1	20.6	1021	0		
Staff room	No	0	0	20.6	1021	0		

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	4
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]



INTERNAL GAS RISK ASSESSMENT VISIT 5

BRUNEL RETAIL PARK, ROSE KILN LANE, READING, RG2 0HS

**ON BEHALF OF
ABERDEEN ASSETT MANAGEMENT
C/O JLL
REPORT 17-142.02-5
OCTOBER 2019**

1.0 Introduction

Aviron Associates Limited (Aviron) previously completed a ground gas risk assessment, which is reported within our report referenced 17-142.01 and dated June 2017.

The gas risk assessment, reported 2017, comprised the drilling and installation of eight monitoring wells (MW1-MW8).

The presence of soil vapours was determined prior to bulk ground gas monitoring on six occasions using a MiniRAE Photon Ionisation Detector (PID) from RAEs Systems.

The presence of hazardous bio-gases including methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) was determined on six occasions using a GA2000 Infra-Red Gas Analyser from Geotechnical Instruments Ltd. The flow rate and atmospheric pressure, in millibars (mB), was also measured during the monitoring process.

Depth to groundwater was measured using an electronic dip meter.

The results of the gas monitoring recorded elevated carbon dioxide, above 5%, being the point at which point BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings' recommends increasing the Characteristic Situation to CS2.

The level of ground gas protection afforded by the existing ground floor slab and any sub-floor passive venting systems was unknown. Hence, it was not possible to determine if existing construction met the criteria of CS2 and provided the necessary ground gas protection to the retail units above.

It was concluded that internal gas monitoring should be completed to determine presence or absence of landfill gases within the occupied retail space.

2.0 Monitoring Method

CIRIA C665 "Assessing risks posed by hazardous ground gas to buildings" provides guidance for internal gas surveys.

Section 5.3.4 states "*Internal gas surveys are generally undertaken within existing buildings, structures and service ducts where there is potential for soil gas ingress*".

The above is considered appropriate for the existing retail units.

Methane and carbon dioxide can be detected using the GA2000 (and GA5000) Gas analyser and volatiles can be detected using a PID; for example the same instruments as the assessment reported June 2017.

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Registered Office

Herschel House, 58 Herschel Street, Slough, Berkshire, SL1 1PG

Company no. 06471259 - VAT no. 929 5083 96

Example 5.2 of C665 provides a recommendation for an internal survey.

The following methodology is recommended which replicates the recommendations of C665:

1. Switch on monitoring equipment and 'run-through' clean to 'zero' equipment. Complete in location away from suspected gas/vapour source; that being out-door air the in the car park of by the front door of the retail unit.
2. Record weather, air temperature and ground conditions.
3. Walk around the perimeter of the building noting airbricks, manhole covers, service entries and shallow excavations. These will assist with location potential gas/vapour entry points into the ground floor.
4. Ensure no cooking, cleaning, smoking etc is occurring within the property as this can influence readings.
5. Attend site with existing ground floor layout plans, if not make a record of rooms.
6. Survey one room at a time and repeat items 6 to 9 for all ground floor rooms.
7. Start in the centre of the room with the monitoring probe at head height, measure the 'ambient' concentration and record. Complete with all both instruments (PID & GA2000).
8. Next measure soil gases/vapours which could ingress through the ground floor. Place probe at floor level where floor meets walls. Where skirting boards are present monitor above and below the skirting. Walk very slowly around the room, holding the probe at the correct level and record any reading which are above 'ambient'. Make a record.
9. Soil vapours/gases can accumulate in cupboards. Locate cupboards and monitor with probe recording any reading above ambient.
10. Do similar for any service entries which can be located at the ground floor and record any reading above ambient.

3.0 Frequency of Monitoring

CIRIA document C665 was also consulted to gain advice on the frequency and number of monitoring events to complete a ground gas risk assessment. The typical number of visits, which is often the industry norm is six, as per the external monitoring assessment.

It is known the site is underlain by a landfill (in places). This would typically indicate a HIGH gas risk hazard. However, given the results of the 'June 2017' monitoring a Characteristic Situation CS2 was determined which equates the LOW.

For the purpose of moving this assessment forward with a level of internal monitoring it is considered that a 'best practice' bench mark of CS3 (MODERATE risk) should be applied to determine the frequency and duration of further monitoring events.

Section 5.5 of C665 suggests the number of monitoring rounds and provides table matrices based on risk and sensitivity (use) of the building.

For a LOW sensitivity (commercial) use building of MODERATE risk a monitoring period of three months is suggested incorporated six monitoring events.

CIRIA C665 highlights the importance of monitoring during worst-case conditions. This is typically during a low pressure front when barometric pressure rapidly falls below 1000mB. Hence, the period of monitoring may need to be extended should worst-case conditions not be encountered.

Therefore, the proposal is to complete **six monitoring visits** over a period of **circa 3 months**.

Furthermore, upon completion of the initial six rounds of monitoring, bi-annual monitoring visits should be completed to confirm the on-going level of risk and enable suitable actions to be taken, if necessary.



4.0 Units to be Monitored

The units to be monitored are as follows:

 Costa	Opens 6:30am, first member of staff around 6am.
 Subway	Opens 7am, first member of staff around 6:30am.
 Pets at Home	Opens 9am, first member of staff around 7am Tues-Thurs, otherwise 8am.
 SCS	Opens 10am, first member of staff around 9:30am
 B&M	Opens 9am, first member of staff around 8:30am.
 Laura Ashley	Opens 9:30am, first member of staff around 9am.
 Brantano (vacant)	Access gained.
 Shoezone	Opens 9am, first member of staff around 8:30am.
 Dreams	Opens 9am, first member of staff around 8:30am.
 Go Outdoors	Opens 9am, first member of staff around 8:30am.
 Next	Opens 9:30am, first member of staff around 9am.
 'Vacant' (Poundland)	Access gained.
 Halfords	CLOSED – fire refurbishment.

The order of monitoring is designed to gain access to units upon staff opening-up such that back-offices can be air monitored prior to staff occupancy. The purpose being to 'as close as possible' evaluate air quality in rooms with closed doors where the air exchange is limited; when compared to rooms with open doors.

Where stores have similar 'opening times' the order of 'access' shall vary from store to store during the progress of the six monitoring visits. It is expected this will apply to B&M, Laura Ashley, SCS, Shoezone, Dreams, Go Outdoors, Halfords and Next.

5.0 Hazardous Ground Gas Monitoring

Monitoring was completed within the aforementioned occupied units using a GA2000 and PID on the dates shown within table 5, which also summarises weather conditions and atmosphere pressure. To determine rising or falling pressures local 'online' weather trends from the Met Office were consulted and the on-site measured barometric pressures v's time were also considered.

Table 5 : Background Gas Monitoring Data

Date	Atmospheric Pressure	Rising/Falling Pressure?	Weather Conditions
08/10/2019	1004mB	Constant	Sunny

Monitoring was completed by an Aviron field technician initially trained by RAE Systems (and subsequently/periodically in-house) to use the RID and Geotechnical Instruments Limited (and subsequently/periodically in-house to operate the GA2000.

Note 2 of C665 indicates 'worst-case' conditions occur during (rapidly) falling and sub-1000mB atmospheric pressures. Section 5.5.1 of C665 indicates 'worst-case' conditions are likely to occur during weather conditions such as rainfall, frost or dry weather.

'Worst-case' conditions were not encountered on 8 October 2019.



6.0 Summary of Results

Results obtained during the monitoring process are **appended** to this report. Table 6 summaries the results obtained.

Table 6 : Summary of Monitoring Results

Gas	Measured Conc. Range (% v/v)		Comments
	Low	High	
CH ₄	0.0	0.1	Methane has been recorded in a very low range. It is noted methane is detected later in the morning of monitoring once stores have been occupied. The early monitoring events have recorded methane at 0.0%. It is considered the records of methane at 0.1%, later in the morning/day, are resultant of human activity. All concentrations are below the trigger value of 1%.
CO ₂	0.0	0.1	Generally, carbon dioxide was recorded between 0.0% and 0.1% with no notable rises in occupied areas. All concentrations are below the trigger value of 5%.
O ₂	20.4	20.8	Oxygen has been ambiently recorded between 20.4% and 20.8% in all units. The marginally lower oxygen concentrations perhaps reflective of earlier monitoring of the units prior to ambient air exchange within. Nonetheless all concentrations are below the trigger value of 18%.
Vapour*	0.0	0.0	No vapour (PID) concentrations have been recorded indicating the absence of volatile organic compounds.

*vapour concentration in parts per million (ppm)

7.0 Conclusions and Recommendations

Landfill gas concentrations within the units are considered to be ambient.

At this stage it is considered the floor slab is provided adequate ground gas protection to occupants of the retail units.

A further one monitoring visit should be completed, following the by bin-annual maintenance monitoring.

Prepared by **James Burkitt** BEng (Hons) CEnv MRICS
Managing Director

Date 31 October 2019
Encs Monitoring Results



VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Pets at Home

PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS

PROJECT NUMBER 17-142.02

DATE 08/10/2019

TIME 08:12

WEATHER/TEMP Sunny

VISIT NUMBER

5

EQUIPMENT

GA2000 + PID

COMPLETED BY

GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	20.7	1004	0		
Main shop floor - left	n/a	0	0	20.5	1004	0		
Main shop floor - right	n/a	0	0.1	20.5	1004	0		
Main shop floor - front	n/a	0	0.1	20.5	1004	0		
Main shop floor - rear	n/a	0	0.1	20.5	1004	0		
Gents w/c	No	0	0	20.5	1004	0		
Ladies w/c	No	0	0.1	20.5	1004	0		
Store room	No	0	0	20.5	1004	0		
Staff room	No	0	0	20.4	1004	0		
Groom room	No	0.1	0	20.5	1004	0		
Prep room	No	0	0.1	20.5	1004	0		
Vets Theatre	No	0	0	20.4	1004	0		
Cats Kennel	No	0	0	20.4	1004	0		
Dog kennel	No	0	0	20.5	1004	0		
Prep room 2	No	0	0	20.4	1004	0		
Consult 1	No	0	0.1	20.5	1004	0		
Consult 2	No	0.1	0	20.5	1004	0		
Consult 3	No	0.1	0	20.5	1004	0		
Storage/isolation	No	0	0	20.4	1004	0		
Office	Yes	0	0	20.5	1004	0		

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

INTERNAL GROUND GAS MONITORING RECORD



UNIT Next
PROJECT NAME Brunel Retail Park, Rose Kiln Lane, Reading, RG2 0HS
PROJECT NUMBER 17-142.02
DATE 08/10/2019
TIME 12:01
WEATHER/TEMP Sunny

VISIT NUMBER 5
EQUIPMENT GA2000 + PID
COMPLETED BY GR

Max. Recorded Stable Concentration

Location	Room left open?	CH4 (% v/v)	CO2 (% v/v)	O2 (% v/v)	BARO (mB)	PID (ppm)	Location of Max. Value	Notes
Outside / front door	n/a	0	0	20.9	1004	0		
Main shop floor - left	n/a	0	0	20.6	1004	0		
Main shop floor - right	n/a	0	0.1	20.7	1004	0		
Main shop floor - front	n/a	0	0	20.7	1004	0		
Main shop floor - rear	n/a	0	0.1	20.7	1004	0		
Mens w/c	No	0	0	20.7	1004	0		
Ladies W/c	No	0	0	20.7	1004	0		
Stockroom clothes	No	0	0	20.7	1004	0		
Main stockroom	No	0	0	20.6	1004	0		
Admin office	No	0	0	20.6	1004	0		
Cash office	No	0	0	20.7	1004	0		
Managers office	No	0	0.1	20.7	1004	0		
Stationary	No	0	0	20.7	1004	0		
Cleaners cupboard	No	0	0	20.7	1004	0		
Disabaled w/c	No	0	0	20.7	1004	0		
Deliveries	No	0	0	20.7	1004	0		
Shoe room	No	0	0	20.6	1004	0		
Electrical cupboard	No	0	0	20.6	1004	0		
Staff room	No	0	0	20.6	1004	0		

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

VISIT NUMBER	5
EQUIPMENT	GA2000 + PID
COMPLETED BY	GR

[illegible]

APPENDIX 11: CCTV DRAINAGE SURVEY REPORT

WJ SHIRLEY

DRAINAGE SERVICES for
COMMERCIAL PROPERTY INVESTMENT

85 Great Portland Street
London
W1W 7LT

www.wjshirley.co.uk
Tel. 0207 100 1930



Wed 4th and
Thurs 5th
December
2019

DRAINAGE REPORT

**BRUNEL RETAIL PARK
ROSE KILN LANE
READING
RG2 0HS**



OVERALL RATING

MODERATE

Most drains are in good structural condition, however there is a collapsed drain and several displaced joints which should be repaired to prevent further deterioration. There are accumulations of silt, scale and debris which should be cleared to restore the system to its full capacity. The foul system is pumped and we recommend the pump is serviced/overhauled and then subject to a regular maintenance programme. There is one oil interceptor which appears to serve only part of the surface-water system and as such we recommend consideration is given to retro-fitting an additional interceptor to protect the whole site. The interceptor currently needs maintaining.

Total length of below-ground drains

2.17 km

MAIN POINTS

- * Foul and surface-water drains are separate.
- * Foul on mains drainage.
- * Surface-water appears to discharge to river.
- * Foul drains pumped.
- ✓ Most drains in good structural condition.
- ✓ Drains operating moderately well overall.
- ✓ Oil interceptor serving part of the site.
- ✗ Collapsed pipe requires excavation.
- ✗ De-silting and de-scaling works required.
- ✗ Displaced joints need repair.
- ✗ Oil interceptor needs maintaining.
- ✗ Consider retro-fitting an additional oil interceptor.
- ✗ Pump requires service/overhaul.
- £ Budget Costs £48,500

OVERALL MODERATE



Overall assessment of the condition of the drainage assets

STRUCTURAL GOOD



Overall assessment of physical condition of the drainage assets

OPERATIONAL MODERATE



Overall assessment of operational condition of the drainage assets

ENVIRONMENTAL MODERATE



Environmental risk presented via the drainage systems

DRAINAGE COSTS

£48,500

The cost figures should be seen as a guide price or allowance for the recommendations and should not be treated as a quotation. A firm price, however, can be provided for any works on request. These figures exclude any premium for out of hours working, disruption or loss of earnings to tenants, administration costs, local variations in the cost of labour or services, and also exclude any further investigative work which may be required except where stated.

There is a full breakdown of costs later in the report.

COST SUMMARY		
	Retro-fit oil interceptor	£30,000
	Excavations	£5,000
	Pump maintenance	£2,500
	De-silting and de-scaling works	£2,500
	Pipe repairs	£1,800
	Maintain oil interceptor	£1,500
	New inspection cover	£800
Total remedial costs		£44,100
Allowance of approx. 10% professional fees		£4,400
£	TOTAL COSTS	£48,500

COST BREAKDOWN	
URGENCY	DIVISION
	
	
HIGH	STRUCTURAL
1%	14%
£600	£6,800
	
MODERATE	OPERATIONAL
97%	12%
£42,700	£5,800
	
LOW	ENVIRONMENTAL
2%	65%
£800	£31,500
	
	PROFESSIONAL FEES
	9%
	£4,400

AT A GLANCE

An overview of whether or not key drainage items are present and their consequences from a strategic viewpoint. This is an indication of what is present rather than an assessment of condition.

Item	Present	Status	Notes
Oil Interceptor(s)	YES		Consideration should be given to retro-fitting an additional interceptor to protect all areas of the site.
Pumped drainage	YES		Some increased vulnerability and maintenance overheads.
Gravity flow drainage	YES		
Discharge from other property(ies)	NO		
Discharge to other property(ies)	NO		
Mains drainage	YES		Surface-water appears to discharge to the river.
Surface-water soakaways	NO		
Septic tank/cesspool	NO		
Environmentally sensitive area	NO		
Combined drainage	NO		
Sustainability measures	NO		
Waste & materials storage	NO		
Property next to a watercourse	NO		

GENERAL

The background, scope of engagement and level of inspection.



General

WJ Shirley Ltd were instructed by

on behalf of and assignable to

Mayfair Capital Investment Management Limited
55 Wells Street
London
W1T 3PT

to carry out a drainage inspection at

Brunel Retail Park
Rose Kiln Lane
Reading
RG2 0HS

We understand this is in relation to an investment acquisition.



Authorisation

Job No:	2356
Report Issue Date:	11/12/2019
Report prepared by:	Hayley Reed B.Sc (Hons)
Position	Associate, WJ Shirley Ltd
Report authorised by:	Robert Shirley B.A., Ph.D
Signature:	APPROVED 
Position	Director, WJ Shirley Ltd



Method of Assessment

Inspection and assessment was carried out by desktop research, a site walkover and a push-rod CCTV inspection along the below-ground drainage pipes where practicable.



Access

We had good general access to the site, however there are some deep chambers (in excess of 3.5m) which we could not fully inspect with standard equipment. For a full investigation of all deep drains a specialist motorised tractor unit would be required, however, given the generally good condition of drains inspected, we have no particular suspicions.

DRAINAGE NETWORKS

An overview of whether or not key drainage items are present and their consequences from a strategic viewpoint.



Type

Foul and surface-water drainage systems are separate, running through different pipes and manholes. The drains flow by gravity with the addition of a pump on the foul system. Foul is on mains drainage with the surface-water discharging in the direction of nearby River Kennet.



Materials

The below-ground drainage is carried through cast iron, concrete, plastic and vitrified clay pipes ranging from 100mm to 375mm in diameter. Access chambers are constructed in brickwork or concrete sections. Inspection covers are heavy duty ductile iron or pressed steel.



Drain Routes

Below-ground drains run according to the plan at the end of this report. There is what appears to be a flow attenuation valve at MH16. This is designed to limit the flow of surface water, however, we can see no clear need for one at this location. It is not on a main part of the drainage system.



Status

Identification of the status of drains on site is beyond the scope of our inspection, however all drains are likely to be private.

CONDITION

A summary and assessment of the current structural condition and operation of the drains, and an outlook for the future.



Operation

Overall the below-ground drains are operating moderately well.
We noted the following operational defects:

OCCURANCES	DEFECT
10	Debris, silt, scale, blockages
1	Buried manhole
1	Pump maintenance

There are accumulations of debris, silt and scale in the below-ground system causing reduced flow and blockages. This has probably occurred through a natural build-up and lack of maintenance. We recommend widespread de-scaling and de-silting works are carried out to restore the full capacity of the system. The most efficient way of doing this is with high pressure jetting in combination with a suction tanker to remove the waste off site.



There is a foul pumping chamber at MH31. We have not carried out any electrical tests on the pump but would recommend it is serviced/overhauled if not already part of a regular maintenance programme to keep it in good working order.



There is also a buried manhole at MH57. We recommend this is located, exposed and broken out and renewed as necessary to allow full maintenance and inspection access.



Structure

Overall, the below-ground drains are in good structural condition. We noted, however, the following structural defects:

OCCURANCES	DEFECT
3	Displaced joint
1	Collapsed drain
1	Crack on cover slab

There is a collapsed drain near MH13. This will need excavation and renewal to repair.

There are also three displaced joints which we recommend are repaired to prevent further deterioration and possible collapse. These can currently be repaired in-situ by patch lining but have the potential to deteriorate and collapse if not dealt with. We recommend one of these (D9) is repaired within the next 3 months to prevent likely collapse.

There is a cracked cover slab at inspection chamber MH15. We recommend this is monitored.





Environmental

Overall, the environmental risk presented by the drainage systems is moderate. We noted the following environmental issue:

OCCURANCES	DEFECT
1	Oil interceptor needs maintaining

There is one oil interceptor protecting the surface-water system taking the rear yards, however it does not appear to serve the whole site and leaves the main car park unprotected. This would need further investigation to determine for certain but we recommend that consideration is given to retro-fitting an additional interceptor in the carpark downstream of MH7. Oil interceptors need to be well maintained to remain effective and this currently is in need of



Oil interceptor

maintenance. We recommend the interceptor is cleared out with a suction tanker and disposed of Hazardous Waste. Oil interceptors are not a legal requirement but present a sensible precaution against causing environmental pollution via the drainage system.

Environmental risk via the drainage system is discussed in more detail later in the report.



Assessment & Outlook

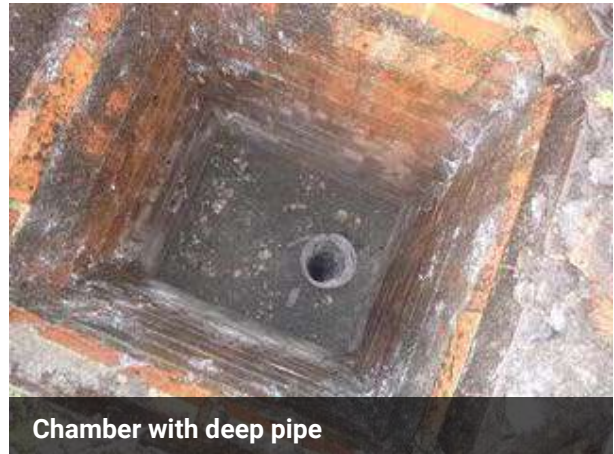
We recommend the de-silting and de-scaling works are carried out to clear the accumulations of silt, scale and debris which will help prevent future blockages and restore the system to its full capacity.

The structural repairs should be carried out to prevent further deterioration and the collapsed pipe repaired as necessary to restore the full integrity, capacity and efficiency of the system. The buried manhole should be located, broken out and renewed as necessary to allow full maintenance and inspection access. The foul pump would benefit from being subject to a regular maintenance programme.

We recommend the oil interceptor is emptied and disposed of as Hazardous Waste and a regular maintenance programme is put in place. Consideration should be given to retro-fitting a suitable oil interceptor to ensure the whole of the surface-water system is protected.

Once our recommendations are carried out we would expect a good outlook for the future.

We noted several chambers with a vertical pipe visible which extends approximately 10m down to some water at the bottom. We are not certain of the purpose of these pipes but do not think they are related to drainage.



Chamber with deep pipe

SUITABILITY

An assessment of the suitability of materialised and opportunity for maintenance access.



Materials

Inspection covers, chambers and drain pipes are in suitable materials.



Access

There is adequate general maintenance access to the drainage systems, with the exception of MH57 which is buried.

ENVIRONMENTAL

An assessment of the environmental risk presented by the drainage systems.¹



Oil Interceptors²

There is one oil interceptor on site (MH26). There is no legal requirement to fit an oil interceptor in most cases³, however there is a legal duty of care to not “knowingly permit” polluting discharge to surface-waters (rivers, streams, ponds etc.) or to groundwater (natural water beneath the site).⁴ Fines and clear-up costs can be severe and in recent years have increasingly

¹ Drainage systems can be one of the primary pathways for causing environmental pollution from a commercial site. With increasing monitoring of the environment, public awareness and the prospect of large fines and remediation costs for environmental damage caused (deliberately, accidentally or via negligence), together with indirect costs of subsequent damage to reputation, raised insurance premiums etc. the potential risks posed by drainage systems should be considered. Surface-water drains usually run either directly to a watercourse, via a public sewer untreated to a watercourse or to groundwater via soakaways and should thus contain only clean uncontaminated water. The risks associated with any particular site can vary greatly depending on pollution sources, any precautionary measures in place, the outfall of the drainage systems and the environmental sensitivity of the site and its surroundings, the probabilities of an initiating event occurring, exposure to the hazard and the receptors being affected by the hazard. There are little or no actual legal requirements in this regard for the layout or installation of precautionary measures on drainage systems such as oil interceptors or shut-off valves (unless they form part of the conditions of an Environmental Permit). However, if pollution does occur (and drainage systems are one of the principle pathways) then prosecutors are likely to take into account the precautionary and preventative measures in place when determining culpability. Reading between the lines, it is our understanding that large companies or institutional owners would be expected to have best available techniques in place regarding pollution prevention on their drainage systems. On a commercial site, especially one that is multi-tenanted, it is a grey area as to whether the landlord or tenant are responsible for implementing pollution prevention measures. There is a principle that the “polluter pays” but if the polluter can’t pay or goes out of business, then costs may fall to the landlord. In addition, it may be argued that the landlord did not provide suitable infrastructure, such as an oil interceptor, which could have prevented a pollution incident. However, for reliable legal advice, a qualified legal advisor should be consulted.

² Oil is one of the principle sources of pollution from industrial and commercial sites in the UK. There are approximately 3,000 oil spills in the UK each year, making up 16% of all pollution incidents. Above-ground oil storage outdoors above 200 litres is governed by the Oil Storage Regulations (not assessed in this report) and covers tank design, siting and secondary containment. A small oil spillage can have large effects: just 2½ litres of oil can cover the area the size of a football pitch when it reaches water.

³ However, may form a legally binding condition of an Environmental Permit or Exemption, or a Trade Effluent Consent if it discharges to the foul drains.

⁴ Environmental Permitting (England and Wales) Regulations 2010

included a deterrent factor.⁵ As such, oil interceptors are recommended by the Environment Agency for sites of this type, are a sensible precaution and offer protection against pollution resulting from oil spillages.⁶ As the oil interceptor does not appear to cover the main car park, we recommend consideration is given to retro-fitting a suitable new oil interceptor to ensure the whole of the site is adequately protected. This will depend partly on the landlord's attitude to risk.

In terms of condition and suitability, being full of water, below-ground and with only a small window of access, oil interceptors generally only provide limited inspection access under normal conditions and we are unable to determine its entire structural condition, size and whether or not it is of sufficient capacity for the area it serves.



Waste & materials storage

We found no waste or materials storage presenting a significant risk of pollution via the drainage systems.



Sustainability

We found no particular sustainability measures⁷ on site relating to the drainage systems.



Wash-down Areas

We found no wash-down areas on site and thus there are no implications for drainage regarding this matter. However, if pressure washers are used, it is a legal requirement to route any effluent to the foul drains with prior permission from the sewer provider and a Trade Effluent consent⁸.

⁵ The Sentencing Council's Environmental Offences Definitive Guideline were introduced in 2014 and a judgement made in 2015 which said that in order to meet the objectives of "punishment, deterrence and the removal of gain (for example by the decision of the management not to expend sufficient resources in modernisation and improvement)" fines may equal up to 100% of a company's pre-tax net profit for the year in question, even if that resulted in a fine exceeding £100m.

⁶ Oil interceptors require regular maintenance to operate properly: if oil levels build up too much or they become too silted, they can be rendered ineffective. Waste from an oil interceptor is likely to be classed as hazardous waste and must be transferred via a consignment note system.

⁷ Possible sustainability measures include rainwater harvesting, flow attenuators, wash-water recycling and SUDS (Sustainable Urban Drainage Schemes).

⁸ The preferred method is to pass through a settlement tank and recycle wash-water but other methods include containment in a tank for periodic emptying by a registered waste carrier.



Re-fuelling Facilities

We found no vehicle re-fuelling facilities on site and thus there are no implications for drainage regarding this.



Trade Effluent Consents

Though beyond the scope of our inspection, we found no practices on site which are likely to require a Trade Effluent Consent.



Environmental Permits

Though beyond the scope of our inspection, we found no practices on site which are likely to require an Environmental Permit.

RECOMMENDATIONS

Details of defects and recommendations arranged by urgency. The cost figures should be seen as a guide price or allowance for the recommendations and should not be treated as a quotation. A firm price, however, can be provided for any works on request.

ASSET	DEFECT	RECOMMENDATION	URGENCY	BY	COST	
MH 45	D 9	Displaced joint, severe	Repair by patch lining	High	Mar 2020	£600
MH 2	D 3	Displaced joint, moderate	Repair by patch lining	Moderate	Dec 2020	£600
MH 6	D 4	Debris, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£2,500
MH 7	D 19	No oil interceptor serving the car park	Consider retro-fitting oil interceptor	Moderate	Dec 2020	£30,000
MH 10	D 12	Silt, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 10	D 13	Silt, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 13	D 6	Collapse,	Excavate and renew pipe	Moderate	Dec 2020	£5,000
MH 13	D 7	Silt, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 14	D 5	Debris, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 15	D 17	Crack on cover slab,	Monitor deterioration	Moderate	Dec 2020	£0
MH 18	D 11	Silt, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 26	D 16	Oil interceptor needs maintaining	Clear out chamber with suction tanker and dispose of as Hazardous Waste	Moderate	Dec 2020	£1,500
MH 29	D 1	Scale, moderate	De-scale	Moderate	Dec 2020	£0
MH 31	D 15	No evidence of pump maintenance	Service/overhaul pumps	Moderate	Dec 2020	£2,500
MH 40	D 2	Scale, moderate	De-scale	Moderate	Dec 2020	£0
MH 44	D 8	Debris, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 52	D 10	Displaced joint, moderate	Repair by patch lining	Moderate	Dec 2020	£600
MH 56	D 14	Silt, moderate	Clear with high pressure water jetting	Moderate	Dec 2020	£0
MH 57	D 18	Buried manhole,	Locate, expose and renew as necessary	Low	Dec 2022	£800
			Total remedial works			£44,100
			Allowance of approx. 10% professional fees			£4,400
TOTAL						£48,500

DRAINAGE ASSETS

Details of the drainage infrastructure inspected including, where appropriate, an note and assessment of any defects.

MH 1

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4361, -0.9747	1600	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 17	375	Concrete	7.1	CCTV
SW 18	375	Concrete	84.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4361, -0.9747	2000	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 17	375	Concrete	7.1	CCTV
SW 20	375	Concrete	85.5	CCTV
SW 21	150	Vitrified clay	4.6	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 2	Displaced joint	Repair by patch lining	Moderate	£600

PHOTOS

MH 2 chamber



Defects



Displaced joint

Section SW 17





Section SW 20





Section SW 21



MH 3

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4361, -0.9748	2750	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 16	375	Concrete	13.9	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 3 chamber



Section SW 16



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4361, -0.9749	2060	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 19	375	Concrete	15.3	CCTV
SW 22	375	Concrete	15.1	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 4 chamber



Section SW 19



Section SW 22



MH 5 -None Selected-

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4361, -0.9751	1200	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 5 chamber



None

MH 6

Surface-water inspection chamber

Budget Costs £2,500

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9745	2200	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 18	375	Concrete	84.3	CCTV
SW 23	300	Concrete	93.3	CCTV
SW 24	100	Vitrified clay	12.5	CCTV

DEFECTS & RECOMMENDATIONS

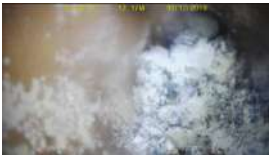
Asset	Defect	Recommendation	Urgency	Cost
MH 6	Debris	Clear with high pressure water jetting	Moderate	£2500

PHOTOS

MH 6 chamber



Defects



Debris

Section SW 18





Section SW 23



Section SW 24



MH 7	Surface-water inspection chamber	Budget Costs £30,000
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4354, -0.9742	1700	Concrete section	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 49	300	Concrete	25.8	CCTV
SW 60	150	Vitrified clay	3.3	CCTV
SW 61	150	Vitrified clay	13.5	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 7	No oil interceptor serving car park	Consider retro-fitting oil interceptor	Moderate	£30000

PHOTOS

MH 7 chamber



Section SW 49



Section SW 60



Section SW 61



MH 8 Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4355, -0.9738	1560	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 44	225	Vitrified clay	33.0	CCTV
SW 49	300	Concrete	25.8	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 8 chamber



Section SW 44



Section SW 49



MH 9

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4355, -0.9732	1660	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 58	100	Vitrified clay	9.5	CCTV
SW 59	150	Vitrified clay	6.2	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 9 chamber



Section SW 58



Section SW 59



MH 10	Surface-water inspection chamber	No Budget Costs
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4355,-0.9731	1520	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 50	300	Concrete	45.9	CCTV
SW 51	300	Vitrified clay	29.4	CCTV
SW 52	150	Vitrified clay	29.1	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 10	Silt	Clear with high pressure water jetting	Moderate	£0
MH 10	Silt	Clear with high pressure water jetting	Moderate	£0

PHOTOS

MH 10 chamber



Defects



Silt

Silt

Section SW 50



Section SW 51



Section SW 52



MH 11

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9727	1460	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 51	300	Vitrified clay	29.4	CCTV
SW 53	150	Vitrified clay	18.7	CCTV
SW 54	150	Vitrified clay	5.1	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 11 chamber



Section SW 51



Section SW 53



Section SW 54



MH 12

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9722	1260	Rendered, probably over brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 25	300	Vitrified clay	64.6	CCTV
SW 26	100	Vitrified clay	16.7	CCTV
SW 27	100	Vitrified clay	4.9	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 12 chamber



Section SW 25



Section SW 26



Section SW 27



MH 13	Surface-water inspection chamber	Budget Costs £5,000
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4357, -0.9721	1300	Concrete sections	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 34	150	Vitrified clay	4.6	CCTV
SW 35	150	Vitrified clay	14.7	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 13	Collapse	Excavate and renew pipe	Moderate	£5000
MH 13	Silt	Clear with high pressure water jetting	Moderate	£0

PHOTOS



MH 14	Surface-water inspection chamber	No Budget Costs
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9721	1350	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 33	150	Vitrified clay	10.0	CCTV
SW 34	150	Vitrified clay	4.6	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 14	Debris	Clear with high pressure water jetting	Moderate	£0

PHOTOS

MH 14 chamber



Section SW 33



Section SW 34



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9720	1150	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 30	225	Vitrified clay	46.7	CCTV
SW 31	150	Vitrified clay	14.6	CCTV
SW 32	150	Plastic	3.0	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 15	Crack on cover slab	Monitor deterioration	Moderate	£0

PHOTOS



MH 16

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9720	1250	Concrete	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 28	100	Plastic	1.3	CCTV
SW 29	150	Plastic	3.6	CCTV
SW 32	150	Plastic	3.0	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 16 chamber



Section SW 28



Section SW 29



Section SW 32



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4351, -0.9719	3400	-None Selected-	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 31	150	Vitrified clay	9.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 17 chamber
Section FW 31



MH 18	Surface-water inspection chamber	No Budget Costs
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4351, -0.9719	1680	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 39	300	Vitrified clay	86.5	CCTV
SW 42	100	Vitrified clay	25.0	CCTV
SW 43	150	Vitrified clay	8.5	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 18	Silt	Clear with high pressure water jetting	Moderate	£0

PHOTOS

MH 18 chamber



Defects



Silt

Section SW 39



Section SW 42



Section SW 43



MH 19

Foul inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4351, -0.9718	3110	Concrete sections	Close

COVER

Size	Material	Description	Inspection
700 x 700	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 33	225	Vitrified	8.6	CCTV
FW 34	0		1.5	Not inspected
SW 43	150	Vitrified clay	8.5	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 19 chamber



Section SW 43



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4360, -0.9753	700	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 1	100	Vitrified clay	25.8	CCTV
FW 2	100	Vitrified clay	4.5	CCTV
FW 3	100	Vitrified clay	6.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 20 chamber



Section FW 1



Section FW 2



Section FW 3



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4357, -0.9754	1080	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 1	100	Vitrified clay	25.8	CCTV
FW 5	100	Vitrified clay	24.5	CCTV
FW 6	100	Vitrified clay	11.6	CCTV
FW 7	100	Vitrified clay	7.7	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 21 chamber



Section FW 1



Section FW 5



Section FW 6



Section FW 7



MH 22

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4356, -0.9754	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 22 chamber

None

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4355, -0.9754	1340	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 10	100	Vitrified clay	7.2	CCTV
FW 11	100	Lined	7.2	CCTV
FW 5	100	Vitrified clay	24.5	CCTV
FW 8	100	Vitrified clay	25.3	CCTV
FW 9	100	Vitrified clay	16.2	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 23 chamber



Section FW 10



Section FW 11



Section FW 5



Section FW 8



Section FW 9





MH 24

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4354, -0.9755	3520	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 2	0		11.9	Not inspected

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 24 chamber



MH 25

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9755	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 25 chamber

None

MH 26

Oil interceptor

Budget Costs £1,500

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9755	3900	Concrete sections	Distant/partial

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Distant/partial

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 26	Oil interceptor needs maintaining	Clear out chamber with suction tanker and dispose of as Hazardous Waste	Moderate	£1500

PHOTOS

MH 26 chamber



None

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9756	3560	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 1	0	Concrete	12.8	Not inspected
SW 2	0		11.9	Not inspected
SW 4	375		28.6	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 27 chamber



Section SW 4



MH 28

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9754	3440	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 1	0		12.8	Not inspected

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 28 chamber



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4353, -0.9754	1780	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 12	100	Vitrified clay	27.6	CCTV
FW 13	100	Vitrified clay	3.3	CCTV
FW 8	100	Vitrified clay	25.3	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 29	Scale	De-scale	Moderate	£0

PHOTOS

MH 29 chamber



Defects



Scale

Section FW 12



Section FW 13



Section FW 8



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4351, -0.9753	2900	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 4	375	Concrete	28.6	CCTV
SW 5	375	Concrete	5.8	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS



MH 31

Pumping chamber foul

Budget Costs £2,500

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9753	3770	Concrete section	Distant/partial

COVER

Size	Material	Description	Inspection
550 x 550	Pressed steel		Distant/partial

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 12	100	Vitrified clay	27.6	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 31	No electrical tests have been carried out	Pump overhaul	Moderate	£2500

PHOTOS

MH 31 chamber



Section FW 12



MH 32

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9753	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 32 chamber
None

MH 33

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9753	3000	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 33 chamber



None

MH 34

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4348, -0.9750	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 34 chamber

None

MH 35

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4348, -0.9750	950	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 10	76	Plastic	0.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 35 chamber



Section SW 10



MH 36

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4348, -0.9749	2320	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 6	300	Concrete	30.3	CCTV
SW 7	300	Vitrified clay	31.9	CCTV
SW 8	150	Vitrified clay	2.5	CCTV
SW 9	150	Vitrified clay	17.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 36 chamber



Section SW 6



Section SW 7



Section SW 8



Section SW 9



MH 37 Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9745	2290	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 11	375	Concrete	15.2	CCTV
SW 12	375	Concrete	17.9	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 37 chamber



Section SW 11



Section SW 12



MH 38

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4348, -0.9745	2770	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 7	300	Vitrified clay	31.9	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 38 chamber
Section SW 7



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9741	1270	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 39 chamber



None

MH 40	Foul inspection chamber	No Budget Costs
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9739	1370	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 16	100	Vitrified clay	8.2	CCTV
FW 17	100	Vitrified clay	10.5	CCTV
FW 18	100	Vitrified clay	10.4	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 40	Scale	De-scale	Moderate	£0

PHOTOS

MH 40 chamber



Defects



Scale

Section FW 17



Section FW 16



Section FW 18



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9738	1500	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 16	100	Vitrified clay	8.2	CCTV
FW 19	100	Vitrified clay	27.5	CCTV
FW 20	100	Vitrified clay	8.7	CCTV
FW 21	100	Vitrified clay	8.5	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 41 chamber



Section FW 16



Section FW 19



Section FW 20



Section FW 21







MH 42

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9738	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 42 chamber

None

MH 43

Foul inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4349, -0.9734	1800	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 19	100	Vitrified clay	27.5	CCTV
FW 24	100	Vitrified clay	13.9	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 43 chamber



Section FW 19



Section FW 24



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9734	2000	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 22	100	Vitrified clay	14.4	CCTV
SW 37	375	Concrete	13.0	CCTV
SW 38	150	Vitrified clay	7.5	CCTV

DEFECTS & RECOMMENDATIONS

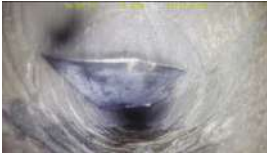
Asset	Defect	Recommendation	Urgency	Cost
MH 44	Debris	Clear with high pressure water jetting	Moderate	£0

PHOTOS

MH 44 chamber



Defects



Debris



Section FW 22



Section SW 37



Section SW 38



MH 45	Foul inspection chamber	Budget Costs £600
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9732	1970	Concrete section	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 22	100	Vitrified clay	14.4	CCTV
FW 25	150	Vitrified clay	33.2	CCTV
FW 26	100	Lined	15.4	CCTV
FW 27	100	Vitrified clay	13.3	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 45	Displaced joint	Repair by patch lining	High	£600

PHOTOS

MH 45 chamber



Defects



Displaced joint

Section FW 22



Section FW 25



Section FW 26



Section FW 27



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9731	2370	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 14	300	Vitrified clay	93.7	CCTV
SW 39	300	Vitrified clay	86.5	CCTV
SW 40	150	Vitrified clay	2.3	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 46 chamber



Section SW 14





Section SW 39





Section SW 40



MH 47

Foul inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9727	0	-None Selected-	Close

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 29	100	Vitrified clay	4.8	CCTV
SW 65	0		1.8	Not inspected

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 47 chamber
Section FW 29



MH 48

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4350, -0.9726	0	-None Selected-	Not inspected

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Not inspected

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 48 chamber

None

MH 49

Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4351, -0.9721	1500	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 36	300	Vitrified clay	89.7	CCTV
SW 41	100	Lined	9.1	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 49 chamber



Section SW 36



Section SW 41



MH 50

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4352, -0.9720	0	-None Selected-	Not inspected

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Not inspected

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 50 chamber

None

MH 51

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4352, -0.9720	0	-None Selected-	Not inspected

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Not inspected

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 51 chamber

None

MH 52	Foul inspection chamber	Budget Costs £600
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4352, -0.9720	2030	Concrete sections	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 31	150	Vitrified clay	9.3	CCTV
FW 32	150	Vitrified clay	10.4	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 52	Displaced joint	Repair by patch lining	Moderate	£600

PHOTOS

MH 52 chamber



Defects



Displaced joint

Section FW 31



Section FW 32



MH 53

Not drains

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4352, -0.9719	1300	Brickwork	Close

COVER

Size	Material	Description	Inspection
650 x 650	Ductile iron heavy duty		Close

PIPE SECTIONS

No data

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 53 chamber



None

MH 54 Surface-water inspection chamber

No Budget Costs

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4358, -0.9739	1240	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 44	225	Vitrified clay	33.0	CCTV
SW 45	150	Vitrified clay	12.8	CCTV
SW 47	150	Vitrified clay	18.8	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 54 chamber



Section SW 44



Section SW 45



Section SW 47



CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4358, -0.9732	1350	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 52	150	Vitrified clay	29.1	CCTV
SW 56	150	Vitrified clay	8.8	CCTV

DEFECTS & RECOMMENDATIONS

No defects

PHOTOS

MH 55 chamber



Section SW 52



Section SW 56



MH 56	Surface-water inspection chamber	No Budget Costs
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CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4358, -0.9727	1350	Brickwork	Close

COVER

Size	Material	Description	Inspection
600 x 600	Ductile iron heavy duty		Close

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
SW 53	150	Vitrified clay	18.7	CCTV
SW 55	150	Vitrified clay	6.6	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 56	Silt	Clear with high pressure water jetting	Moderate	£0

PHOTOS

MH 56 chamber



Defects



Silt

Section SW 53



Section SW 55



MH 57

Foul inspection chamber

Budget Costs £800

CHAMBER

Location (Lat,Lon)	Depth mm	Construction	Inspection
51.4352, -0.9718	0	-None Selected-	Not inspected

COVER

Size	Material	Description	Inspection
0 x 0	-None Selected-		Not inspected

PIPE SECTIONS

Section	Diameter mm	Material	Length m	Inspection
FW 32	150	Vitrified clay	10.4	CCTV

DEFECTS & RECOMMENDATIONS

Asset	Defect	Recommendation	Urgency	Cost
MH 57	Buried manhole	Locate and renew buried manhole if necessary	Low	£800

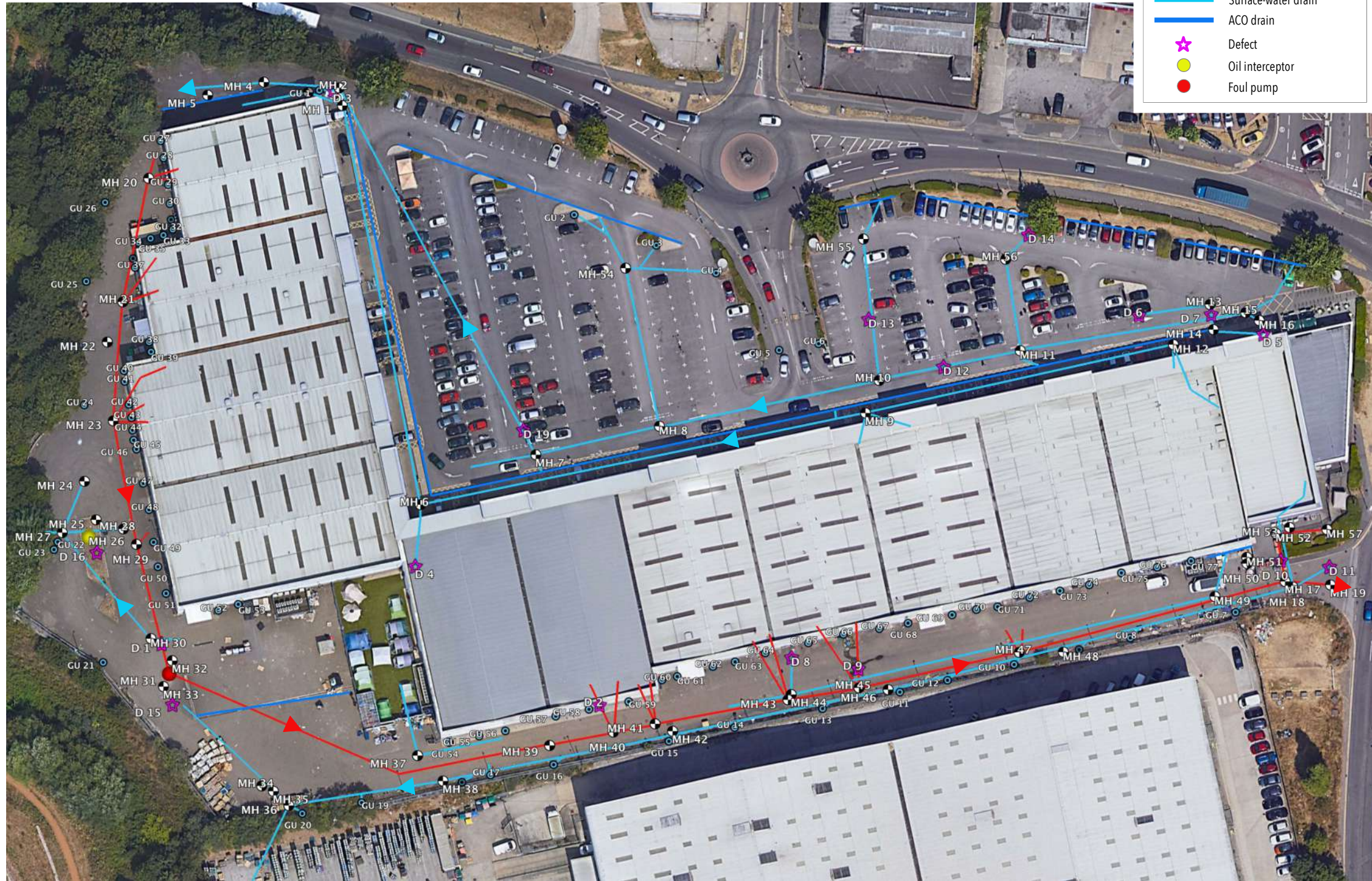
PHOTOS

MH 57 chamber
Section FW 32



Drainage Plan

	Foul drain
	Surface-water drain
	ACO drain
	Defect
	Oil interceptor
	Foul pump



APPENDIX 12: EXTENT OF SURVEY LIMITATIONS AND DEFINITIONS

EXTENT OF SURVEY AND LIMITATIONS

This report is for your sole use, and consequently no responsibility whatsoever is undertaken or accepted to any third party for the whole or any part of its contents. Paragon accept no responsibility or liability for the consequences of this document being used for any purpose or project other than for which it was commissioned or a third party with whom an agreement has not been executed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Paragon, a charge may be levied against such approval.

The report has been designed to address potential source, pathway and receptor pollutant linkages associated with the proposed development, by means of intrusive investigation. The content and findings of the report are based on data obtained by employing site assessment methods and techniques, considered appropriate to the site as far as can be interpreted from desk-based materials and a visual walkover of the site. Such techniques and methods are subject to limitations and constraints set out in the report. The findings and opinions are relevant at the time of writing, and should not be relied upon at a substantially later date as site conditions can change. For example, seasonal groundwater levels, natural degradation of contaminants etc.

No liability can be accepted for the conditions that have not been revealed by the exploratory hole locations, or those which occur between each location. Whilst every effort will be made to interpolate the conditions between exploratory locations, such information is only indicative and liability cannot be accepted for its accuracy. By their nature, exploratory holes provide a relatively small and localised snapshot of the ground conditions relative to the size of the site.

Specific comment is made regarding the site's status under Part 2A of the Environmental Protection Act (EPA) 1990, which provides a statutory definition of Contaminated Land and as revised under The Contaminated Land (England) (Amendment) Regulations 2012. Unless specifically stated as relating to this definition, references to 'contamination' and 'contaminants' relate in general terms to the presence of potentially hazardous substances in, on or under the site.

The opinions given within this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. If additional information or data becomes available which may affect the opinions expressed in this report, Paragon reserves the right to review such information and, if warranted, to modify the opinions accordingly. Paragon reserves the right to charge additional fees for; un-anticipated second opinion reviewing of previous reports.

Paragon has prepared this report with reasonable skill, care and diligence. The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources. We cannot provide guarantees or warranties for the accuracy of third-party data, which is reviewed in good faith and assumed to be representative and accurate.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed. No liability can be accepted for the effects of any future changes to such guidelines and legislation. In the event that guidance / legislation changes it may be necessary for Paragon to update or modify reports. The risk assessment is completed in line with the relevant land use agreed for the site and the time of completing the works. Changes to site conditions or land use may require a reassessment.

DEFINITIONS

For the avoidance of doubt, Paragon Building Consultancy Limited (Paragon) has prepared the following alphabetical list of definitions and reservations to aid the client in understanding the content of our advice and or written reports(s):

Accuracy	Level of agreement between true value and observed value.
ACM's	Asbestos Containing Materials
Conceptual site model	Textual and or schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the base of the information from the preliminary investigation and refined during subsequent phases of investigation and which is an essential part of the risk assessment process. Note 1: The conceptual exposure model is initially derived from the information obtained by the preliminary investigation. This conceptual model is used to focus subsequent investigations, where these are considered to be necessary, in order to meet the objectives of the investigations and the risk assessment. The results of the field investigation can provide additional data that can be used to further refine the conceptual model.
Contamination	Presence of a substance which is in, on or under land, and which has <u>the potential</u> to cause significant harm or to cause significant pollution of controlled water. Note 1: There is no assumption in this definition that harm results from the presence of the contamination. Note 2: Naturally enhanced concentrations of harmful substances can fall within this definition of contamination. Note 3: Contamination may relate to soils, groundwater or ground gas.
Controlled water	Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three-mile limit of territorial waters. Note 1: See Section 104 of The Water Resources Act 1991.
Enquiries	Any enquiries undertaken by Paragon of local authorities and statutory undertakers are made verbally in respect of environmental issues. Local searches are not undertaken and no responsibility is accepted for any inaccurate information provided.
Harm	It is further assumed unless otherwise stated that all necessary licences, permits etc either run with the property or are transferable to a new occupier as appropriate. Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case humans, including property.
Hazard	Inherently dangerous quality of a substance, procedure or event.
Pathway	Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.
Precision	Level of agreement within a series of measurements of a parameter.
Receptor	Persons, living organisms, ecological systems, controlled water, atmosphere, structures and utilities that could be adversely affected by the contaminant(s).

Risk	Probability of the occurrence, magnitude and consequences of an unwanted adverse effect on a receptor.
Risk assessment	Process of establishing, to the extent possible, the existence, nature and significance of risk.
Sampling	Methods and techniques used to obtain a representative sample of the material under investigation.
Soil	Upper layer of the earth's crust composed of mineral parts, organic substance, water, air and living matter. Note 1: In accordance with BS 10175:2001 the term soil has the meaning ascribed to it through general use in civil engineering and includes topsoil and subsoil; deposits such as clays, silt, sand, gravel, cobbles, boulders and organic deposits such as peat; and material of natural or human origin (e.g. fills and deposited wastes). The term embraces all components of soil, including mineral matter, organic matter, soil gas and moisture, and living organisms.
Source	Location from which contamination is, or was, derived. Note 1: This could be the location of the highest soil or groundwater concentration of the contaminant(s).
Uncertainty	Parameter, associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurement.