



PHASE II GEO-ENVIRONMENTAL ASSESSMENT

GRANGE TRAVEL COACH HIRE, CANAL ROAD, GRAVESEND, KENT, DA12 2RS

Job Number:

GEO-GTCH-001-24

Site Address:

Grange Travel Coach Hire
Canal Road
Gravesend
Kent
DA12 2RS

Report Date: 14th June 2024

Version Number:

FINAL

Customer:

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Document Issue Record

Publication Title	Phase II Geo-Environmental Assessment Grange Travel Coach Hire Canal Road Gravesend Kent DA12 2RS
Volume Number	Volume 1 of 1
Version	FINAL
Date	14 th June 2024
Project Reference	GEO-GTCH-001-24

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Issue Status	FINAL
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EXECUTIVE SUMMARY

A Phase II Geo-Environmental Assessment was requested by Grange Travel Coach Hire Limited. The purpose of the assessment was to identify any contaminative issues associated with former land use at Grange Travel Coach Hire, Canal Road, Gravesend, DA12 2RS which might impact on the site's redevelopment.

SITE DETAILS

Approximate site area	0.27 ha
Current use / historic use	A single, zinc-corrugated structure in use as a coach servicing and maintenance unit currently occupies the east of the site, with steel containers/portacabins to the west of the site in use as offices. Information obtained from the landowner suggested historically, the site was used as a Timber Yard. The Thames and Medway Canal also ran through the site until approximately 1969 where it was infilled.
Proposed use	Erection of a new portal frame shed for servicing and maintaining coaches, including an office on a mezzanine floor & storage on the ground floor.

PHASE 1 NON-INTRUSIVE INVESTIGATION

Expected geology	Superficial deposits of Alluvium underlain by the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation.
Groundwater	Alluvium and Tidal River/Creek Deposits are classified as a Secondary (Undifferentiated) aquifer suggesting variable permeability. The underlying bedrock Lewes Nodular Chalk Formation, Seaford Chalk and Newhaven Chalk Formation is classified as a Principle Aquifer. The site does not lie within a Source Protection Zone.
Surface water	Gravesend Canal Basin is located approximately 20m west of the site. The River Thames is located approximately 100 m north of the site.

PHASE 2 SITE INVESTIGATION

Ground Conditions	A thin veneer of tarmac hardstanding, underlain by a limited thickness of Made Ground up to 2.80m thick was encountered in the area of investigation. Alluvium was encountered beneath the Made Ground to a depth of 5.00m below ground level. The base of the Alluvium was not proven during the current scope of investigation.
Contamination	Samples with elevated pH levels and 3nr slightly elevated PAH levels within Made Ground. No asbestos identified. PAH contamination identified within groundwater. Further investigation required to confirm presence of off-site contamination from adjacent former Gas Works.



RECOMMENDATIONS	
Remediation	Additional boreholes to be undertaken across the wider site in conjunction with a programme of extended gas and groundwater monitoring.
Waste classification	Assumed non-hazardous for Made Ground.
Re-use of site-won materials	Not anticipated for the scope of proposed development.



SECTION 1 INTRODUCTION

- 1.1 Grange Travel Coach Hire Limited proposes to develop an area of land located at Grange Travel Coach Hire, Canal Road, Gravesend, Kent for commercial development purposes. The proposed development comprises the *erection of a portal framed shed for servicing and maintaining coaches, including an office on a mezzanine floor & storage on the ground floor*.
- 1.2 G.D. Ground Engineering Services Limited (hereby referred to as GDGES) has been commissioned by M2 Technical Services Ltd (on behalf of Grange Travel Coach Hire Ltd) to undertake an assessment and advise on the geo-environmental implications of the development of the site for the proposed end use.
- 1.3 The objectives of the investigation are to:
- Identify & assess surface and sub-surface ground conditions;
 - Identify hazards associated with ground contamination which may place constraints on the site and the proposed development;
 - Evaluate the risks associated with any identified hazards;
 - Provide recommendations for the mitigation of any significant risks identified and further phases of assessment if necessary.
- 1.4 A Phase 1 (Non-intrusive Investigation) and a Phase 2 Site Investigation have been undertaken for the subject site.
- 1.5 This report presents the findings of the phase II geo-environmental site investigation and provides an interpretation of the geo-environmental conditions that exist at the site. The contaminative status of the site and the implications with respect to development have been interpreted in accordance with the current government guidance on source-pathway-receptor risk assessment. This report uses a Tier 1 risk assessment to define a conservative qualitative appraisal of the hazards associated with the site.
- 1.6 This report has been prepared for M2 Technical Services (on behalf of Grange Travel Coach Hire Limited) for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult M2 Technical Services/Grange Travel Coach Hire Ltd and GDGES Ltd as to the extent to which the findings may be appropriate for their use.

SECTION 2 PHASE 1 (NON-INTRUSIVE INVESTIGATION)

2.1 INTRODUCTION

- 2.1.1 The non-intrusive investigation has been conducted with reference to the documents and sources detailed in Table 1 below:

Table 1: Published Data and Information Sources

Source Data	Envirocheck Data
BGS Historical Boreholes	Ordnance Survey (OS) historical maps scaled at 1:10,560, 1:10,000, 1:2,500 and 1:1,250 dated 1869 – 2023
BGS Geology of Britain 1:50,000 online maps	Water abstraction, discharge and pollution data
Radon: guidance on protection measures for new dwellings	Registered waste management sites
Environment Agency (EA) online data maps	Mining records and natural ground stability data
UK National Air Quality Archive, online	Protected areas of environmentally sensitive land use or conservation

- 2.1.2 The above sources are all authoritative and it is believed that they are reasonably reliable. However, independent verification of the information supplied has not necessarily been carried out and GDGES cannot be held liable for inaccuracies or deficiencies in the information.

2.2 SITE LOCATION AND SETTING

- 2.2.1 The site is located Grange Travel Coach Hire, Canal Road, Gravesend, Kent, DA12 2RS.
- 2.2.2 The site occupies an area of approximately 0.27 hectares located at National Grid Reference S65810, 174210 and indicated on the drawing presented in Appendix 1 of this report.

2.3 SITE WALKOVER

- 2.3.1 A site walkover was undertaken at the site address on 15th March 2024 by an Engineer from G.D. Ground Engineering Services Ltd. This survey was carried out in accordance with BS1075:2011.
- 2.3.2 The site under consideration was a 0.27 Ha L-shaped plan area. It was accessible via Canal Road off Canal Basin which ran adjacent to western and northern boundaries of the site. The entrance to the site was located on the northern boundary, composed of a short concrete driveway leading into the main site which was primarily comprised of tarmac hardstanding. The general topography of the site was flat and relatively even.



Hardstanding was present across the entire site in the forms of concrete and tarmac with no areas of soft landscaping observed.

- 2.3.3 The site itself is currently in use as an active coach park and with car parking facilities for staff. Coaches are stored in the east portion of the site with staff car parking located on the southern boundary. In general, the site was in good condition and relatively even in topography across all areas, the entire site was bounded by palisade fencing. Information obtained suggested that the site was formerly used as Timber Yard.
- 2.3.4 The main structure on-site located along the eastern boundary leading up to the near centre of the site, was a single storey, relatively newly built rectangular corrugated zinc structure, currently in use as a servicing and maintenance facility for the coaches on site. Information from staff suggested this was approximately only 12 months old.
- 2.3.5 Two nr. temporary portacabins (stacked upon one another) were in use as offices and staff welfare were present along the western boundary of the site. There was also another steel portacabin situated next to the offices, presumably used as a storage facility.
- 2.3.6 On the eastern boundary, beyond the palisade fencing was a neighbouring industrial building. The building was undergoing refurbishment and at the time of the walkover a steel-erect scaffolding and protective netting had been erected.
- 2.3.7 Beyond the northern boundary, there were various industrial-use buildings operating as metal merchants, MOT service centre and a nuts and bolts suppliers.
- 2.3.8 Various inter-alia material was observed laden along the eastern boundary, primarily timber pallets loaded with glass windscreens, assumed to be spares for the coaches on site. Just to the left of the entrance on the northern boundary, a small stockpile was observed, comprised of general building materials (concrete, tarmac, stone and gravel) the source of which was unknown. There were also rubber coach tyres resting against the palisade fencing on the northern boundary.
- 2.3.9 No surface water was observed on site at the time of the inspection. It was noted that an 11kV OH line ran E-W adjacent to the northern boundary just before the entrance to the site. Information from the site owner suggested no known buried services were running beneath the site.



2.4 SITE HISTORY

- 2.4.1 The site history, based on a review of the historic and current maps, dating from 1869 to 2023 is summarised in Table 1. below. Potentially contaminative land uses are shown in **bold**. Copies of key maps used in this review are provided in Appendix 2.

Table 2: Summary of the key features shown on historic maps

Data Source	Site / Surroundings
1859 – 1874 (1:2,500 and 1:10,560 scale).	Site: The site was an undeveloped area with the Thames and Medway Canal running directly through the centre of the site. The west of the site was part of the lock for the Canal Basin. Surroundings: Canal Steam Mills was present approximately 20m north and a Soap works factory immediately west of the site. A Gas works was present immediately south of the site. The Albion Baths were present approximately 100 m northeast of the site. A Coal Store was present approximately 100 m southwest of the site. The Canal Basin is located less than 100m west of the site.
1897 – 1899 (1:2,500 and 1:10,560 scale).	Site: The site remains undeveloped with the Thames and Medway Canal running directly through the site. Surroundings: Milton and Thames Iron works were present approximately 120 m northwest of the site. The Gas works are still present immediately south of the site. A tramway runs W-E into the Gas Works through the southern boundary.
1909 – 1910 (1:2,500 and 1:10,560 scale).	Site: No significant changes from the previous map edition. Surroundings: The surroundings to the site remain relatively unchanged. However, a residential road (Russel Road) is situated approximately 110 m southwest of the site. A relatively large, unnamed building is located approx. 60m southwest of the site.
1923 (1:10,560 scale)	Site: No significant changes from the previous map edition. Surroundings: The unnamed building in the previous map edition is now labelled as an Electrical Works, located approx. 60m southwest of the site.
1931 – 1932 (1:10,560 scale).	Site: No significant changes from the previous map edition. Surroundings: An increase in industrial developments to the north of the site. It appears the Gas Works has now been decommissioned. There is also an increase in the development of residential dwellings approximately 100m southwest of the site.
1936 (1:2,500 scale).	Site: No significant changes from the previous map edition. Surroundings: Various industrial developments: Engineering Works, Foundries, a Timber Yard and Thames Iron Works are located approx 50-100m north of the site. There several chimneys labelled on buildings within 100m diameter of the site.



Data Source	Site / Surroundings
1954 (1:2,500 scale)	Site: No significant changes from the previous map edition. Surroundings: Campbell Engineering Works is located approx. 50m northwest of the site.
1954 – 1969 (1:1,250 scale)	Site: No significant changes from the previous map edition. Surroundings: A veneer works is present approx. 80m northwest of the site with other numerous industrial works and a timber yard approx. 20m north of the site. The former Gas Works immediately south of the site appears to have been demolished however, a Gasholder Station is now labelled approximately 100m south of the site. A power station is now present 80m southwest of the site with a chemical works present approx. 250m southwest of the site.
1969 – 1984 (1:1,250 and 1:10,000 scale)	Site: The Thames and Medway Canal running through the site appears to have been infilled. The Canal Basin is approx. 70m west of the site. A single unlabelled structure is now present on the western part of the site. Surroundings: A timber yard is located approx. 50m east of the site. A Mill and various works are situated approx. 20m north of the site. The former power station is now labelled Laboratories located 80m southwest of the site.
1999 (Historic Aerial Photography)	Site: In addition to the existing unlabelled structure, aerial photography reveals there is now numerous containers located in the eastern part of the site. Surroundings: What appears to be a scrap metal yard is located approx. 20m north of the site. A car storage facility located approx. 40m northeast of the site.
2006 (Google Earth Imagery)	Site: The site remains relatively unchanged. Surroundings: There is a large semi-circular development named "Ian Mack loose covers and upholstery" located approx. 30m southwest of the site.
2013 (Google Earth Imagery)	Site: The structure on the western part of the site is no longer present. It appears there is a Timber yard now present on the eastern portion of the site. Surroundings: No significant changes from the previous map edition.
2019 – 2023 (Google Earth Imagery)	Site: The site appears to be in use in its current form as a coach park. Surroundings: A general increase in industrial developments surrounding the site. The Gas Works to the south of the site were demolished between 2021-2022.

2.4.2 In summary, historic plans show that, the site was undeveloped until approximately 1969 when a single structure was present on the site. The surrounding area, particularly north of the site, has consistently been associated with industrial developments since the 1800s. The Thames and Medway Canal ran through the site until somewhere

between 1969-1974 where it appears to have been infilled. The site itself has experienced little/minimal changes between 1969 - 2013 where satellite imagery suggests the site was in use as a Timber Yard. The current site configuration has been present since 2019.

- 2.4.3 Off-site, potentially significant contaminative land uses within 250m is evident, the most significant being a former Gas Works. Online information suggests that the Gasholder stations approx 100m south of the site were retired from use in 2010 and demolished between 2021-2022.
- 2.4.4 The surrounding land use within 250m of the site generally comprised industrial works and scrap yards to the north and east with gas depot/power station/laboratory to the south.
- 2.4.5 Given the nature of the historical mapping process (scale, representation of conditions at discreet time intervals, frequency etc.), any such maps and plans may not provide a comprehensive account of a site's history. Identification of pertinent land uses and associated potentially contaminative activities may therefore be absent from mapping records.

2.5 GEOLOGY

- 2.5.1 The British Geological Survey (BGS) indicates that the site is underlain by the following geological sequence:

Table 3: Summary of Published Geology

Geological Unit	Type	Description
Superficial	Alluvium	Clay, silt, sand and peat
	Tidal River or Creek Deposits	Tidal channel deposits, silts, clays and localised peat.
Bedrock	Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation	Chalk

- 2.5.2 There are 4 accessible historic BGS borehole logs within 100 m of the site. These can be viewed and found in Appendix 3.
- 2.5.3 The borehole log: 'TQ67SE71' was taken approximately 80 m south west of the site. The recorded geology can be described as follows:

Table 4: Summary of Historic Borehole Logs (TQ67SE71)

Interpreted Geological Unit	Strata (General Description)	Depth to Top of Range (m bgl)	Thickness Range (m)
Made Ground	Olive brown very silty fine sand with ash, flint, chalk and roots.	0	0 – 1.60
Superficial (Alluvium)	Soft blue-grey and brown silty clay with peat and organic mud, occasional flint fragments/Firm blue-grey silty clay with pockets of peat and fine sand.	1.60	1.60– 10.00

- 2.5.4 BGS data indicates that the site contains made/infilled ground from the Thames and Medway Canal which formally ran through the centre of the site.

2.6 Background Soil Chemistry

- 2.6.1 A summary of the data published by the BGS of estimated soil chemistry is summarised in Table 5 below:

Table 5: Summary of published estimated soil chemistry

Arsenic	Lead	Cadmium	Chromium	Nickel
15-25 mg/kg	200-300 mg/kg	<1.8 mg/kg	90-120 mg/kg	30-45 mg/kg

- 2.6.2 When assessed against commercial *Suitable for Use Levels* (S4ULs) published in 2015 by LQM/CIEH¹ the concentrations are considered not to be significantly elevated. For lead the DEFRA Category 4 Screening Level² has been used as this is based on updated toxicological data and a low risk to human health.

¹ Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. *The LQM/CIEH S4ULs for Human Health Risk Assessment*. Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3100. All rights reserved. Including August 2015 nickel update.

² SP1010 *Development of Category 4 Screening Levels Main Report* (Dec 2013) and SP1010 *Policy Companion Document* (Mar 2014).

2.7 HYDROGEOLOGY

- 2.7.1 The Aquifer status of groundwater held within the geological units, the presence of Source Protection Zones and Groundwater Vulnerability are summarised in Table 6 below:

Table 6: Summary of Published Geology

Geological Unit	Aquifer Designation	Source Protection Zone	Groundwater Vulnerability
Superficial	Secondary Undifferentiated	No	High
Bedrock	Principle Aquifer	No	High

- 2.7.2 There is a single groundwater abstraction located approx. 838 m SE of the site.
- 2.7.3 The risk on site to groundwater flooding is low. However, approximately 26m west of the site, there is high risk relating to the Canal Basin.

2.8 HYDROLOGY

- 2.8.1 The Canal Basin is located approximately 20m to the west of the site, this runs into the Thames Estuary which is located approximately 120m north/north-west of the site.
- 2.8.2 There is a high risk of flooding from rivers and the sea on site according to the Environment Agency (EA). Flood defences are located approx. 120m North of the site, relating to the Thames Estuary.
- 2.8.3 A site-specific Flood Risk Assessment was undertaken on the site by DKM Consultants Ltd in February 2022 who concluded that the level of flood risk posed by all sources being; rivers and sea, directly from rainfall on the ground surface and overwhelmed sewers and drainage systems combined with the level topography of the site, poses low risk to the development.

2.9 CURRENT SITE ISSUES

- 2.9.1 Potentially significant environmental issues have been investigated within relevant distances of the site, based on the database of records supplied by Envirocheck. These relate to the following searches:
- Water discharge or pollution incidents within 250 m of the site;
 - Waste management sites within 250 m of the site;

- iii. Statutory authorisations within 50 m of the site;
- iv. Trade directory entries of possible contaminative use within 50 m of the site;
- v. Special protection or conservation areas within 50 m of the site; and
- vi. Any other relevant issues.

2.9.2 Potentially significant environmental issues identified by the above searches are summarised in Table 7.

Table 7: Potentially significant environmental issues

Environmental Category	Description
Water discharge or pollution incidents within 250 m	Discharge consents include the following - Ref: PO3509 - Recorded on 19th March 1991 – The discharge of 'Other Matter-Surface Water' from was discharged from either land or soakaway into land approx. 185m South of the site. - There are 4 other discharge consents which replicate the above between 195-205m south of the site. Pollution incidents include the following: 230m west – On the 22nd December 1993 - the incident involved an industrial chemical spill (Aluminium Sulphate) (Ref: 931306). No impact was recorded for water/air or land however, the impact was classed as Significant (Category 2).
Historical landfill sites within 250 m	Historical Landfill Sites: 0m west & 215m southeast – Inert and commercial waste by Gas Works – Canal (Ref: 2200/7031). Local Authority Landfill Coverage is provided by Gravesham Borough Council
Waste management sites within 250 m	There are no active waste management sites within 250m
Statutory authorisations within 50 m	An historic permit for the use of bulk cement was located 30m northwest of the site.
Trade directory entries of possible contaminative use within 50 m	Current (active) potentially contaminative industrial sites within 50 m include: Garage Services, 7 and 37 m northwest; Historic trade directory entries for an Oil Company, Car body repairs and Car breakers/dismantlers and engine re-builders

Environmental Category	Description
	were located 0m northeast, 6m northwest and 35 m northwest of the site. It is considered that these facilities have the potential to impact the site.
Special protection or conservation areas within 50 m	None.
Other relevant issues	The site lies within a Nitrate Vulnerable Zone. It is located within the Coastal Streams to Lower Thames zone which is vulnerable through groundwater.

2.10 INDICATIVE GROUND STABILITY HAZARDS

2.10.1 The following natural ground subsidence hazard rating have been prescribed:

Table 8: Summary of Natural Ground Subsidence Hazards

Type	Hazard rating
Shrink swell clays	Low
Running sands	Very Low
Compressible deposits	Very Low
Collapse deposits	Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

2.11 RADON GAS

2.11.1 The licensed Radon Potential Dataset for the site has been consulted. The site is in a Lower Probability Radon area (Less than 1% of homes are estimated to at or above the Action Level).

2.11.2 No Radon protection measures are necessary in the construction of new dwellings or extensions.

**2.12 UXO**

- 2.12.1 Regional Unexploded Bomb Risk Maps published by Zetica have been consulted which show that the area is within a High Bomb Risk zone. During the phase II site investigation undertaken on 11th April 2024, a suitably qualified UXO Engineer was present during the intrusive works to mitigate any risk to the site and its operatives.

2.13 AIR QUALITY

- 2.13.1 The site does not lie within a designated Air Quality Management Area (AQMA) for Gravesham Borough Council.

2.14 ECOLOGY

- 2.14.1 There were no ecological receptors found that are relevant to the land contamination conceptual site model.

2.15 PREVIOUS INVESTIGATIONS

- 2.15.1 No known previous investigation data exists for the site.

2.16 PRELIMINARY CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

- 2.16.1 From the Phase 1 assessment a preliminary site conceptual model and risk assessment have been produced using the framework established in Part IIA of the *Environmental Protection Act 1990* and detailed in Environment Agency guidance *Land Contamination Risk Management* published on www.gov.uk.

- 2.16.2 Risk from contamination has been assessed using the source-pathway-receptor and pollutant linkage methodology, whereby a risk can only exist if all elements of; source, pathway and receptor, are present.

- 2.16.3 Potential Sources

- 2.16.4 Potential Sources of contamination on site and its surroundings include:

- i.* Infilled ground has been identified by the Envirocheck records which is source of ground gas.
- ii.* The area surrounding the site has been subject to numerous industrial uses (Iron works, Mills, Scrap metal yards, Chemical Works, Gas Works, Power Station).
- iii.* Current adjacent land uses include: MOT service stations/ Car repair workshops and Metal works.



- 2.16.5 The above are potential sources of a range of contaminants including heavy metals, Total Petroleum Hydrocarbons (TPH), Polyaromatic Hydrocarbons (PAH), asbestos and ground/gas vapours.
- 2.16.6 Potential Pathways
- 2.16.7 Potential pathways for contamination exposure include; direct contact, ingestion/inhalation of soils and dusts, inhalation of gases and vapours. Migration of ground gas could occur in the permeable superficial deposits beneath the site. Permeable strata would also allow the migration of groundwater and any contamination within.
- 2.16.8 The migration of contamination will however, be limited by the presence of hardstanding across the site.
- 2.16.9 Potential Receptors
- 2.16.10 Potential receptors include the following:
- i. Adjacent commercial properties;
 - ii. New infrastructure;
 - iii. Underlying Secondary aquifer within the Alluvium and Principle aquifer in the Chalk.
 - iv. Construction workers; and
 - v. Future site users and general public.
- 2.16.11 Pollutant Linkages and Risk Ratings
- 2.16.12 From the Phase 1 assessment a preliminary site conceptual model has been produced as Table 9 which identifies the potential pollutant linkages. These have been used to inform the Phase 2 intrusive investigation presented in the subsequent sections.

Table 9: Preliminary Conceptual Model

Possible Pollutant Linkage			Risk Characterisation
Potential Sources	Pathways	Receptors	
Heavy metals and hydrocarbons (made ground)	Contact with contaminated soil	Human health (current users)	Low to Moderate risk identified. Thames and Medway Canal which formerly ran through the site has been infilled. Potential for fill material to contain made ground. However, hardstanding is present across most of site.
	Ingestion and inhalation of contaminated soil and dust	Human health (current users)	
Heavy metals and hydrocarbons (made ground)	Contact with contaminated soil	Human health (future residents and construction workers)	Low to Moderate risk identified. Thames and Medway Canal which formerly ran through the site has been infilled. Potential for fill material to contain made ground. However, hardstanding is present across most of site.
	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	
Asbestos (made ground)	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	Moderate risk identified. Thames and Medway Canal which formerly ran through the site has been infilled. If this includes construction and demolition waste the presence of asbestos would be strongly suspected.
Contamination (all forms)	Vertical migration to aquifer	Controlled waters	Low to Moderate risk identified. Potential for contamination if present, to affect the alluvium aquifer.
Contamination (all forms)	Horizontal migration to surface water	Controlled waters	Low to Moderate risk identified. Surface waters adjacent to the site could be affected by contamination. The Canal Basin is approx. 20m west of the site. The potential exists for runoff to enter the canal unless carefully managed. The migration of contamination will however, be limited by the presence of Hardstanding across the site and its general topography.
Hydrocarbons	Direct contact	Plastic water pipes	Low to Moderate risk identified. Cannot rule out presence of hydrocarbon contamination at this stage.
Hazardous Gas/Vapours in soil	Ingress into buildings and voids	Human health (future residents and construction workers)	Moderate risk identified. Potential for made/infilled ground which could act as source of hazardous gas. Cannot rule out fuel spillages as source of vapours.

SECTION 3 SITE INVESTIGATION RATIONALE

3.1 INTRODUCTION

3.1.1 A site investigation rationale has been devised in accordance with the findings of the Phase 1 investigation and the resultant preliminary conceptual site model and risk assessment.

3.1.2 Intrusive sampling locations were chosen based on targeting the infilled ground highlighted from the Phase 1 Desk Study and to obtain spatial coverage across the footprint of the proposed commercial development.

3.2 SITE INVESTIGATION

3.2.1 A phase II intrusive site investigation was carried out by M2 Technical Services Ltd on 11th April 2024 and comprised the following scope of work:

- i. 2 nr. cable percussion boreholes (BH01 & BH02) to 5 metres below ground level (m bgl);
- ii. Standard Penetration Testing (SPTs) throughout the depth of each borehole; and
- iii. Installation of 2 nr. Gas and Groundwater monitoring wells in boreholes BH01 and BH02.

3.2.2 An exploratory hole location plan is provided in Appendix 4. Logging of exploratory holes was undertaken by an Engineer from GDGES. Depths of the exploratory holes, descriptions of strata encountered and comments on the groundwater conditions are presented in the borehole logs presented within Appendix 5.

3.2.3 Heavy duty cable percussion drilling equipment (Dando 2000) was used to advance boreholes BH01 & BH02. Standard Penetration Tests (SPTs) were performed at approximate 1 metre intervals to 5m. The tests involved driving a steel cone tipped series of rods into the ground over 450mm using the repeated blows of a 63.5kg drop hammer, allowed to free fall over a distance of 750mm. The total number of blows required for the final 300mm penetration (the 'N' value) is recorded on the drilling logs.

3.2.4 Upon completion of drilling, both boreholes BH01 & BH02 were installed with gas/groundwater monitoring standpipes to 5.00m bgl.

3.2.5 A summary of the gas/groundwater monitoring standpipes is highlighted in the table below.

Table 10: Summary of Gas and Groundwater Monitoring Installation

Location Ref	Depth To Top of Response Zone (m bgl)	Depth To Base of Response Zone (m bgl)	Strata
BH01	2.5	5.0	Made Ground /Alluvium
BH02	2.0	5.0	Made Ground /Alluvium

- 3.2.6 Representative soil samples were taken from various depths and strata to assess the contaminative status of the site. Soil samples were submitted to an MCERTS/ UKAS accredited laboratory for chemical analysis of a broad suite of potential contaminants. Samples were also tested for a wide range of herbicides and pesticides. The results are provided in Appendix 5.

SECTION 4 GROUND CONDITIONS

4.1 SURFACE GROUND CONDITIONS

- 4.1.1 The majority of the site was surfaced with hard standing (tarmac/concrete). No soft landscaping was observed in any area of the site.

4.2 SUB-SURFACE GROUND CONDITIONS

- 4.2.1 The sub-surface ground conditions generally comprised a thin veneer of Tarmac overlying a limited thickness of Made Ground. Alluvium was encountered beneath the Made Ground. Alluvium was encountered in all the exploratory holes, the base of which was not proven in any of the holes.
- 4.2.2 A summary of the ground conditions encountered is presented in Table 11 below and described in the following section.

Table 11: Summary of Sub-surface Ground Conditions

Strata	Depth Encountered (m bgl)	Maximum Measured Strata Thickness (m)
Tarmac	0	0.20
Made Ground	0.20	3.00
Alluvium	3.00	2.00



4.2.3 MADE GROUND

4.2.4 Made Ground was encountered beneath tarmac hardstanding in both boreholes BH01 and BH02. The stratum encountered was found to be 2.80 m in thickness from 0.20m to 3.00 m bgl. There was a high degree of variability within the Made Ground identified on site, generally comprising loose gravelly sand, loose sandy gravel of angular to subrounded quartz and flint with occasional chalk fragments and slightly gravelly sandy clay with lenses of silt. Anthropogenic inclusions were also observed within the Made Ground and comprised concrete, brick, ceramic, asphalt and rare wood pieces. It is considered that the Made Ground is associated with the infilled land on the site, which was formerly the Thames and Medway Canal.

4.2.5 It was also noted that olfactory evidence in the form of "strong hydrocarbon odour" observed from the borehole logs, within a sample obtained from 1.20-1.65m bgl indicating potential contamination. This was again observed within the gravel horizon between 1.90 – 2.90m bgl in BH01, with the Engineers log noting a 'tar-like' odour.

4.2.6 Within the gravel horizon in BH02 at a depth of 1.70-3.00m bgl the engineers log again noted the presence of a 'slight hydrocarbon odour'.

4.2.7 Groundwater was observed and recorded as a water seepage within the Made Ground in borehole BH02 at 1.30m bgl rising to 1.25m bgl after 20 mins. It is suspected this is indicative of perched groundwater within the formation.

4.2.8 Two SPT's were undertaken within the Made Ground within both boreholes BH01 and BH02 at depths ranging from approximately 1.20m to 4.00m bgl. N-values were typically recorded between 0 and 5, indicative of very loose and low strength sands and clays respectively.

4.2.9 ALLUVIUM

4.2.10 Alluvium was encountered in both exploratory holes (BH01 and BH02) underlying the Made Ground at a depth of 3.00 m bgl. This stratum generally comprised soft, light to dark grey, approximately low strength silty clay with rare gravel and shelly fragments, rare lenses of peat were recorded in BH02 at a depth of 4.50 – 4.70m bgl.

4.2.11 There was no visual or olfactory evidence of contamination observed within the formation.

4.2.12 Three SPTs were undertaken within the Alluvium, one within borehole BH01 at 3.00m and two within BH02 at depths ranging between 3.00m and 4.00m bgl.

SECTION 5 ENVIRONMENTAL ASSESSMENT

5.1 RESULTS OF SOIL ANALYSIS

5.1.1 A total of 6 soil samples from within the Made Ground were submitted to the laboratory for chemical analysis. The laboratory chemical analysis certificates are provided in Appendix 6. The results of the analysis are summarised in Table 12.

5.1.2 An initial screening exercise has been undertaken whereby contaminant concentrations recorded in soils have been assessed against *Suitable for Use Levels* (S4ULs) published in 2015 by LQM/CIEH². These precautionary screening levels are designed to be representative of minimal risk to human health in a number of land use scenarios. In this report, S4ULs have been selected for commercial end use.

For lead the DEFRA Category 4 Screening Level³ has been used as this is based on updated toxicological data and a low risk to human health.

Table 12: Summary of Soils Chemical Analysis Results

CONTAMINANT	No of Tests	MAX (mg.kg ⁻¹)	MEAN (mg.kg ⁻¹)	SCREENING LEVEL (SL) (mg.kg ⁻¹)	No > SL*
HUMAN HEALTH RISK ASSESSMENT					
Asbestos in soil	6	nil	N/A	Detected	0
pH	6	10.5	9.25	9	1
Arsenic	6	17	13.5	640	0
Barium	6	230	140.16	22000	0
Cadmium	6	0.2	0.20	190	0
Chromium (III)	6	29	23.6	9600	0
Hexavalent Chromium	6	1.8	1.80	33	0
Lead	6	980	256	2300	0
Mercury	6	0.3	0.30	1100	0
Nickel	6	20	16.2	980	0
Selenium	6	1	1.0	12000	0
Vanadium	6	46	40.8	9000	0
TPH Aliphatic >EC ₁ - EC ₆	6	0.02	0.020	3200	0
TPH Aliphatic >EC ₆ - EC ₉	6	0.02	0.020	7800	0
TPH Aliphatic >EC ₉ - EC ₁₇	6	0.05	0.050	2000	0

² Nathanael, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanael, J. F. 2015. *The LQM/CIEH S4ULs for Human Health Risk Assessment*. Land Quality Press, Nottingham. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3100. All rights reserved. Including August 2015 nickel update.

³ SP1010 Development of Category 4 Screening Levels Main Report (Dec 2013) and SP1010 Policy Companion Document (Mar 2014).

CONTAMINANT	No of Tests	MAX (mg.kg ⁻¹)	MEAN (mg.kg ⁻¹)	SCREENING LEVEL (SL) (mg.kg ⁻¹)	No > SL*
TPH Aliphatic >EC ₁₅ - EC ₂₂	6	1.4	1.08	9700	0
TPH Aliphatic >EC ₁₅ - EC ₁₈	6	13	5.65	59000	0
TPH Aliphatic >EC ₁₅ - EC ₂₇	6	24	13.15	1600000	0
TPH Aliphatic >EC ₁₅ - EC ₃₅	6	130	55.83	1600000	0
TPH Aromatic >EC ₅ - EC ₇	6	0.01	0.010	26000	0
TPH Aromatic >EC ₅ - EC ₈	6	0.01	0.010	56000	0
TPH Aromatic >EC ₈ - EC ₃₅	6	0.05	0.050	3500	0
TPH Aromatic >EC ₁₀ - EC ₁₂	6	10	3.11	16000	0
TPH Aromatic >EC ₁₂ - EC ₁₈	6	280	72.3	36000	0
TPH Aromatic >EC ₁₈ - EC ₂₅	6	1800	429.83	28000	0
TPH Aromatic >EC ₂₅ - EC ₃₅	6	1100	511.66	28000	0
Benzene	6	5	5	27	0
Toluene	6	5	5	56000	0
Ethylbenzene	6	5	5	5700	0
Xylene	6	5	5	5900	0
Naphthalene	6	7.2	3.41	130	0
Acenaphthylene	6	3.3	0.99	83000	0
Acenaphthene	6	30	8.63	84000	0
Fluorene	6	51	13.45	63000	0
Phenanthrene	6	260	69.43	22000	0
Anthracene	6	65	17.89	520000	0
Fluoranthene	6	250	68.57	23000	0
Pyrene	6	200	55.23	54000	0
Benzo(a)anthracene	6	96	25.67	170	0
Chrysene	6	84	23.15	350	0
Benzo(b)fluoranthene	6	96	25.08	44	1
Benzo(k)fluoranthene	6	94	10.09	1200	0
Benzo(a)pyrene	6	82	22.38	35	1
Indeno(1,2,3-c,d)pyrene	6	38	10.57	500	0
Dibenzo(a,h)anthracene	6	9.1	2.37	3.5	1
Benzo(g,h,i)perylene	6	41	11.32	3900	0
Phenol	6	1.0	1.0	440	0
PHYTOTOXICITY RISK ASSESSMENT					
Copper	6	38	16.3	200	0
Nickel	6	20	16.2	110	0
Zinc	6	140	103.8	300	0

Notes: * Number of samples exceeding screening level

nd = not detected



- 5.1.3 **Zootoxic Metals (harmful to human health)**
- 5.1.4 No exceedances above the adopted screening levels were recorded.
- 5.1.5 **Phytotoxic Metals (harmful to plant health)**
- 5.1.6 No exceedances above the adopted screening levels were recorded.
- 5.1.7 **Organic Contaminants**
- 5.1.8 No exceedances above the adopted screening levels were recorded.
- 5.1.9 **Inorganic Contaminants/pH**
- 5.1.10 Three samples exhibited elevated pH levels at 9.2, 9.4 and 10.5. The exceedances within the samples were in Made Ground layers in which concrete inclusions had been noted within the sample description for BH01 confirming the presence of concrete. The presence of concrete could cause the elevation in pH and is not necessarily representative of wider soil chemistry. All other samples were within the appropriate range.
- 5.1.11 **Hydrocarbons**
- 5.1.12 The sample from 2.00m bgl within BH01 exhibited elevated concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(a,h)anthracene. This sample was retrieved from within the gravel horizon of Made Ground strata.
- 5.1.13 **Asbestos**
- 5.1.14 Asbestos containing materials (ACM's) were not identified in any soil samples submitted for screening.
- 5.1.15 **Summary**
- 5.1.16 Contamination noted in the investigation comprised Polycyclic Aromatic Hydrocarbons (PAH) within an individual sample, noted to be from borehole BH01 at a depth of 2.00m bgl. Slightly elevated pH concentrations were noted from both boreholes BH01 & BH02.
- 5.1.17 It is acknowledged that the screening levels adopted in this report are designed to be protective of human health and may not be protective of groundwater and surface waters. However, it is the case that those PAH contaminants identified are of typically low mobility in the environment. In addition, given that the pathway to the receptor mitigated through the hardstanding present across the site, the risk level posed by the contaminants in soil is considered to be low. The soils encountered during the sampling are not considered to present a source of contamination that is relevant to the protection of controlled waters.



5.2 GROUNDWATER

- 5.2.1 During the investigation, groundwater was encountered as a seepage within BH02 at 1.30m rising to 1.25m after 20 mins. This was subsequently sealed off during the drilling process.
- 5.2.2 Groundwater levels were recorded on three occasions on 3rd, 10th May and 14th May 2024.
- 5.2.3 During the initial follow up visit on 3rd May, groundwater levels were recorded as dry.
- 5.2.4 Groundwater depths during subsequent monitoring rounds ranged between 1.12 m and 1.16 m bgl respectively.
- 5.2.5 It is considered that the water sampled within the boreholes has potentially percolated through the gravel horizon of the Made Ground into the standpipe.
- 5.2.6 Groundwater Samples were submitted to the laboratory for analysis of a typical contamination suite. Screening levels for groundwater have been derived from the maximum concentrations set out in the Water Supply (Water Quality) Regulations 2018 (England) where prescribed, or for those determinands not included the 1989 Regulations along with the Environmental Quality Standards.
- 5.2.7 Screening levels with respects to Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH) have also been compared (where applicable) against the SoBRA groundwater vapour (gwvap) GACs. The laboratory chemical analysis certificate is contained in Appendix 7 and groundwater level data is contained in Appendix 8. A summary of groundwater contaminant concentrations is contained in Table 13.

Table 13: Summary of Groundwater Chemical Analysis Results

Contaminant	Units	Max	Mean	No. Tests	Screen Level (SL) (DWS)	SoBRA gwvap GAC	EQS for Freshwaters AA (µg/l)	No. > SL
pH	-	8.1	8.1	2	6.5**	-	-	2
Arsenic	µg/l ³	3.82	3.74	2	10	-	50	0
Cadmium	µg/l ³	<0.02	<0.02	2	5	-	0.45	0
Chromium (total)	µg/l ³	0.8	0.7	2	50	-	1.8	0
Copper	µg/l ³	0.9	0.9	2	2000	-	1	0
Lead	µg/l ³	0.2	0.2	2	10	-	34	0
Mercury	µg/l ³	0.05	0.05	2	1	95	0.07	0
Nickel	µg/l ³	11	10.5	2	20	-	34	0
Selenium	µg/l ³	3	2.75	2	10	-	-	0
Zinc	µg/l ³	4.5	4.5	2	5000	-	10.9	0
Sulphate	mg/l ¹	380	365.5	2	250	-	400,000	0
TPH - Aliphatic >C5 - C6	µg/l ³	<1	<1	2	-	150,000	-	0

Contaminant	Units	Max	Mean	No. Tests	Screen Level (SL) (DWS)	SoBRA gwvap GAC	EQS for Freshwaters AA (µg/l)	No. > SL
TPH - Aliphatic >C6 - C8	µg.l ⁻¹	<1	<1	2	-	150,000	-	0
TPH - Aliphatic >C8 - C10	µg.l ⁻¹	<1	<1	2	-	5,700	-	0
TPH - Aliphatic >C10 - C12	µg.l ⁻¹	<10	<10	2	-	3,600	-	0
TPH - Aliphatic >C12 - C15	µg.l ⁻¹	<10	<10	2	-	-	-	0
TPH - Aliphatic >C16 - C21	µg.l ⁻¹	<10	<10	2	-	-	-	0
TPH - Aliphatic >C21 - C35	µg.l ⁻¹	<10	<10	2	-	-	-	0
TPH - Aliphatic >C35	µg.l ⁻¹	<10	<10	2	-	-	-	0
TPH - Aromatic >EC5 - EC7	µg.l ⁻¹	<1	<1	2	-	20,000,000	-	0
TPH - Aromatic >EC7 - EC8	µg.l ⁻¹	<1	<1	2	-	21,000,000	-	0
TPH - Aromatic >EC8 - EC10	µg.l ⁻¹	<1	<1	2	-	190,000	-	0
TPH - Aromatic >EC10 - EC12	µg.l ⁻¹	25	22.5	2	-	660,000	-	-
TPH - Aromatic >EC12 - C15	µg.l ⁻¹	220	190	2	-	3,700,000	-	-
TPH - Aromatic >EC16 - EC21	µg.l ⁻¹	340	290	2	-	-	-	-
TPH - Aromatic >EC21 - EC35	µg.l ⁻¹	88	77	2	-	-	-	-
TPH - Aromatic >EC35	µg.l ⁻¹	670	575	2	-	-	-	-
BTEX	µg.l ⁻¹	<3.0	<3.0	2	-	-	-	-
PAH (total)	µg.l ⁻¹	43.4	42.4	2	-	-	-	-
PAH****	µg.l ⁻¹	0.19	0.19	2	0.1	-	0.27	0
Benzo[a]pyrene*****	µg.l ⁻¹	0.14	0.07	2	0.01	-	0.27	0
Naphthalene	µg.l ⁻¹	8.7	8.65	2	-	23.00	130	-
Phenols	µg.l ⁻¹	11	10.5	2	0.5	-	7.7	2

Notes: * Samples exceeding screen level

** Minimum value applies (i.e. most acid)

*** Not detected above screening level

**** sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene & indeno(1,2,3-cd)pyrene

***** Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene is used for comparison with the biota EQS or the corresponding AA-EQS in water

AA – Annual Average for Freshwaters

5.2.8 pH was above screening levels in groundwater from BH01 & BH02. It is noted that pH levels were also elevated in the samples of Made Ground tested and it is considered



likely to originate from cement bound and concrete inclusions within the Made Ground strata.

- 5.2.9 PAH screening levels detected 2hr samples were above the criteria for the Drinking Water Standards, however, when compared to the EQS Annual averages these levels were recorded below the selected screening criteria for freshwaters.
- 5.2.10 Screening levels for Phenols in groundwater from BH01 & BH02 was marginally in excess of the AA EQS. However, are not considered to present a significant risk to human health.
- 5.2.11 There were no other exceedances above screening levels in the two water samples obtained.

5.3 HAZARDOUS GAS

- 5.3.1 Gas monitoring has been undertaken on one occasion from standpipes responding from 2 to 5 m bgl in the Made Ground and Alluvium on 3rd May. Levels of methane, carbon dioxide and oxygen were recorded in each standpipe, together with associated parameters including borehole flow and ambient air pressure. The results of the gas monitoring round are contained in Appendix 8.
 - 5.3.2 During two subsequent monitoring rounds on the 10th and 14th May, the water levels in boreholes BH01 and BH02 was found to be above the depth of the screened section, resulting in flooding of the wells. The gas results from these dates have been excluded from the gas risk assessment as they are not representative of the soil atmosphere in these locations.
 - 5.3.3 During the single monitoring round where data was obtained barometric pressure was recorded at 1011 mb. Positive steady state flow was recorded in BH02 at 0.1l/hr. Over the individual monitoring round methane (CH₄) was detected at a maximum of 3.4% by volume (% v/v), carbon dioxide (CO₂) was detected to a maximum of 0.0 % v/v with a corresponding depleted oxygen concentration of 17.7% v/v.
 - 5.3.4 In scenarios whereby wells have become flooded following site investigation, it is best practice and increasingly important to consider multiple lines of evidence and understanding of the ground model. This is discussed further in the Risk Assessment.
- ### 5.4 WASTE CLASSIFICATION, OFF-SITE DISPOSAL OR RE-USE
- 5.4.1 **Waste Considerations**
 - 5.4.2 Initial screening would suggest that that soil materials are likely to be generally classified as non-hazardous material for the purpose of disposal.



- 5.4.3 No asbestos containing material was identified in the site investigation and subsequent laboratory testing of the soils.
- 5.4.4 Natural as-dug could be classed as inert waste without the requirement for WAC testing.
- 5.4.5 Materials, including waste soils which are not to be retained on site, should be removed and disposed of in accordance with all relevant statutes including the *Environmental Protection Act 1990* (as amended), *The Controlled Waste Regulations 2012* (as amended), *The Waste (England and Wales) Regulations 2011* (as amended), *The Hazardous Waste (England and Wales) Regulations 2005* as amended, *The Waste Management (England and Wales) Regulations 2006*, and *The Environmental Permitting (England and Wales) Regulations 2016* (as amended).
- 5.4.6 It is a requirement of these regulations that waste sent to landfill should have been subject to measures to reduce the amount of waste, reduce harmful or hazardous properties and facilitate recycling. These requirements may be satisfied by measures such as segregation and screening of wastes to recover suitable fill and material for crushing, segregation of inert materials and putrescible wastes.
- 5.4.7 **Re-use Considerations**
- 5.4.8 The re-use of site won materials is not anticipated for the proposed development.

SECTION 6 RISK ASSESSMENT

- 6.1 The potential sources of contamination at the site and the implications with respect to development have been interpreted in accordance with the current government guidance on source-pathway-receptor risk assessment.
- 6.2 The site investigation demonstrates that the infilled ground at the site contains the presence of some localised polyanomatic hydrocarbons and elevated pH levels. These materials would not be able to migrate significant distances either vertically or laterally. Groundwater samples taken from standpipes in both BH01 & BH02 were found to contain elevated levels of PAH. It is acknowledged that the investigation density is low given it is limited to the infilled basin and it is possible that other areas of contamination may be present which have not been identified to date.
- 6.3 The potential impacts of contamination sources have been considered with respect to the following receptors:
- General public and present site users,
 - Users of future development,



- iii. Groundwater,
- iv. Surface water,
- v. Construction workers,
- vi. Infrastructure.

6.4 In each case the existence of a pollutant linkage requires a pathway by which the receptor could be exposed to the source. A qualitative assessment of risk is thus considered in the first instance with respect to the site in its current condition and is summarised in the sections below.

6.5 General public and present site users

6.5.1 The site is in current use a Coach hire and servicing facility. Currently, a single-story zinc corrugated structure, located to the east of the site is used as the servicing and maintenance area. A two-tiered steel portacabin lies to the west of the site, which is in use as offices and a welfare facility.

6.5.2 In respect to the contaminants, namely three PAH exceedances identified during the site investigation within the Made Ground, the concrete/tarmac hardstanding present across the entirety of the site is preventing contact with any contaminated soils, therefore breaking the exposure pathway.

6.5.3 The risk to this class of receptor is considered to be low.

6.6 Users of Future Development (Soil Contamination and Hazardous Gas)

6.6.1 The site will be developed for commercial use. It is not anticipated that any existing structures on-site are to be demolished. Hardstanding is present across the entirety of the site with no proposed soft landscaping areas related to the new development. The hardstanding across the site will effectively break the exposure pathway

6.6.2 Three PAH exceedances were detected in the Made Ground within the area of investigation. The PAH contamination within the Made Ground from a single sample substantially exceeds the thresholds for individual species and appears to be commonly elevated in the Made Ground. However, the PAH is considered to be of low mobility within the environment. Concrete/Tarmac hardstanding is present across the site therefore breaking the exposure pathway between source and receptor.

6.6.3 Given the entirety of the site is surfaced with hardstanding and no soft landscaping areas are anticipated for the proposed development, the risks from general contaminants in the soil to future users is considered to be low.



- 6.6.4 Desk study and site investigation has identified that the infilled ground identified on site could be a credible source of ground gas. However, due to response zones in the standpipes within BH01 & BH02 being inundated with water during two or follow up monitoring rounds, the data from these visits has been deemed to be inconclusive with regards to hazardous ground gas emissions to confidently surmise a calculation for the Gas Screening Value and therefore, an alternative multiple lines of evidence approach has also been considered using CLAIRE RB17 "A Pragmatic Approach to Ground Gas Risk Assessment", in addition to reviewing of the historical maps and site development history.
- 6.6.5 The infilled ground at the site has low quantities of readily degradable organic material and therefore a low ground gas generation potential. Gas monitoring completed in wells installed in the Made ground and Alluvium between 3rd – 14th May (Three rounds over a three week period) recorded the following: Carbon dioxide concentrations recorded up to a max of 0.1%, with a typical carbon dioxide concentration of 0.1%. Methane was recorded up to a max of 3.4%. Steady flow rates were recorded up to a max of 0.1 within BH02 on 3rd May 2024 with the remaining steady flow rates below the equipment's detection levels on the following visits (10th & 14th May 2024).
- 6.6.6 In the instances where the absence of measurable sustained gas flow rate is recorded, this is typical of material whereby only a low volume of organic content is present. In these situations, the organic material is degraded aerobically to produce carbon dioxide at such low rates they are not emitted at quantities or rates sufficient to sustain migration and pose a risk to receptors. With the ground gas effectively entrained in the soil matrix and oxidising prior to being emitted at surface level.
- 6.6.7 Within the infilled ground and alluvium, Methane was recorded at a maximum level on 3rd May at 3.4%. A review of the borehole logs identifies a strong hydrocarbon odour present within BH01 at a depth of 1.20-1.65m bgl and a slight tar-like odour at a depth of 1.90m bgl. A slight hydrocarbon odour was also detected within BH02 at a depth of 1.70mbgl, in addition to perched water table within the well headspace on two of the three monitoring occasions (10th & 14th May). Given these two factors, it indicates two processes may be at work to cause the finding of methane present:
- Hydrocarbons degrading within the well headspace to produce methane. The degradation process and volume of hydrocarbons in these circumstances is small and will result in small volumes of methane which give high concentrations within the well headspace. Outside of the constrained well headspace, whilst the degradation of the hydrocarbons still occurs it is at very low rates, causing the methane to oxidise completely to carbon dioxide prior to reaching the surface.
 - Where groundwater is present in a well headspace (above the response zone) any methane present within it may partition out of the groundwater and accumulate in the



well headspace until equilibrium is achieved. The methane is then trapped in the well headspace resulting in high methane concentrations during monitoring/sampling. Outside of the well headspace, whilst partitioning from the groundwater will also occur (as stated for the hydrocarbons) the methane will oxidise/dilute in the vadose zone. High methane concentrations will therefore only occur in the soil air spaces above the groundwater.

6.6.8 Total Organic Carbon

6.6.9 Total Organic Carbon (TOC) analysis on soil samples from the infilled/ made ground material recorded TOC concentrations between 0.8% - 4.0% with an average concentration of 1.18%. Accounting for the presence of asphalt in the material which would contribute to the high TOC concentration whilst not being degradable, the low TOC value is consistent with low ground gas generation potential of the infilled ground.

6.6.10 The ground gas monitoring provides a body of quantitative evidence to the qualitative assessment of the infilled ground located on site and is considered to have a low ground gas generation potential owing to the low quantity of readily degradable organic material present in the soil matrix.

6.6.11 Using the alternative approach from CLAIRE RB17 in conjunction with soil TOC results, average depth of the infilled ground and an understanding of the age of the infilled basin on site (>50 years) in the absence of a GSV value, a Characteristic situation (based on maximum TOC results) of CS2 has been designated for the site. Therefore, ground gas protection measures will be required.

6.6.12 Ground Model

6.6.13 Assessment of the ground model from historical mapping has been considered with regards to potential for the generation of ground gases. The site in question has had limited development history with the previous uses associated only with a Timber Yard present to the east of the site between 2013 - 2019. The Thames and Medway Canal was infilled sometime between 1969-1984, this highlights the main change to the site during the course of its history.

6.6.14 Furthermore, given historical mapping and historical BH logs of the surrounding area indicating that generally, cohesive alluvium is present and the potential for gas to migrate through these soils is considered to be low.

6.7 Controlled waters

6.7.1 The underlying superficial geology (Alluvium) beneath the site is classified as a Secondary (undifferentiated) aquifer. Although site investigation has not proven the thickness of the Alluvium strata it is however, cohesive in nature. It is considered likely



that the Alluvium does not perform as an aquifer on the site. The nearest surface water receptor is the Canal Basin approximately 20m west of the site. Elevated concentrations of PAH have been detected in two groundwater samples taken from BH01 & BH02.

- 6.7.2 Review of the screening levels from Environmental Quality Standards (EQS), shows that the PAH levels recorded are below the annual average however, assessment should not be deduced from a single round of testing. In addition, it is considered the nature of the PAH species are of low mobility in the environment, the ground model is largely cohesive Alluvial soils and therefore it is unlikely that this will be able to leach and migrate to impact either groundwater or the Canal Basin.

- 6.7.3 The combination of the abovementioned scenarios suggests that the PAH in groundwater will be largely diluted, dispersed and/or degraded by the time they reach the receptor. Furthermore, looking at the potential sources of contamination, it is possible that the PAH levels recorded within groundwater samples are linked to the former Gas works located immediately south of the site, the gravel horizon identified within the infilled basin on the current site have the potential to act as a pathway for migration from the adjacent former Gas Works. It is considered likely that the contamination present is likely to be associated with the off-site source, this being groundwater has percolated through the gravel horizon of the made ground from the adjacent former gas works into the standpipes.

- 6.7.4 At this stage the overall risk to controlled waters is considered to be low.

6.8 Construction workers

- 6.9 With reference made to the proposed plans of the development and Michael Evans Associates drawing 18-085 SK1. The proposed excavations associated with the building are not expected to exceed 450mm below ground level. Due to the relatively shallow nature of excavations during construction work, the receptor (that being workers on site) are not anticipated to come into contact with any of the contamination identified during the site investigation. Therefore, the risk associated with this class of receptor is considered to be low.

6.10 Infrastructure

- 6.10.1 Contamination with the potential to permeate polymeric services has been identified by this investigation, however upon review of the design and access statement provided as part of the planning process, it is not anticipated that mains water will be used inside the proposed development building. If mains and running water supply are associated with the proposed development, it is recommended that the utility provider is consulted with respect to their requirements for water supply pipes. Utility companies apply strict guideline levels on use of polymeric pipes and may consider all made ground unsuitable for typical plastic pipe use.

SECTION 7 UPDATED CONCEPTUAL MODEL

- 7.1 Following completion of Phases 1 and 2 of the investigation and a qualitative risk assessment, the conceptual model for the site, with relation to pollutant linkages, has been updated. The revised model is presented in Table 14 below.

Table 14: Revised Conceptual Model

Potential Sources	Possible Pollutant Linkage		Risk Characterisation
	Pathways	Receptors	
Heavy metals and hydrocarbons (Made Ground)	Contact with contaminated soil	Human health (current users)	Low risk identified Made Ground contains elevated PAH but current use is for commercial purposes and risk of exposure is limited given the handstanding present across the site.
	Ingestion and inhalation of contaminated soil and dust	Human health (current users)	
Heavy metals and hydrocarbons (Made Ground)	Contact with contaminated soil	Human health (future residents and construction workers)	Low risk identified Made Ground contains slightly elevated PAH from a single sample. However, PAH mobility is low in the environment. In addition handstanding present across the site – no viable pathway/pollutant linkage to receptor from contaminated soil.
	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	
Asbestos (made ground/existing buildings)	Ingestion and inhalation of contaminated soil and dust	Human health (future residents and construction workers)	Very Low Risk No asbestos has been identified during the investigation within the made ground during the intrusive works.
Contamination (all forms)	Vertical migration to aquifer	Controlled waters	Low risk identified PAH contamination is of low mobility in the environment. The area of investigation is underlain by cohesive Alluvium. Handstanding layer will limit the potential for contaminants to mobilise through the soil. Although depth not proven during current scope of works, cohesive Alluvium is an additional barrier to downward migration to deeper aquifers.
Contamination (all forms)	Horizontal migration to surface water	Controlled waters	Low risk identified PAH contamination is of low mobility in the environment. The majority of the site is underlain by cohesive Alluvium. The Canal Basin is located approx. 25m west of the site, but migration pathways to the Canal are limited.

Possible Pollutant Linkage			Risk Characterisation
Potential Sources	Pathways	Receptors	
Hydrocarbons	Direct contact	Plastic water pipes	Low risk identified Expected presence of PAH suggest possible risk to polymeric water services. However, on review of the design and access statement provided as part of the planning process, is anticipated no main water supply will be used in the internal building.
Hazardous Gas/Vapours in soil/TOC	Ingress into buildings and voids	Human health (future residents and construction workers)	Low to moderate risk identified Gas monitoring inconclusive from current scope of works. Additional works required. However, analysis of soil TOC results and age of infilled ground suggest CS2. Ground Gas protection required
Gas Works (Off-site)	Permeable strata within Made Ground	Human health (future residents and construction workers)	Low risk identified Soil and Groundwater analysis have identified elevated PAH – source is likely to be from the former Gas Works given the limited development history of the site. However, contamination in soil mitigated by Hardstanding present across the site.
Gas Works (Off-site)	Permeable strata within Made Ground	Controlled Waters	Low to Moderate risk identified Groundwater contamination present. The granular horizon of the infilled basin is suspected to act as a receptor to the adjacent gas works. However given the low mobility of the PAH within the site specific environment in addition to the underlying cohesive geology and potential off site source, contamination is not expected significantly effect controlled waters of the site.



SECTION 8 PRELIMINARY REMEDIATION STRATEGY

- 8.1 The identified risks at the site can be mitigated by removal of either the source, pathway or receptor. With reference to the conceptual model for the site a remediation strategy, based on source or pathway removal, has been designed.
- 8.2 **Soil**
- 8.3 The Land Contamination Risk Management framework set out with 'LCRM 2020' (Updated 2023) is applicable to the redevelopment of sites that maybe affected by land contamination.
- 8.4 The risk management process set out has three main components:
- Risk assessment
 - Options appraisal
 - Implementation
- 8.5 This risk assessment has identified the presence of PAH within the Made Ground, albeit that these samples were taken from beneath existing hardstanding at a depth of 2.00m bgl. Therefore, no pollutant linkage exists between source and receptor and no remedial works are envisaged.
- 8.6 However, it is understood that the scope of the investigation is limited to the infilled basin and the extent of PAH contaminants present across the wider site cannot be adequately estimated from the current scope of investigation. Additional investigation and ground gas monitoring are necessary to determine the full extent of remedial works necessary.
- 8.7 No asbestos was detected within the Made Ground soils.
- 8.8 **Gas**
- 8.9 Specific building design with regards to implementation of gas protection measures within new buildings should be submitted to the Local Authority's Environmental Health Officer and Building Control Department for approval. However, the basic requirement with regards to gas protection measures are given in the following sections and have been adapted from advice given in the following publications:
- Environment Agency and Building Research Establishment. Protective Measures for Housing on Gas-contaminated Land. 2001.
 - Building Research Establishment. Constructions of New Buildings on Gas-Contaminated Land, BR212, 1991.

- G B Card, Protecting Development from Methane. CIRIA Report 149, 1995.
- S Wilson *et al.* Assessing risks posed by hazardous ground gases to buildings. CIRIA C659, 2005.
- BS8485: Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings, 2015.

- B.10 In accordance with BS8485:2015 the proposed development on site is a Type C Building being 'Commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including gas protection measures. Single occupancy of the ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas'.
- B.11 Based on the building type, BS8485:2015 gives a minimum gas protection score to be achieved in order to ameliorate any potential gas risk. For Type C Building and CS2 the score to be achieved is 2.5 and the potential solutions given in the table below should be followed:

Table 15: Gas Protection Measures

Protection Element	Score	Comments	
Barriers (Table 5 BS8485:2015)			
Block and beam floor slab	0	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breached in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performance.	
Reinforced concrete ground bearing slab	0.5		
Reinforced concrete ground bearing foundation raft with linked service penetration that are cast into slab	1		
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around it.	1.5		
Protection Element	Score	Comments	
slab penetrations and at joints			
fully tanked basement (BS8104:2009)	2 – 2.5		
Ventilation/Extraction (Table 6 BS8485:2015)			
Passive sub-floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)	Very Good Performance	2.5	If passive ventilation is poor this is generally unacceptable and some form of active system will be required.
	Good Performance	1.5	
Sub-floor ventilation with active extraction/pressurisation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)	1.5	2.5	There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurisation.
	2.5		
ventilated car park (basement or underground)	4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and ExtractE guidance.	



Membranes (Table 7 BS8485:2015)		
Gas resistant membrane meeting all of the following criteria: • Sufficiently impervious to the gases with a methane gas transmission rate $\leq 10 \text{ cm}^3/\text{day}/\text{m}^2/\text{atm}$ (average) for sheets and joints. • Sufficiently durable to remain serviceable for the anticipated life span of the building and duration of gas emissions. • Sufficiently strong to withstand in-service stresses. • Sufficiently strong to withstand the installation process and following tracks until covered. • Capable, after installation, of providing a complete barrier to the entry of the relevant gas. • Installation by a qualified and experienced installer. • Verified in accordance with ORA C735.	2	If a membrane is installed that does not meet all the criteria in Column 1 the score is zero.

- B.12** Materials, including waste soils which are not to be retained on site, should be removed and disposed of in accordance with all relevant statutes including the *Environmental Protection Act 1990* (as amended), *The Controlled Waste Regulations 2012* (as amended), *The Waste (England and Wales) Regulations 2011* (as amended), *The Hazardous Waste (England and Wales) Regulations 2005* as amended, *The Waste Management (England and Wales) Regulations 2006*, and *The Environmental Permitting (England and Wales) Regulations 2016* (as amended).

B.13 Groundwater

- B.14** Groundwater contamination has been identified within the samples tested for analysis. This mainly comprised elevated levels of pH and PAH. The PAH contamination is suspected to be from an off-site source, that being the adjacent former Gas Works situated beyond the southern boundary of the site. The contamination present is suspected to have migrated through the permeable gravel horizon within the made ground strata. It is understood that the current scope of the investigation is confined to the infilled basin and additional investigative work will be required along the boundary and across the wider site to confirm the further presence of PAH contamination. However, if the off-site contamination source is confirmed it is considered that any remedial measures will not be the responsibility of the site owner and the remediation of the contaminants would therefore be negated without remediation of the adjacent site.

- B.15** It is recommended that this report is submitted to the regulators (Local Authority EHO and Planners, Environment Agency Planning Liaison and NHBC) for approval prior to commencement of the works.

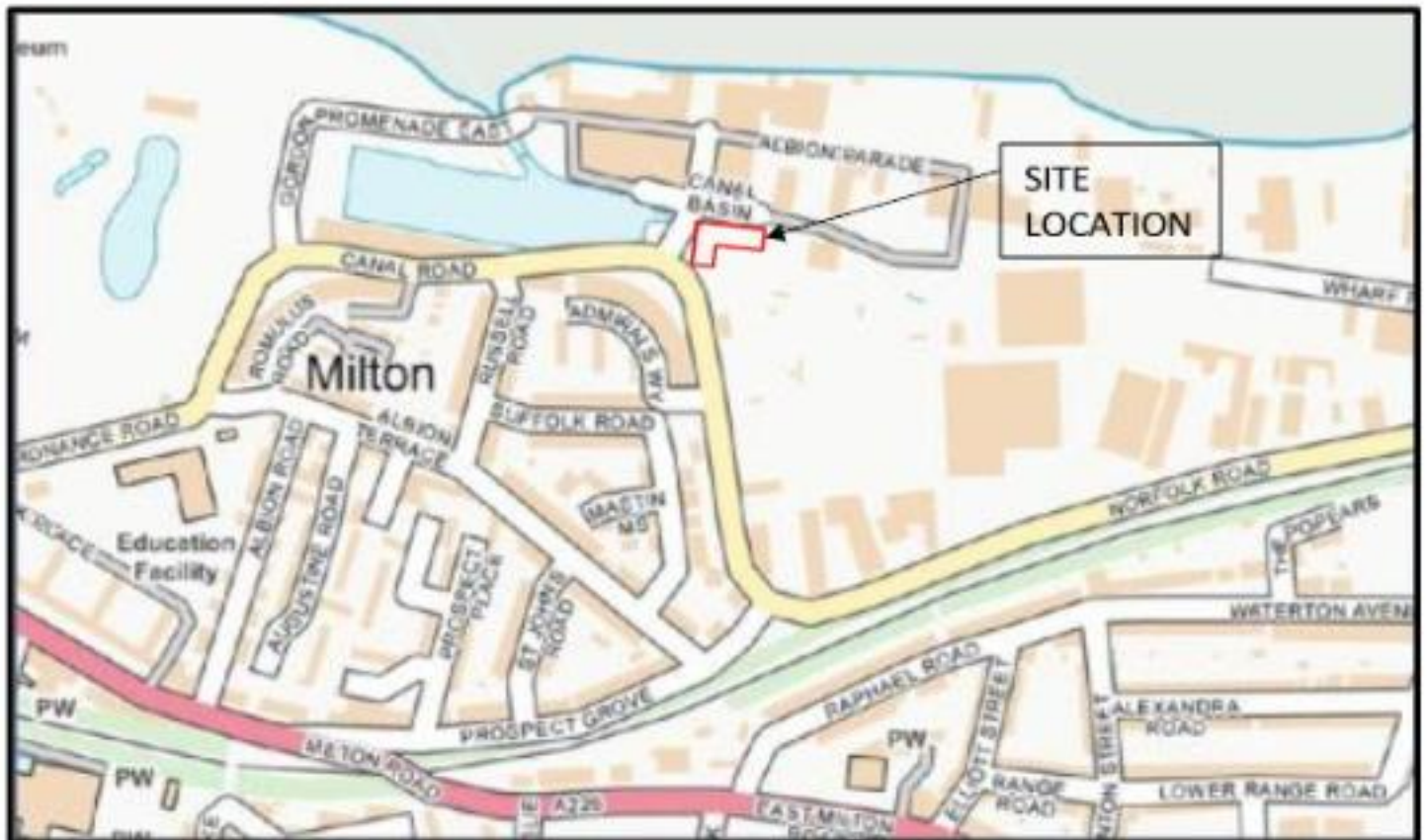
- B.16** Any observations of ground conditions atypical of those already described should be reported to GDGES immediately so that an assessment of appropriate action can be taken at the earliest possible instance.

SECTION 9 CONCLUSIONS

- 9.1 The ground conditions identified in the investigation generally comprised a thin veneer of Tarmac Hardstanding over Made ground to a depth of 3.00m bgl. This was underlain by cohesive Alluvium to a depth of 5.00m bgl.
- 9.2 Exceedances of PAH have been detected within the Made Ground however, the risk to end-users is considered to be low given the current hardstanding present across the majority of the site. PAH contamination has also been identified within groundwater samples taken from boreholes within the investigation area. The current scope of the investigation is confined to the infilled basin and therefore to confirm if groundwater contamination is linked with the off-site source, additional investigation and testing will be required across the wider site.
- 9.3 Additional further work at the site will be required including:
- i. Additional boreholes across the wider site and in proximity to the southern boundary to assess the potential of further PAH contamination associated with the adjacent Gas Works.
 - ii. Additional ground gas and groundwater monitoring during falling atmospheric conditions to further deduce the presence of the potential off-site contamination source.



APPENDIX 1 ▪ Site Drawings





APPENDIX 2 ▪ Historical Plans



Envirocheck

LANDMARK INFORMATION INC.

Kapitel

Published 1989

Source map scale = 1:10,000

[illegible]

Map Name(s) and Date(s)



Historical Map - 5 Scale A



Order Details

Order Number	99811752
Customer Ref	1700002
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Blow	0
Site Area Ref	0.00
Account Balance	0.00

Site Data No.

Orange-Tanaka-Cook & Warr Ltd. (Printed Name) 09/04/2000
 (Date)

Landmark

Essex

Published 1872

Source map scale - 1:10,560

The historical maps shown were reproduced from maps purchased at the sale adopted for England, Wales and Scotland in the 1860's. The 1:10,560 scale was adopted for mapping urban areas. These maps used a spacing of 1:10,560. The published data were transferred after some years later for the same purpose. Before 1868, all maps were based on the Cassin Projection, with independent surveys of a county or group of counties, giving rise to significant inconsistencies in scale. In the late 1860's, a Provisional Ordnance Survey was produced, which was a 1:10,560 mapping from a number of sources. The maps appear uniform, with arbitrary ranges and other details, and some old maps were actually overprinted with the National Grid. In 1973, the first 1:10,560 maps were produced using the Ordnance Survey Project, which was a continuous and complete, with new editions appearing 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 31801707_1_1
Customer Ref: GTCHEG
National Grid Reference: 505810, 174210
Site: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Grange Travel/Coach Hire Ltd, Canal Road, GRAVES
DA12 3RS

Kent

Published 1909

Source map scale - 1:10,560

The historical maps shown were reproduced from maps prepared at the scale adopted for England, Wales and Scotland in the 1800's at the 1:10,560 scale was adopted for mapping urban areas. These maps used to replace the 1:10,560 maps. The published data goes back to the late 19th century, with some years later than the source data. Before 1909, all maps were based on the Cassin Projection, with independent surveys of a county or group of counties, giving rise to significant inaccuracies in some areas. In the late 1900's, a Provisional Edition was produced, which is the 1:10,560 mapping from a number of sources. The maps appear to be of a similar scale and other details, which were not necessarily everywhere with the National Grid. In 1970, the first 1:10,560 maps were produced using the Ordnance Survey Project to which the maps continued with accuracy, with new editions appearing 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 31801707_1_1
Customer Ref: GTCHEG
National Grid Reference: 505810, 174210
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Site Area (Ha): 0.27
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Site Details

Orange Travel Coach Hire Ltd, Canal Road, GRAVESEND, DA12 3RS

Kent

Published 1909

Source map scale - 1:10,560

The historical maps shown were reproduced from maps purchased at the sale adopted for England, Wales and Scotland in the 1890's at the 1:10,560 scale was adopted for mapping urban areas. These maps used to replace the 1:10,560 maps. The published data goes back to the late 1800's, after some years later than the source data. Before 1909, all maps were based on the Cassini Projection, with independent surveys of a county or group of counties, giving rise to significant inconsistencies in scale. In the late 1880's, a Provisional Edition was produced, which was the 1:10,560 mapping from a number of sources. The maps appear unaltered, with arbitrary ranges and other details that were not maps were already incorporated with the National Grid. In 1970, the 1:10,560 maps were produced using the Improved Major Project, which was a continuation of the existing, with new editions appearing 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

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Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVESEND, DA12 3RS

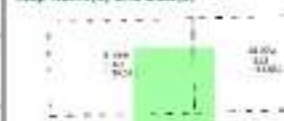
Essex

Published 1923

Source map scale - 1:10,560

This historical map shows the original layout of the site and its surroundings. It is a valuable source of information for understanding the site's history and its relationship to the surrounding area. The map is a detailed representation of the site and its surroundings, showing the original layout of the site and its surroundings. It is a valuable source of information for understanding the site's history and its relationship to the surrounding area. The map is a detailed representation of the site and its surroundings, showing the original layout of the site and its surroundings. It is a valuable source of information for understanding the site's history and its relationship to the surrounding area.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 00001757-1-1
Customer Ref: 070900
Reference Grid Reference: 100000, 100000
Site: A
Site Area (sq): 0.01
Search Buffer (m): 1000

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVESEND
DA11 9BS



Enviroched

● LANDFARM INFORMATION GSC

Kyari

Published 1931 - 1932

Source map scale - 1:10,560

For the first time, a group of researchers has shown that a single gene can control the development of the entire nervous system. The researchers found that a single gene, called *Ubx*, controls the development of the entire nervous system in the fruit fly *Drosophila melanogaster*. The researchers found that the *Ubx* gene controls the development of the entire nervous system in the fruit fly *Drosophila melanogaster*. The researchers found that the *Ubx* gene controls the development of the entire nervous system in the fruit fly *Drosophila melanogaster*.

Map Name(s) and Date(s)



Historical Map - 5 Scale A



Order Details

Order Number	99881152
Customer Ref	2170002
Posting Date Reference	607810, 114210
Blow	0
Site Area Ref	0.27
Account Name	1000

Site Data No.

George Taylor-Cochran Inc., 124 Canal Street, DRAUGHT
Bart 1975

Landmark



Envirocheck

LANDMARK INFORMATION GROUND

Kent

Published 1938 - 1951

Source map scale - 1:10,560

The historical map shows a detailed representation of the landscape at the time the map was published. It is a black and white map, and the information is presented in a clear and concise manner. The map is a valuable resource for anyone interested in the history of the area, and it provides a detailed view of the landscape at the time the map was published. The map is a valuable resource for anyone interested in the history of the area, and it provides a detailed view of the landscape at the time the map was published.

Map Name(s) and Date(s)



Historical Map - Scale A



Order Details

Order Number: 100011101
 Customer Ref: 100011101
 Reference: 100011101
 Date: 10/10/2010
 Site Area: 1000
 Amount: 1000

Site Details

Orange, Tisbury, Kent, UK, 100011101, 100011101, 100011101

Landmark



Enviroched

LANDMARK INFORMATION GBC

ERROR

Published 1938

Source map scale - 1:10,560

The main advantage of using the standardized, validated instrument is that it can be used by a wide range of researchers, and the results can be compared. The 12-item of the low-back-pain rating scale was used. These items related to symptoms in the last 6 months. The questionnaire also asks whether the other main point raised by the investigated study, namely, that, in fact, the results are based on self-reported information, and whether the symptoms are in fact related to the physical condition, pointing the study back to a more objective study. The questionnaire also asks whether the respondent has been treated by a health professional, and what remedy was used, and whether the respondent also has been treated with a remedy, usually, given by a health professional, in 1975, as the study was conducted in a general, and not in a hospital setting. Physical condition was assessed by the following, self-reported information:

(1) any of the following conditions:

Map Name(s) and Date(s)



Historical Map - Slide A



Order Details

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Size:	A
Side Area (sq.)	0.27
Search Radius (m)	0000

Site Details

Orange Tree Cooperative Ltd, Cassel Road, GRAVESEND
DA11 8BN

Envirocheck

LANDMARK INFORMATION GROUP

Ordnance Survey Plan

Published 1973 - 1975

Source map scale - 1:10,000

The Ordnance Survey map is a detailed map of the United Kingdom, showing the coastline, rivers, and other geographical features. It is a black and white map, published by the Ordnance Survey, which is the national mapping agency for Great Britain and Ireland. The map is a plan, meaning it is a two-dimensional representation of the three-dimensional world. It is a source map, meaning it is the original map from which other maps are derived. The map is published at a scale of 1:10,000, meaning that 1 unit on the map represents 10,000 units in the real world. The map is published in 1973-1975, meaning it is a historical map. The map is a plan, meaning it is a two-dimensional representation of the three-dimensional world. It is a source map, meaning it is the original map from which other maps are derived. The map is published at a scale of 1:10,000, meaning that 1 unit on the map represents 10,000 units in the real world. The map is published in 1973-1975, meaning it is a historical map.

Map Name(s) and Date(s)



Historical Map - Scale A



Order Details

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Customer Ref: 100011100
Reference: 100011100
Site Area: 1.27
Acquire & Plot only: 1000

Site Details

Orange Throat Green, 100011100, 100011100, 100011100
SAR 1000

Landmark

Ordnance Survey Plan

Published 1994

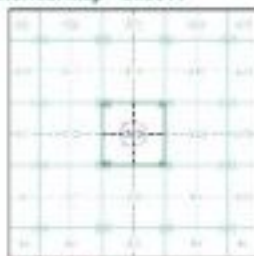
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The historical maps shown were reproduced from maps produced at the scale adopted for England, Wales and Scotland in the 1840's, to the 1:2,500 scale was adopted for mapping urban areas. These maps were used to create the 1:10,000 maps. The published data gives the best available information for the area shown. The published data gives the best available information for the area shown. The published data gives the best available information for the area shown.

Map Name(s) and Date(s)

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Historical Map - Slice A



Order Details

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Site: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
DA12 2RS



Envirocheck

LANDMARK INFORMATION GROUP

VectorMap Local

Published 2023

Source map scale - 1:10,000

VectorMap Local (VectorMap Local) is a high-resolution, vector-based map of the United Kingdom, published by Landmark Information Group. The map is designed to provide a detailed view of the UK's geography, including roads, buildings, and natural features. The map is available in a variety of formats, including a web-based version and a downloadable version. The map is updated regularly to reflect changes in the landscape.

Map Name(s) and Date(s)

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0.00000000000000000000000323117426778526435496644019812382480246603596508828125%	0.000000000000000000000000323117426778526435496644019812382480246603596508828125%
0.000000000000000000000001615587133892632177483220099061912401233017982544140625%	0.0000000000000000000000001615587133892632177483220099061912401233017982544140625%
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0.00000000000000000000000040389678347315804437080502476547810030825449563603515625%	0.000000000000000000000000040389678347315804437080502476547810030825449563603515625%
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0.000000000000000000000000000197215226305252951352932140998729541166139939275173670044140625%	0.0000000000000000000000000000197215226

Enviroche

LANDMARK INFORMATION GROUP

Kent

Published 1874

Source map scale - 1:2,500

This is a map segment with a scale of 1:2,500. It is a black and white map showing a coastal area with a large bay or harbor. The map is oriented with North at the top. The bay is labeled 'CASAL BAY'. To the right of the bay is a large area labeled 'MANKS AND'. Below this is a large area labeled 'RAILWAY'. The map shows various buildings, roads, and other features. A large circular area is highlighted in the center of the map, and a smaller rectangular area is highlighted within it. The map is a historical map, published in 1874.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 00801757_1_1
Customer Ref: 0701905
National Grid Reference: 4948 55, 1948 55
Scale: A
Site Area (sq. m): 0.27
Search Buffer (m): 500

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVESEND, DA11 9BS

Landmark

Essex

Published 1888

Source map scale - 1:2,500

The historical maps shown were reproduced from maps produced at the scale adopted for England, Wales and Scotland in the 1840's. By the 1:2,500 scale was adopted for mapping urban areas and by 1888 covered the whole of what were considered to be the cultivated parts of Britain. The published date given below is often some years later than the original date. Before 1888, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties giving rise to significant inaccuracies in adjoining areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

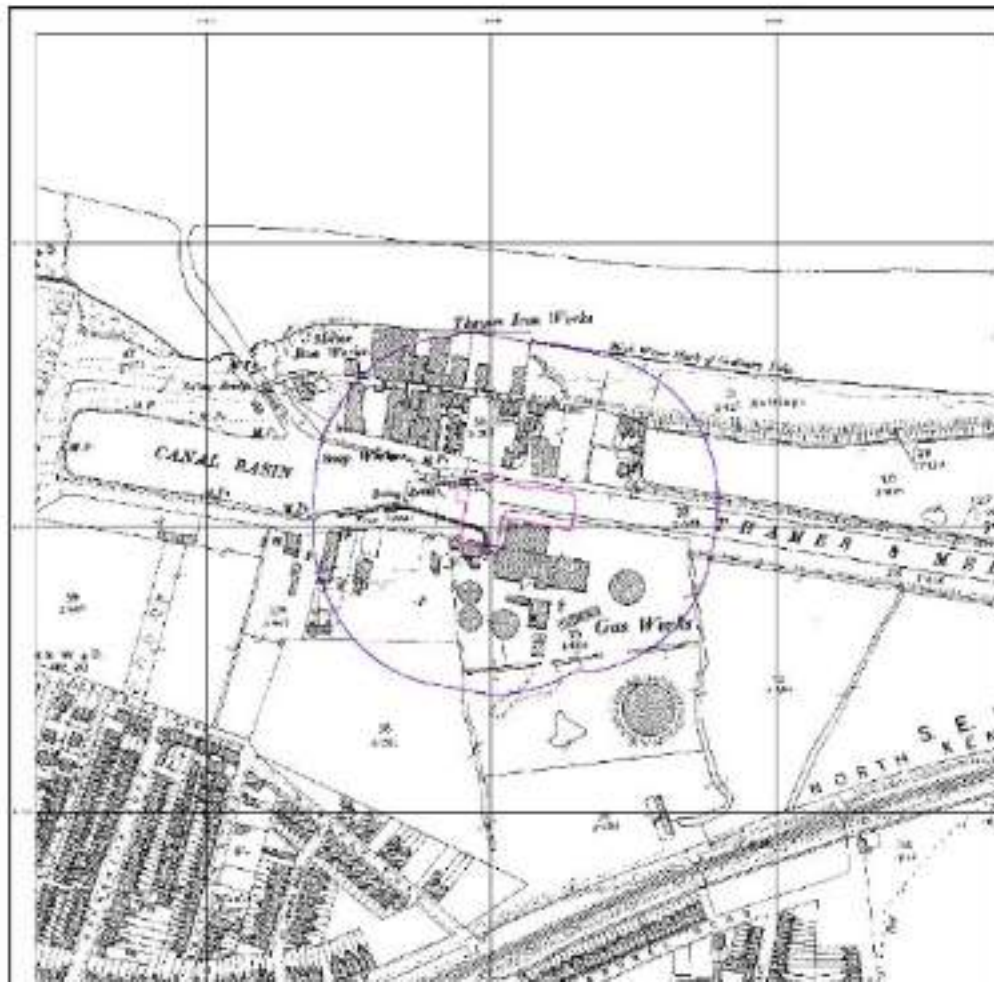


Order Details

Order Number: 339831757_1_1
 Customer Ref: QTC000
 National Grid Reference: 585810, 174210
 Size: A
 Site Area (Ha): 0.27
 Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
 DA12 2RS



Envirocheck

● LANDMARK INFORMATION GRC

Kent

Published 1897

Source map scale - 1:2,500

The main study group was stratified into two subgroups on the basis of age: 18 to 24 years and 25 to 64 years. The 18 to 24 age group was selected for being a high-risk group of the study because of its high rate of sexual contact with the infected partner. The national sex prevalence in 1996 was 1.6% for men and 1.3% for women. The 25 to 64 age group was selected for being a high-risk group of the study because of its high rate of sexual contact with the infected partner.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	000001757
Customer Ref:	0709000
Regional Cost Reference:	495610, 114010
Ship:	A
Class Invoice (Y/N):	0.07
Search Index (Y/N):	0.00

Site Details

Orange Tree Computers Ltd, Cassel Road, GRAVESEND
DA11 8NS

Landmark

2012

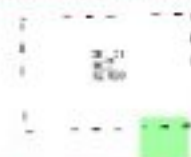
Essex

Published 1897

Source map scale - 1:2,500

The historical maps shown were reproduced from maps produced at the scale adopted for England, Wales and Scotland in the 1840's. In the 1:2,500 scale was adopted for mapping urban areas and by 1898 covered the whole of what were considered to be the cultivated parts of Britain. The published date given below is often some years later than the original date. Before 1850, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties giving rise to significant inaccuracies in adjoining areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 339631757_1_1
 Customer Ref: QTC000
 National Grid Reference: 585810, 174210
 Site: A
 Site Area (Ha): 0.27
 Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
 DA12 2RS

Enviroche

LANDMARK INFORMATION GROUP

Kent

Published 1909

Source map scale - 1:2,500

This is a map of Kent, showing the River Thames and the surrounding area. The map is a historical map, published in 1909, and is a source map for the Kent area. The map shows the River Thames flowing through the area, with the surrounding land divided into fields and other features. The map is a detailed map, showing the layout of the land and the surrounding area. The map is a historical map, published in 1909, and is a source map for the Kent area.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 00001757-1-1
Customer Ref: 0701905
National Grid Reference: 4948 50, 1949 50
Site: A
Site Area (sq. ft): 0.27
Search Buffer (m): 50

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVESEND, DA11 9BS

Landmark

Kent

Published 1936

Source map scale - 1:2,500

This is a map segment with a scale of 1:2,500. It is a black and white map showing a street layout and a large circular area. The map is oriented with North at the top. The circular area is drawn in purple ink. The map is a historical map of Kent, published in 1936. The map shows a street layout and a large circular area. The map is oriented with North at the top. The circular area is drawn in purple ink. The map is a historical map of Kent, published in 1936.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 00801757-1-1
Customer Ref: 0701903
National Grid Reference: 4948 55, 1949 55
Site: A
Site Area (sq m): 0.27
Search Buffer (m): 50

Site Details

Orange Tree Golf Course Ltd, Canal Road, GRAVESEND, DA11 9BS

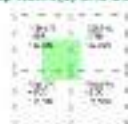
Ordinance Survey Plan

Published 1955 - 1958

Source map scale - 1:2,500

This is a black and white map showing the area around the site. The map is a plan view of the ground, showing buildings, roads, and other features. The map is a plan view of the ground, showing buildings, roads, and other features. The map is a plan view of the ground, showing buildings, roads, and other features.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 00801757 - 1, 1
Customer Ref: 0701903
National Grid Reference: 4948 55, 1742 18
Site: A
Site Area (m²): 0.27
Search Buffer (m): 50

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVES
SA1 1 2JL

Ordnance Survey Plan

Published 1964 - 1969

Source map scale - 1:2,500

The historical maps shown were reproduced from maps commissioned and published by Ordnance Survey. These are based on the 1:25,000 scale 1:2,500 scale maps which were produced by Ordnance Survey for the purpose of showing the location of the site. The historical maps shown here are not to be used for any other purpose. The historical maps shown here are not to be used for any other purpose. The historical maps shown here are not to be used for any other purpose.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	328801757_1_1
Customer Ref:	0704020
National Grid Reference:	565810, 174215
Site:	A
Site Area (ha):	0.27
Search Buffer (m):	100

Site Details

Orange Travel Coaches Ltd, Canal Road, GRAYES
(SA12 2PS)

Additional SIMs

Published 1964

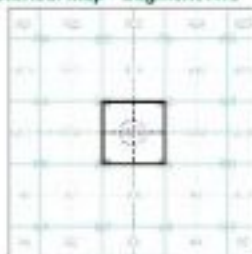
Source map scale - 1:2,500

The following Ordnance Survey's Survey of Information on Manure further detail editions of mapping which were produced and published between the main editions as an area was updated. They date from 1964, and contain detailed information on buildings, roads and water. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 305831757_1_1
Customer Ref: GTCOGD
National Grid Reference: 565810, 174210
Site: A
Site Area (Ha): 0.27
Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVESEND
DA12 2RS

Ordnance Survey Plan

Published 1970

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly at the scale adopted for England, Wales and Scotland in the 1940's. In the 1:2,500 scale was adopted for mapping urban areas and by 1968 covered the whole of what were considered to be the cultivated parts of Britain. The published date given below is often some years later than the map's date. Before 1950, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties giving rise to significant inaccuracies in adjoining areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 339631757_1_1
Customer Ref: QTCMGD
National Grid Reference: 585810, 174210
Site: A
Site Area (Ha): 0.27
Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
DA12 2RS

Supply of Unpublished Survey Information

Published 1974

Source map scale - 1:1,250

As per Supply of Unpublished Survey Information section of the Environmental Protection Act 1987 and 1988, in order to comply with the provisions of the Act, we have a duty to supply a copy of a written report or other written statement of the results of a survey. These maps were originally published in 1974 at a scale of 1:1,250. They were published in 1974 at a scale of 1:1,250 and 1:1,250.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	32883 1757_1_1
Customer Ref:	0704020
National Grid Reference:	565810, 174216
Site:	A
Site Area (ha):	0.27
Search Buffer (m):	100

Site Details

Orange Travel Coaches Ltd, Canal Road, GRAYES (SA12 2PQ)

Ordnance Survey Plan

Published 1978

Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly at the scale adopted for England, Wales and Scotland in the 1940's. In the 1:2,500 scale was adopted for mapping urban areas and by 1958 covered the whole of what were considered to be the cultivated parts of Britain. The published date given below is often some years later than the map's date. Before 1958, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties giving rise to significant inaccuracies in adjoining areas.

Map Name(s) and Date(s)



Map Name
1:1,250
12.2.18

Historical Map - Segment A13



Order Details

Order Number: 339631757_1_1
Customer Ref: QTCMGD
National Grid Reference: 585810, 174210
Site: A
Site Area (Ha): 0.27
Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
DA12 2RS

Additional SIMs

Published 1978 - 1988

Source map scale - 1:1,250

The following information is provided for the purpose of providing a visual reference to the location of the site within the map area. It is not intended to provide any information on the site's location or to provide any information on the site's location or to provide any information on the site's location.

Map Name(s) and Date(s)

Map Name	1:1,250
Map Date	1978 - 1988
Map Scale	1:1,250
Map Source	1:1,250
Map Title	1:1,250

Historical Map - Segment A13



Order Details

Order Number	00000100_1_1
Customer Ref	0701000
Customer Code Reference	100000, 100000
Site	A
Site Area (m²)	0.27
Search Buffer (m)	0.0

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVES

DA12 9BS

Additional SIMs

Published 1981 - 1992

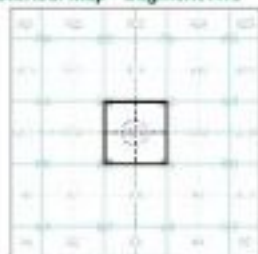
Source map scale - 1:1,250

The following Ordnance Survey's Series of Information on Manure further detail editions of mapping which were produced and published between the main editions as an area was updated. They date from 1981, 1984, and contain detailed information on buildings, roads and water. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 305831757_1_1
Customer Ref: GTCMD
National Grid Reference: 565810, 174210
Site: A
Site Area (Ha): 0.27
Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVESEND
DA12 2RS

Additional SIMs

Published 1992

Source map scale - 1:1,250

The SIMs (Source Information Maps) Survey of Information on Mobility further, minor editions of mapping which were produced and published between the main editions as an area was updated. They date from 1984, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 339631757_1_1
 Customer Ref: GTC000
 National Grid Reference: 585810, 174210
 Size: A
 Site Area (Ha): 0.27
 Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVES
 DA12 2RS

Envirocheek

LANDMARK INFORMATION GROUP

Large-Scale National Grid Data

Published 1993

Source map scale - 1:1,250

Large-Scale National Grid Data is a computerized database of national grid data. It is a computerized version of the 1:1,250 scale map published in 1993. The data is stored in a database and can be accessed via a computer. The data is used for a variety of purposes, including site location, site assessment, and site planning. The data is also used for the creation of maps and other documents. The data is available in a variety of formats, including digital and paper. The data is also available in a variety of languages, including English and French. The data is also available in a variety of currencies, including US dollars and Canadian dollars. The data is also available in a variety of units, including meters and feet. The data is also available in a variety of scales, including 1:1,250 and 1:250,000. The data is also available in a variety of formats, including digital and paper. The data is also available in a variety of languages, including English and French. The data is also available in a variety of currencies, including US dollars and Canadian dollars. The data is also available in a variety of units, including meters and feet. The data is also available in a variety of scales, including 1:1,250 and 1:250,000.

Map Name(s) and Date(s)

Map Name	Date
Envirocheek	1993
Envirocheek	1993
Envirocheek	1993

Historical Map - Segment A13



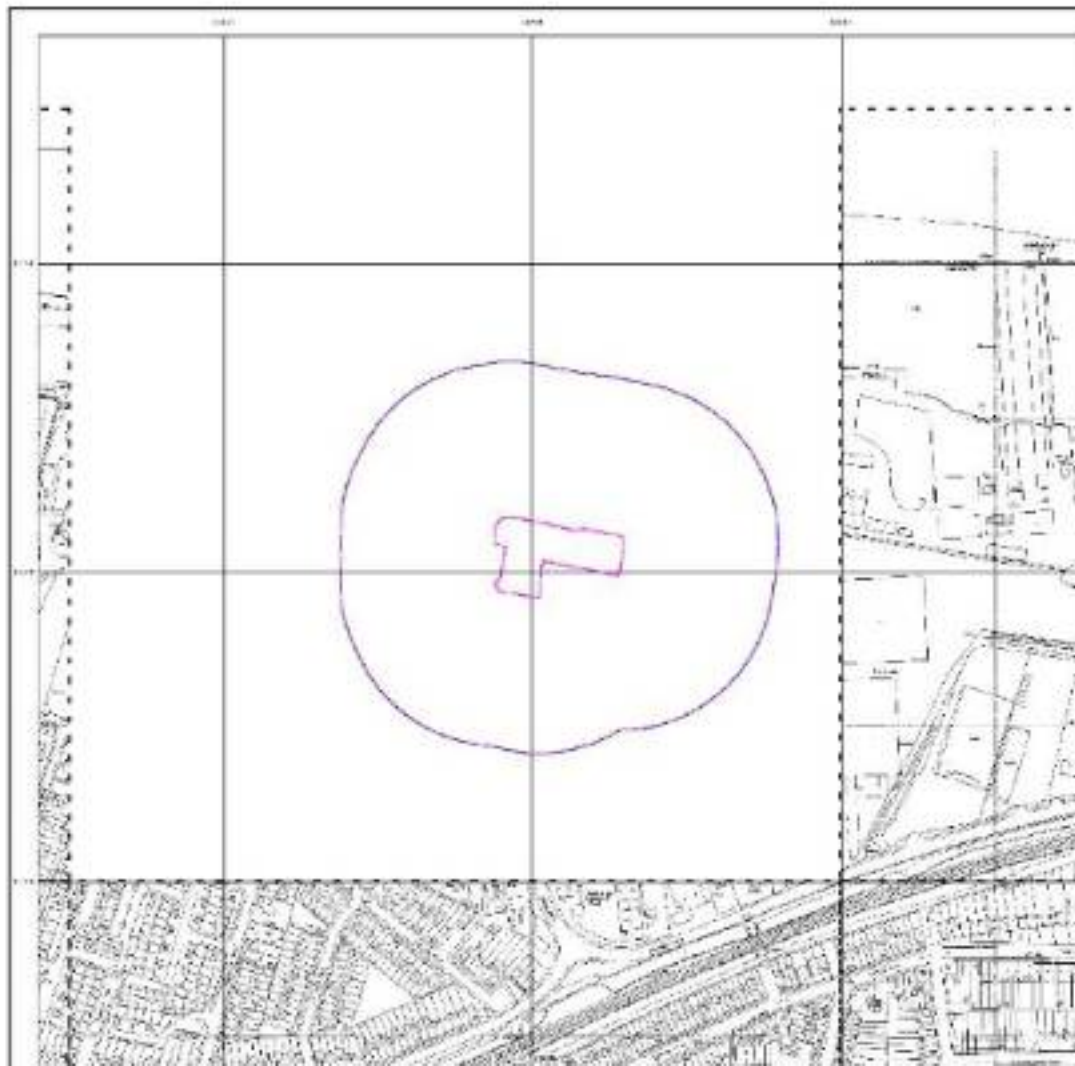
Order Details

Order Number	00001757 - 1 - 1
Customer Ref	0701905
National Grid Reference	548450, 174210
Site	A
Site Area (m ²)	0.27
Search Buffer (m)	500

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVES
SA12 9BS

Landmark



Envirocheck

LANDMARK INFORMATION GEOGRAPHIC

Large-Scale National Grid Data

Published 1983

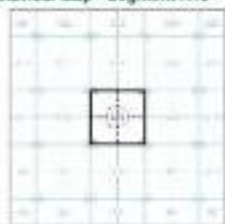
Source map scale - 1:1,250

Large Scale National Grid Data, superseding 1981 Data, contains the Survey of England and Wales, 1982, and is derived from the 1:1,250 scale 1982. These maps are derived from the 1:1,250 scale 1982 and are published at a scale of 1:1,250. The maps are published at a scale of 1:1,250. The maps are published at a scale of 1:1,250. The maps are published at a scale of 1:1,250.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	32001757_1_1
Customer Ref:	0704020
National Grid Reference:	565810, 174215
Scale:	A
Site Area (ha):	8.27
Search Buffer (m):	100

Site Details

Orange Travel Coaches Ltd, Canal Road, GRAYES, SA17 2PS

Landmark

100 200 300 400 500 600 700 800 900 1000

Large-Scale National Grid Data

Published 1994

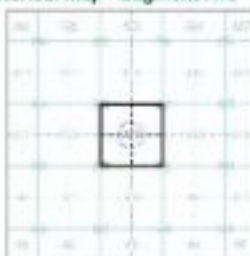
Source map scale - 1:1,250

Large-Scale National Grid Data superimposed 800 scale Ordnance Survey (OS) maps on 1:1,250 scale maps. The maps were produced in 1994. These maps were the first source of digital mapping and provide detailed information on features and roads. The maps show topographic features such as vegetation. These maps were produced at 1:1,250 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 200801757_1_1
 Customer Ref: GTCHEG
 National Grid Reference: 565810, 174210
 Site: A
 Site Area (Ha): 0.27
 Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVESEND, DA12 2RS

Large-Scale National Grid Data

Published 1996

Source map scale - 1:1,250

Large Scale National Grid Data superseded 500 cards (Ordinance Survey of Information on Microfilm) in 1992, and continued to be produced until 1996. These maps were the first series of digital mapping and provide detailed information on houses and roads, but tend to show topographic features such as vegetation. These maps were produced at 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 339631757_1_1
 Customer Ref: QTC000
 National Grid Reference: 585810, 174210
 Size: A
 Site Area (Ha): 0.27
 Search Buffer (m): 100

Site Details

Grange Travel Coach Hire Ltd, Canal Road, GRAVESEND, DA12 2RS



Envirochee

LANDMARK INFORMATION GROUP

Historical Aerial Photography

Published 1999

This aerial photograph was taken in 1999. It is a black and white photograph and is a composite of several images taken in 1999.

Historical Aerial Photography - Segment



Order Details

Order Number: 00001757_1_1
Customer Ref: 0701909
National Grid Reference: 464810, 174010
Scale: A
Site Area (Ha): 0.27
Search Buffer (m): 500

Site Details

Orange Tree Golfcourse Ltd, Canal Road, GRAVESEND, DA11 9BS



APPENDIX 3 ▪ BGS Borehole Logs

KENT COUNTY COUNCIL
HIGHWAYS LABORATORY

Sheet 1 of 2

BOREHOLE LOG TR 675E 71

TR 65739 74215

Date started 10th. June 1973 Date completed 15th. June 1974

Scheme Norfolk Rd./Canal Rd. Link

Location

Borehole No. 3 Ground Level. 4.645 m AOD

Form No. 493

KEY

KENT COUNTY COUNCIL

HIGHWAYS LABORATORY

Sheet 1 of 2

BOREHOLE LOG TQ 673571

TQ 673571

Date started 20th. June 1973 Date completed 26th. June 1973

Scheme Norfolk Rd./Canal Rd. Link

Location

Borehole No. 3 Ground Level 4.645 m AOD

Sample			Section	Depth from O.D. or below Ground Level	Thickness of Stratum m.	Description of Soil	Penetration Test	
No.	Type	Depth m.					Pen'tn mm.	No. & Elve
1	•	0.50		1.00	1.00	Chalk, silt, ash, coal and gravel MADE GROUND		
2	•	0.90						
3	•	1.00						
4	•	1.50		1.00	1.00	Soft blue-grey and brown silty CLAY, with peat and organic mud. ALLUVIUM/MADE GROUND		
5	•	1.70						
6	•	2.25						
7	•	2.25		2.00	2.00	Soft grey-green or blue silty CLAY. Scattered flint fragments becoming grey, with apparent polished faces. ALLUVIUM		
8	•	3.00						
9	•	3.20						
10	•	4.00		4.00	1.40	Firm blue grey silty CLAY with peat pockets, and scattered shell fragments. ALLUVIUM		
11	•	4.15						
12	•	4.90						
13	•	5.15		5.40	0.70	Very soft peat. ALLUVIUM		
14	•	5.75						
15	•	6.40						
16	•	6.50		6.10	0.80	Medium dense pale grey sandy clay SILT, with a little peat. ALLUVIUM		
17	•	7.00						
18	•	7.55						
19	•	8.10		6.90	2.00	Medium dense, alternating bands of pale grey SILT and silty SAND, fully with scattered shell fragments, and peat pockets. penetrated. ALLUVIUM		
20	•	8.65						
21	•	9.10						
22	•	9.10		9.10		End of borehole.		

HOLST & CO. LTD.
SITE INVESTIGATION DEPT.
PARKSIDE LANE
LEEDS LS115SX.

Contract No. T3770/F1622

Location Gravesend

Client Livesey, Henderson & Partners

Borehole No. 1

Ground Level

Date 28th July, 1970

BOREHOLE LOG

STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	γ lb/cu. ft.	φ deg.	m.c. %	γ lb/cu. ft.	N
MADE GROUND:- Soil, Ashes Brick, Stones.			7'3"	I					6
		7'3"	8'0"	I					25
MADE GROUND:- Gault and Clay		12'6"	5'3"	I					
Very soft light brown silty mottled clay		16'0"	3'6"	□	200	0	39.3	113	
Very soft dark grey organic silty clay			8'0"	□	190	0	54.0	98	
		24'0"	25'0"						
Brown Peat		26'0"	2'0"	□	450	0	32.9	112	
Light grey organic silt		29'6"	3'6"						
			30'0"	I					25
Compact sand, gravel and flints		34'6"	5'0"	I					
			35'3"	I					57
Compact light grey silt		37'0"	2'6"	I					
Compact gravel and flints			40'0"	I					21
			8'0"	I					
		45'0"	45'3"	I					24
Compact light brown sand gravel and flints			51'0"	I					18
		19'0"	56'3"	I					28
			60'0"	I					30
		64'0"							

RECORD OF SHAFT OR BOREHOLE

used as 4,20 000 Map Registration No.

TQ 67 SE / 25

Name and Number of Shaft or Borehole.

Trail hole at Gas Works

Five sheets made

From or Village Grassend cray KentExact step difference to a fixed point on $T=20$ at $L=10000$ Map.

National Grid Reference

6587. 7418

Join us 9:58 AM
New Science Map No.

Excess VC of
Controlled by

271

Purpose for which made

Ground level at shaft _____ relative to O.D. _____ in. If not ground level give O.D. at beginning of shaft _____ in.

Monday, May 11, 2009

Date of sinking

Reformations: Issues

Section at a trial hole at the gas works,
GRAVESEND, KENT.

From The F.C. Construction Co. Ltd.

J. Stat. Med. 271



Geological Classification

classmate

Depth
marker 12

Make Ground	5
Blue clay	3
Brown clay	87 1/2
Flint	2
Blue sandy clay	2
Blue clay and small pebbles	2
White cherty sand	1 1/2

5th December 1927

KENT COUNTY COUNCIL
HIGHWAYS LABORATORY

Sheet 1 of 2

BOREHOLE LOG TQ 673E 72

TQ 673E 72

Date started 15th June 1978. Date completed 19th June 1978

Scheme Norfolk Rd./Canal Rd. Link.

Location

Borehole No. 4 Ground Level 4.470 ± AOD

- KEY
- Disturbed Sample
 - ↑ Bulk Disturbed Sample
 - 100 mm Undisturbed Sample
 - Standard Penetration Test
 - Δ Water Sample

Sample			Section	Depth about O.D. or below Ground Level	Thickness of Stratum m.	Description of Soil	Penetration Test	
No.	Type	Depth m.					Pen's mm.	No. of Blows
1	●	0.40		0.40	0.40	Coal dust. MADE GROUND		
2	—	0.60				Olive brown very silty fine SAND, with ash, flint, chalk and roots.		
3	—	1.10			1.20	MADE GROUND		
	—	1.60		1.60		Loose pale grey SILT, with ash, peat, chalk.		
4	●	1.80			1.10	DISTURBED ALLUVIUM		
5	—	2.10						
6	—	2.55		2.70		Pale blue, becoming chocolate brown soft silty CLAY, with decayed roots and peat pockets, and traces of chalk and flints.		
7	—	2.70						
8	—	2.85						
9	—	3.30						
10	—	3.50						
11	—	3.70						
12	—	4.15			3.20			
13	—	4.35						
14	—	4.45						
15	—	4.90						
16	—	5.30						
17	—	5.55		5.90		Hard CHALK lumps, fragments, peat pockets, and grey/yellow silty sand.		
18	—	6.00			1.00	ALLUVIUM		
19	—	6.10						
20	—	6.55		6.90		Sub-angular flint GRAVEL, 50mm, with a little silty fine sand.		
21	—	7.05			0.70	ALLUVIUM		
22	—	7.10						
23	—	7.55		7.60		Medium dense blue-grey sandy SILT, with traces of chalk, flin- ts, and shell.		
24	—	7.75			1.95	ALLUVIUM		
25	—	7.85						
26	—	8.30				Uniform grey/gold sandy coarse SILT.		
27	—	8.40						
28	—	8.45						
29	—	8.90						
30	—	9.00						
31	—	9.45						
32	—	9.55		9.55	0.95	ALLUVIUM		
33	—	10.00		10.00		End of borehole.		

10.00 Not fully penetrated



APPENDIX 4

- Exploratory Hole Location Plan
- Gas/groundwater Monitoring Installation Plan



Block Plan

Site plan provided by Client

Key:

- Site Boundary Line
- ⓑ Borehole Location & Monitoring Well Installation

PROJECT: GEO-GTCH-001-24

**Grange Travel Coach Hire, Canal Road, Gravesend,
Kent, DA12 2RS**



APPENDIX 5 ▪ Exploratory Hole Logs



Key to exploratory hole symbols and abbreviations

SAMPLE TYPES

ACM - Asbestos sample	AMAL - Amalgamated sample	B - Bulk disturbed sample
BLK - Block sample	C - Core sample	CBR - CBR test sample
D - Disturbed sample	ES - Environmental sample	EW - Environmental water sample
G - Gas sample	J - Jar sample	L - Liner sample
TW - Pushed thin wall sample	U - Undisturbed sample	UT - Undisturbed thin wall sample
W - Water sample		

IN-SITU TESTS

HV - Hand shear vane	HV(r) - Hand shear vane residual	PID - Photo ionisation detector
PP - Hand penetrometer	SPT - Standard penetration test	

GROUNDWATER



Groundwater strike



Groundwater rest level

ROTARY CORE DETAILS

TCR - Total core recovery (%)	SCR - Solid core recovery (%)	RQD - Rock quality designation (%)
FI - Fracture index	NI - Non-intact core	AZCL - Assumed zone of core loss

LEGEND

Topsoil	Clay	Chalk	Sand backfill
Peat	Silt	Breccia	Gravel backfill
Made ground	Sand	Conglomerate	Arisings
Concrete	Gravel	Metamorphic	Bentonite
Wood	Cobbles	Igneous	Concrete
Brick	Boulders		Grout
Bituminous material	Mudstone		Plain pipe
Gypsum	Siltstone		Slofted pipe
Coal	Sandstone		
Void	Limestone		



BH01

Sheet 1 of 1

Node Type

Conclusions

Northling

Ground Level (m)

Results

Project Name

Project Name: Grande Travel Coach Hire

Project No. _____

DEQ-DTCH-201-24

Start Date

2024-11-04

End Date

2024-11-04

Client

M2 Technical Services Ltd (on behalf of Grange Towel Coach Hire)

Contractor

M2 Technical Services Ltd

Consultant:

Ground Engineering Services Ltd

No.	Backfill	Water Levels	Samples and Tests		Level (ft)	Depth (ft)		Strata	
			Depth (m)	Type Test		Results	Legend	Description	
						0.00		TARMAK (TARMACADAM)	
			0.00 - 0.40	N-1		0.00			
			0.40	N-2		0.40			
			1.00	N-3		1.00			
			1.50	SPT	MHA (L205 + L20)	1.50			
			1.50	D-6				Wood pieces observed: (1.30 - 1.50m)	
			1.50 - 1.99	D-6				Strong hydrocarbon odour present: (1.30 - 1.45m)	
						1.80			
			1.99	D-6					
			2.00	SPT	MH (1.01 & 1.0)	2.00			
			2.00	D-6					
			2.00 - 2.40	D-6					
			2.40 - 2.99	N-6		2.40			
						2.80			
			2.99	D-10		2.99			
			3.00	SPT	NH (1.00 + 1.00)	3.00			
			3.00 - 3.49	D-11					
						3.49			
			3.50	D-12					
			3.50 - 4.49	G-13	Shows 2R	4.00			
			4.50 - 4.99	G-14		4.50			
						4.99			
						5.00			

Future studies

inspector PM is fully out

Method, Plant, Stability, Dimensions.

张其成 1 月 28 日

0-200 + 0.0009 (CP: 10/0000-2000)

Leaves

3. D. N. S. 1974

Q. D. Davis



Borehole Log

BH02

Sheet 1 of 1

Hole Type:
IP-CP

Easting

Northing

Ground Level (m)

Scale

Project Name

Grange Travel Coach Hire

Project No.

GEO-GTCH-001-24

Start Date

2024-11-04

End Date

2024-11-04

Client

M2 Technical Services Ltd (on behalf of Grange Travel Coach Hire)

Contractor

M2 Technical Services Ltd

Consultant

G.D. Ground Engineering Services Ltd

Backfill	Water Level	Samples and Tests		Level (m)	Depth (m)	Strata	
		Depth (m)	Type Ref			Legend	Description
		0.00 - 0.40	R 1		0.00		TARMAC (TARMACADAM)
					0.00		
		0.40 - 0.60	R 2		0.40		Reddish-brown very gravelly SAND. Sand is fine to coarse. Gravel is sub-angular to rounded fine to coarse of brick, quartz, flint, asphalt and occasional concrete fragments. (MADE GROUND)
					0.60		
		0.60 - 1.00	R 3		0.60		Reddish-grey very gravelly SAND. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of brick, concrete, chalk and flint with rare asphalt. (MADE GROUND)
					1.00		
		1.00	ES 4		1.00		
		1.00 - 1.40	SPT D 2		1.40		
					1.70		
		1.70 - 2.00	R 4		1.70		Greenish-brown slightly sandy slightly clayey GRAVEL. Sand is fine. Gravel is angular to sub-angular fine to coarse of brick, flint, quartz, concrete and rare chalk fragments. Slight hydrocarbon odour present. (MADE GROUND)
					2.00		
		2.00 - 2.40	SPT ES 1 D 3		2.40		
		2.40 - 2.80	R 5		2.80		
					3.00		
		3.00 - 3.40	SPT D 10 D 11 D 12		3.40		Soft and slightly wet greenish-brown slightly gravelly silty CLAY. Gravel is angular to sub-rounded fine to coarse of flint and quartz. (ALLUVIUM)
					3.80		
		3.80 - 4.20	SPT D 14 D 15		4.20		Soft light grey very silty CLAY with occasional shelly fragments. (ALLUVIUM)
					4.50		
		4.50 - 4.70			4.70		Hard lenses of peat from 4.50m - (4.50 - 4.70m)
					5.00		
					5.00		End of Borehole at 5.00m

Remarks

Inspection PM to 1.30pm Sat

Method, Plant, Stability, Dimensions

0.00 - 1.20m IP

1.20 - 5.00m CP - 100mm 3000

Logger

O Doyle

O Doyle



APPENDIX 6 • Laboratory Soil Analysis Certificates

G.D. Ground Engineering Services Ltd
92a Oakleigh Park Drive
Leigh-On-Sea
Essex
SS9 1RS

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

e: gdgroundengineeringservices@gmail.com

Analytical Report Number : 24-014841

Project / Site name:	Gravesend Bus Station	Samples received on:	15/04/2024
Your job number:	CON-GTCH-001	Samples instructed on/ Analysis started on:	15/04/2024
Your order number:	GD-24-04-001	Analysis completed by:	24/04/2024
Report Issue Number:	1	Report issued on:	25/04/2024
Samples Analysed:	6 soil samples		


Signed:

Dominika Liana
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

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

Analytical Report Number: 24-014841
Project / Site name: Gravesend Bus Station
Your Order No: GD-24-04-001

Lab Sample Number	174264	174265	174266	174267	174268
Sample Reference	BM1	BM2	BM3	BM4	BM5
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.00	2.00	3.50	1.00
Date Sampled	11/04/2024	11/04/2024	11/04/2024	11/04/2024	11/04/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Acids	Level of detection	General reference	Soils	

Stone Content	%	4.1	N/A	< 0.1	< 0.1	84.9	53.5	< 0.1
Moisture Content	%	5.05	N/A	13	13	11	6.9	11
Total mass of sample received	kg	3.1	N/A	0.9	0.9	0.4	0.9	0.9

Substance in Soil Detected/Not Detected	Type	RL	RL	RL	RL	RL	RL	RL
Substance Analyzed: ID	AN	AN	AN	AN	AN	AN	AN	AN

General Inorganics	pH (20°C)	RL	RL	RL	RL	RL	RL	RL
Water Soluble Sulphate as SO ₄ (4hr extraction (2:1))	mg/kg	2.5	100	200	500	100	200	300
Water Soluble SO ₄ (6hr extraction (2:1))	mg/l	1.05	100	100	200	110	150	140
Organic Matter (automated)	%	3.1	100	0.8	4	3.0	1.7	2.3
Total Organic Carbon (TOC) - Automated	%	3.1	100	0.4	3.3	2.1	1	0.8

Total Phenols	mg/kg	1	100 <td>< 1.0</td> <td>< 1.0</td> <td>< 1.0</td> <td>< 1.0</td> <td>< 1.0</td>	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
---------------	-------	---	---	-------	-------	-------	-------	-------

Speciated PAHs	mg/kg	0.05	100	mg/kg	< 0.05	7.7	6.9	5.19	0.18
Acenaphthylene	mg/kg	0.05	100	mg/kg	< 0.05	2	3.3	5.12	0.18
Acenaphthene	mg/kg	0.05	100	mg/kg	0.18	17	30	2.38	0.99
Fluorene	mg/kg	0.05	100	mg/kg	0.19	25	51	0.29	0.41
Benzo[a]pyrene	mg/kg	0.05	100	mg/kg	1.9	120	280	1.9	2.8
Indeno[1,2,3-cd]pyrene	mg/kg	0.05	100	mg/kg	0.40	20	65	0.60	1.2
Fluoranthene	mg/kg	0.05	100	mg/kg	3.6	100	250	4	0.8
Pyrene	mg/kg	0.05	100	mg/kg	2.2	80	200	3.4	1.8
Benzo[a]anthracene	mg/kg	0.05	100	mg/kg	1	30	96	1.5	2.5
Chrysene	mg/kg	0.05	100	mg/kg	0.95	37	94	1.6	2.4
Benzo[b]fluoranthene	mg/kg	0.05	100	mg/kg	0.86	40	86	1.9	3
Benzo[k]fluoranthene	mg/kg	0.05	100	mg/kg	0.51	17	54	0.88	1.7
Benzo[e]pyrene	mg/kg	0.05	100	mg/kg	0.8	35	62	1.7	2.6
Indeno[1,2,3-cd]pyrene	mg/kg	0.05	100	mg/kg	0.47	17	26	0.96	1.8
Benzo[g]hantrene	mg/kg	0.05	100	mg/kg	0.17	5.1	9.1	0.22	0.44
Benzo[h]perylene	mg/kg	0.05	100	mg/kg	0.13	18	40	1.1	1.9

Total PAH	mg/kg	8.4	100	13	620	1340	20.5	34.3
-----------	-------	-----	-----	----	-----	------	------	------

Lab Sample Number	174264	174265	174266	174267	174268
Sample Reference	BNC1	BNC1	BNC1	BNC1	BNC1
Sample Name	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.00	1.00	1.00	1.00	1.00
Date Sampled	11/04/2024	11/04/2024	11/04/2024	11/04/2024	11/04/2024
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analysis Parameter (Sci. Analysis)					

Aluminum (aqueous extraction)	mg/kg	1	<0.0075	17	16	13	13	14
Aluminum (aqueous extractable)	mg/kg	1	<0.0075	1.8	1.8	1.3	1.2	1.6
Cadmium (aqueous extractable)	mg/kg	0.1	<0.0075	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (total extract)	mg/kg	1.0	<0.0075	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium (ED)	mg/kg	1	<0.0075	23	29	23	25	23
Chromium (aqueous extractable)	mg/kg	1	<0.0075	23	29	23	25	23
Copper (aqueous extraction)	mg/kg	1	<0.0075	24	26	24	24	24
Copper (aqueous extractable)	mg/kg	1	<0.0075	1.6	1.6	1.3	1.6	1.6
Heavy metals (aqueous extractable)	mg/kg	0.1	<0.0075	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Mercury (aqueous extractable)	mg/kg	1	<0.0075	16	20	17	17	15
Selenium (aqueous extraction)	mg/kg	1	<0.0075	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (aqueous extractable)	mg/kg	1	<0.0075	27	46	42	46	34
Zinc (aqueous extraction)	mg/kg	1	<0.0075	100	120	83	88	140

Parameter	Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis	Normality	Linearity
TRNGW - Alameda > 75 - 120 m ² /a	80.76	9.61	69.82	99.00	-0.020	-0.833	-0.028	-0.020
TRNGW - Alameda > 75 - 120 m ² /a	80.76	9.61	69.82	99.00	-0.020	-0.833	-0.028	-0.020
TRNGW - Alameda > 75 - 120 m ² /a	80.76	9.61	69.82	99.00	-0.020	-0.833	-0.028	-0.020
TRNGW - Alameda > 120 - 172 m ² /a	80.76	1	< 69.875	< 9.9	0.0	1.6	< 1.0	< 1.0
TRNGW - Alameda > 172 - 1200 m ² /a	80.76	1	< 69.875	< 9.9	1.2	1.0	< 1.0	< 1.0
TRNGW - Alameda > 120 - 1220 m ² /a	80.76	0	< 69.875	< 9.9	24	22	< 9.3	< 9.3
TRNGW - Alameda > 220 - 120 m ² /a	80.76	0	< 69.875	23	120	89	22	14
TRNGW - Alameda > 220 - 144 m ² /a	80.76	0	< 69.875	24	140	89	208	32
TRNGW - Alameda > 75 - 178 m ² /a	80.76	10	9.92	23	100	113	25	19
TRNGW - Alameda > 120 - 244 m ² /a	80.76	10	9.92	08	500	273	180	08

[illegible]

ATTEE (Maths Tertiary Unit: ECU)	year0	0	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
Overseas	year0	0 <td>year0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td>	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
Local	year0	0 <td>year0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td>	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
Study/Research	year0	0 <td>year0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td>	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
Other	year0	0 <td>year0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td>	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
Program	year0	0 <td>year0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td> <td>< 0.0</td>	year0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0

Bull Vol 20 #11811-1-Blackened Bull Head - CDSH 623 CH-09 - FR.km

Analytical Report Number: 24-014841
Project / Site name: Gravesend Bus Station
Your Order No: GD-24-04-001

Lab Sample Number	174269			
Sample Reference	9H02			
Sample Number	None Supplied			
Depth (m)	2.00			
Date Sampled	11/04/2024			
Time Taken	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

Stone Content	%	0.1	MORE	< 0.1
Moisture Content	%	0.01	MORE	8.5
Total mass of sample received	kg	0.1	MORE	0.9

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	MIN

General Inorganics

pH (L099)	pH units	N/A	MCERTS	9.2
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	300
Water Soluble SO ₄ 16hr extraction (2:1)	mg/l	1.25	MCERTS	150
Organic Matter (automated)	%	0.1	MCERTS	0.8
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.5

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.09
Acenaphthylene	mg/kg	0.05	MCERTS	0.34
Acenaphthene	mg/kg	0.05	MCERTS	3.7
Fluorene	mg/kg	0.05	MCERTS	3.8
Phenanthrene	mg/kg	0.05	MCERTS	20
Anthracene	mg/kg	0.05	MCERTS	11
Fluoranthene	mg/kg	0.05	MCERTS	38
Pyrene	mg/kg	0.05	MCERTS	31
Benzo(a)anthracene	mg/kg	0.05	MCERTS	14
Chrysene	mg/kg	0.05	MCERTS	13
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	13
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	6.5
Benzo(a)pyrene	mg/kg	0.05	MCERTS	12
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	5.2
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.2
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	5.4

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	179
-----------------------------	-------	-----	-----------	-----

Analytical Report Number: 24-014041
 Project / Site name: Gravesend Bus Station
 Your Order No: GD-24-04-001

Lab Sample Number	174269		
Sample Reference	B/K2		
Sample Number	None Supplied		
Depth (m)	2.00		
Date Sampled	11/04/2024		
Time Taken	None Supplied		
Analytical Parameter: (Soil Analysis)	Units	Limit of detection	Accreditation Notes

Heavy Metals / Metalloids

Arsenic (aqueous extractable)	mg/kg	1	PCR75	8.2
Barium (aqueous extractable)	mg/kg	1	PCR75	81
Cadmium (aqueous extractable)	mg/kg	0.2	PCR75	< 0.2
Chromium (hexavalent)	mg/kg	1.8	PCR75	< 1.8
Cobalt (II)	mg/kg	1	NDM	16
Chromium (aqueous extractable)	mg/kg	1	PCR75	16
Copper (aqueous extractable)	mg/kg	1	PCR75	28
Lead (aqueous extractable)	mg/kg	1	PCR75	50
Mercury (aqueous extractable)	mg/kg	0.3	PCR75	< 0.3
Nickel (aqueous extractable)	mg/kg	1	PCR75	8.2
Selenium (aqueous extractable)	mg/kg	1	PCR75	< 1.0
Vanadium (aqueous extractable)	mg/kg	1	PCR75	40
Zinc (aqueous extractable)	mg/kg	1	PCR75	28

Petroleum Hydrocarbons

THC/WG - Aliphatic > C5 - C6 m, i, o, n	mg/kg	100	NDM	< 0.020
THC/WG - Aliphatic > C6 - C8 m, i, o, n	mg/kg	100	NDM	< 0.020
THC/WG - Aliphatic > C8 - C10 m, i, o, n	mg/kg	100	NDM	< 0.050
THC/WG - Aliphatic > C10 - C12 m, i, o, n	mg/kg	1	PCR75	< 1.0
THC/WG - Aliphatic > C12 - C16 m, i, o, n	mg/kg	2	PCR75	2.2
THC/WG - Aliphatic > C16 - C21 m, i, o, n	mg/kg	8	PCR75	8.6
THC/WG - Aliphatic > C21 - C25 m, i, o, n	mg/kg	8	PCR75	28
THC/WG - Aliphatic > C25 - C40 m, i, o, n	mg/kg	8.4	NDM	< 5.4
THC/WG - Aliphatic > C5 - C35 m, i, o, n	mg/kg	18	NDM	46
THC/WG - Aliphatic > C5 - C40 m, i, o, n	mg/kg	18	NDM	46

THC/WG - Aromatic > EC5 - EC7 m, i, o, n	mg/kg	100	NDM	< 0.020
THC/WG - Aromatic > EC7 - EC8 m, i, o, n	mg/kg	100	NDM	< 0.020
THC/WG - Aromatic > EC8 - EC10 m, i, o, n	mg/kg	100	NDM	< 0.050
THC/WG - Aromatic > EC10 - EC12 m, i, o, n	mg/kg	1	PCR75	< 1.0
THC/WG - Aromatic > EC12 - EC16 m, i, o, n	mg/kg	2	PCR75	37
THC/WG - Aromatic > EC16 - EC21 m, i, o, n	mg/kg	18	PCR75	280
THC/WG - Aromatic > EC21 - EC25 m, i, o, n	mg/kg	18	PCR75	320
THC/WG - Aromatic > EC25 - EC44 m, i, o, n	mg/kg	8.4	NDM	24
THC/WG - Aromatic > EC5 - EC35 m, i, o, n	mg/kg	18	NDM	640
THC/WG - Aromatic > EC5 - EC40 m, i, o, n	mg/kg	18	NDM	660

VOCs

MTE (Methyl Tertiary Butyl Ether)	ug/kg	5	NDM	< 5.0
Benzene	ug/kg	5	PCR75	< 5.0
Toluene	ug/kg	5	PCR75	< 5.0
Ethylbenzene	ug/kg	5	PCR75	< 5.0
p & m-Xylene	ug/kg	5	PCR75	< 5.0
o-Xylene	ug/kg	5	PCR75	< 5.0

US = Unsuitable Sample VS = Insufficient Sample ND = Not detected

Analytical Report Number : 24-014841

Project / Site name: Gravesend Bus Station

* 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 soil 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 *
174264	BH01	None Supplied	0.5	Brown sand with brick
174265	BH01	None Supplied	1	Brown loam and sand with gravel
174266	BH01	None Supplied	2	Brown clay with stones
174267	BH02	None Supplied	0.5	Brown sand with stones
174268	BH02	None Supplied	1	Brown clay and sand with gravel
174269	BH02	None Supplied	2	Brown sandy gravel ¹⁵

Analytical Report Number : 24-014841

Project / Site name: Gravesend Bus Station

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A0038	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L0085	D	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 (Walkley Black Method)	In-house method	L0085	D	MCERTS
Proximate Content	Proximate content, determined gravimetrically (up to 30°C)	In-house method	L0080	W	MCERTS
Stonics content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stonics > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements	L0090	D	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 BS EN ISO 17025 Methods for the Determination of Metals in Soil	L0088	D	MCERTS
Sulphate, water soluble, in soil (10% extraction)	Sulphate, water soluble, in soil (10% extraction)	In-house method	L0080	D	MCERTS
Spectroal EPA 16 PAHs and/or 3 semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAHs) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L0040	D	MCERTS
WTEK analyzer Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L0736	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L0085/L0080	D/W	MCERTS
Chromium (III) in soil	In-house method by calculation from total Cr and Cr (VI)	In-house method by calculation	L0080	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by reduction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L0080	W	MCERTS
Ponchydric 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	L0080	W	MCERTS

Analytical Report Number : 24-014841

Project / Site name: Gravesend Bus Station

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
pH in soil (estimated)	Determination of pH in soil by addition of water followed by extended electronic measurement.	In-house method	1099	D	M CERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

*b - Unaccredited sample matrix.



APPENDIX 7

- Groundwater Laboratory Analysis Certificates



4041

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92a Oakleigh Park Drive
Leigh-On-Sea
Essex
SS9 1RS

e: gdgroundengineeringservices@gmail.com



Environmental Science

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Herts,
WD18 8YS

t: 01923 225404

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e: reception@i2analytical.com

Analytical Report Number : 24-019145

Project / Site name:	Grange Travel Coach Hire	Samples received on:	13/05/2024
Your job number:	GEO-GTCH-24-001	Samples instructed on/ Analysis started on:	13/05/2024
Your order number:	GD24-05-001	Analysis completed by:	17/05/2024
Report Issue Number:	1	Report issued on:	21/05/2024
Samples Analysed:	2 water samples		

Signed:

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

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

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

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

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

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

Analytical Report Number: 24-019145

Project / Site name: Grange Travel Coach Hire

Your Order No: GD24-05-001

Lab Sample Number	196380			196381
Sample Reference	BM01-W1			BM02-W2
Sample Number	None Supplied			None Supplied
Depth (m)	1.12			1.12
Date Sampled	10/05/2024			10/05/2024
Time Taken	None Supplied			None Supplied
Analytical Parameter (Water Analysis)	Depth	Limit of detection	Accreditation Status	

General Inorganics

pH (1000)	pH Units	N/A	ISO 17025	8.1	8.1
Orthophosphate as PO ₄ ³⁻	mg/l	0.05	ISO 17025	389	351
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	19.1	20.3

Total Phosphate

Total Phosphate (molybdenic)	mg/l	10	ISO 17025	< 10	11
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Speciated PAHs

Fluoranthene	mg/l	0.01	ISO 17025	0.6	0.7
Azaphthalene	mg/l	0.01	ISO 17025	< 0.01	< 0.01
Azaphthalene	mg/l	0.01	ISO 17025	17	16
Fluorene	mg/l	0.01	ISO 17025	4.5	4.5
Phenanthrene	mg/l	0.01	ISO 17025	5.5	5.3
Anthracene	mg/l	0.01	ISO 17025	1.3	1.3
Fluoranthene	mg/l	0.01	ISO 17025	3.7	3
Pyrene	mg/l	0.01	ISO 17025	2.2	1.9
Benzo(a)anthracene	mg/l	0.01	ISO 17025	0.11	0.23
Chrysene	mg/l	0.01	ISO 17025	0.09	0.2
Benzo(b)fluoranthene	mg/l	0.01	ISO 17025	< 0.01	0.18
Benzo(k)fluoranthene	mg/l	0.01	ISO 17025	< 0.01	0.1
Benzo(a)pyrene	mg/l	0.01	ISO 17025	< 0.01	0.14
Indeno(1,2,3-cd)pyrene	mg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)fluoranthene	mg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(g,h,i)perylene	mg/l	0.01	ISO 17025	< 0.01	< 0.01

Total PAH

Total PAH-16 PAHs	mg/l	0.18	ISO 17025	41.6	41.6
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Heavy Metals / Metalloids

Arsenic (dissolved)	mg/l	0.15	ISO 17025	3.67	3.00
Barium (dissolved)	mg/l	0.05	ISO 17025	120	120
Cadmium (dissolved)	mg/l	0.02	ISO 17025	< 0.02	< 0.02
Chromium (dissolved)	mg/l	0.2	ISO 17025	0.8	0.6
Copper (dissolved)	mg/l	0.5	ISO 17025	< 0.5	0.9
Lead (dissolved)	mg/l	0.2	ISO 17025	< 0.2	0.2
Mercury (dissolved)	mg/l	0.05	ISO 17025	< 0.05	< 0.05
Nickel (dissolved)	mg/l	0.5	ISO 17025	10	11
Selenium (dissolved)	mg/l	0.5	ISO 17025	3	2.5
Vanadium (dissolved)	mg/l	0.2	ISO 17025	2.1	2.6
Zinc (dissolved)	mg/l	0.5	ISO 17025	< 0.5	4.5

Chromium (hexavalent)	mg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (III)	mg/l	5	NONE	< 5.0	< 5.0

Analytical Report Number: 24-019145

Project / Site name: Grange Travel Coach Hire

Your Order No: GD24-05-001

Lab Sample Number	196380	196381
Sample Reference	BH01-W1	BH02-W2
Sample Number	None Supplied	None Supplied
Depth (m)	1.12	1.12
Date Sampled	10/05/2024	10/05/2024
Time Taken	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection
		Accreditation Status

Petroleum Hydrocarbons

TPH - Aliphatic >C5 - C8 (15, 12, 9)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >C6 - C8 (15, 10, 8)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >C8 - C10 (10, 10, 8)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aliphatic >C10 - C12 (10, 10, 8, 10)	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C12 - C16 (10, 10, 8, 10)	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C16 - C21 (10, 10, 8, 10)	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C21 - C35 (10, 10, 8, 10)	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C5 - C35 (10, 10, 10, 8, 10)	µg/l	10	NONE	< 10	< 10

TPH - Aromatic >EC5 - EC7 (10, 10, 10)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 (10, 10, 10)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 (10, 10, 10)	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 (10, 10, 10, 10)	µg/l	10	NONE	20	25
TPH - Aromatic >EC12 - EC16 (10, 10, 10, 10)	µg/l	10	NONE	160	220
TPH - Aromatic >EC16 - EC21 (10, 10, 10, 10)	µg/l	10	NONE	240	340
TPH - Aromatic >EC21 - EC35 (10, 10, 10, 10)	µg/l	10	NONE	66	88
TPH - Aromatic >EC5 - EC35 (10, 10, 10, 10, 10)	µg/l	10	NONE	480	670

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0

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

Analytical Report Number : 24-019145

Project / Site name: Grange Travel Coach Hire

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B-GW, 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	L0528	W	ISO 17025
Total organic carbon in water	Determination of total organic carbon in water by TOC/DIC/NDIR analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L0376	W	ISO 17025
Total petroleum hydrocarbons with carbon banding by GC-MS in water	Determination of total petroleum hydrocarbons in water by GC-MS/MS with carbon banding aliphatic and aromatic	In-house method	L0706	W	NONE
BTEX and/or 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 USEPA 8260	L0738	W	ISO 17025
Chromium (III) in water	In-house method by calculation from total Cr and Cr-VI	In-house method by calculation	L080	W	NONE
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method by continuous flow analyser. Accredited Matrices: SW, GW, PW	L080	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	ISO 17025
Total petroleum hydrocarbons by GC-MS HS in water	Determination of total petroleum hydrocarbons in water by GC-MS HS	In-house method	L086	W	ISO 17025
pH at 20°C in water (auto-titration)	Determination of pH in water by electronic measurement. Accredited matrices: SW PW GW	In-house method	L099	W	ISO 17025
Speciated BPA-16 PAHs and/or Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds (including PAHs) in leachate by extraction in dichloromethane followed by GC-MS	In-house method based on USEPA 8270	L0388	W	ISO 17025

Analytical Report Number : 24-019145

Project / Site name: Grange Travel Coach Hire

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate in water	Determination of sulphate in water after filtration by acidification followed by ICP-OES. Accredited Matrices: SW, GW, PW, PrW, LL	In-house method based on MEWAT 2006 Methods for the Determination of Metals in Soil	L0398	W	ISO 17025

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent[s])
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - underscores to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Sample Deviation Report



Analytical Report Number : 24-019145

Project / Site name: Grange Travel Coach Hire

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
BH01-W1	N/A	W	196380	c	pH at 20°C in water (automated)	L099	c
BH02-W2	N/A	W	196381	c	pH at 20°C in water (automated)	L099	c



APPENDIX 8 ▪ Field Monitoring Records (Gas and Groundwater)

