Design and Construction

Combined Ground Investigation Report (GIR)

Cottam Parkway: Access Road and Car Park

Geotechnical Report No. CLM07b-LCC-RP-600-0001

Lancashire County Council

www.lancashire.gov.uk

Document Control Sheet

Record of Issue

Version	Status	Author + Date	Check + Date	Authorised + Date
Version 1	Final	Jean Walmsley 10.12.2021	Richard Seddon 15.12.2021	John Standing 15.12.2021

Distribution

Organisation	Contact	Format	Copies

DISCLAIMER

This report is presented to LCC City Deal Team and Jacobs in respect of Cottam Parkway: Road and Car Park and may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this Report.

Notwithstanding anything to the contrary contained in the report, the LCC Geotechnical Team is obliged to exercise reasonable skill, care and diligence in the performance of the services required by LCC City Deal Team and Jacobs, and the LCC Geotechnical Team shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by the LCC Geotechnical Team. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

The LCC Geotechnical Team has used reasonable skill, care and diligence in the design and interpretation of the ground investigation, however, the inherent variability of ground conditions allows only definition of the actual conditions at the location and depths of exploratory holes and samples/tests therefrom, while at intermediate locations conditions can only be inferred.

New information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

DESIGN AND CONSTRUCTION

GEOTECHNICAL REPORT NO: CLM07b-LCC-RP-600-0001

Cottam Parkway Access road and carpark

Contents

APPENDIX LIST:

Appendix A	Site location Plan
Appendix B	Site Walkover Photographs
Appendix C	Borehole Location Plans and Logs
Appendix D	CCG Factual Report 2021
Appendix E	Geotechnical and Chemical Test Results
Appendix F	Geotechnical Ground Model
Appendix G	PWD Carriageway Cores
Appendix H	HazWaste Report

1. EXECUTIVE SUMMARY

The Cottam Parkway scheme is a proposed new link road between the Cottam Link Road (currently under construction) and the proposed Cottam Railway Station. The scheme will involve the construction of a two-way single carriageway approximately 450m long with a proposed new car park which will serve the railway station. In addition, an unnamed watercourse, which is a tributary of Savick Brook, is to be culverted under the car park

The ground investigation comprised window sample boreholes following the alignment of the road with further boreholes and trial pits to inform the details for the car park area and culvert.

The investigation found topsoil to depths of 0.20m and 0.30m. The underlying material predominantly comprised brown, firm to stiff, slightly sandy, slightly gravelly, silty clay of low to intermediate plasticity. Sand deposits, described as medium dense, brown silty, clayey sand, were encountered in two boreholes.

Geotechnical testing found the shear strength of the clay, measured by hand vane, to be between 60kPa and 110kPa, with DCP testing indicating CBR values of between 2% and 44%.

Samples of excavated material were tested for contamination and the concentrations were found to be below the long-term human health risk assessment criteria. In addition, analysis indicates that if any material should be taken off site it would be classed as non-hazardous waste.

2. INTRODUCTION

2.1 Scope and objective of the report

This Ground Investigation Report (GIR) has been produced in accordance with Design Manual for Roads and Bridges CD 622 'Managing geotechnical risk'. The report is based on recent intrusive site investigation works combined with information from historical site investigations which impinge on the scheme.

The report will outline both the geotechnical and contamination information derived from the ground investigation and an evaluation of that information. The report will outline the range of geotechnical parameters encountered within the superficial deposits, which will be further developed into design parameters within the Geotechnical Design Report. In addition, an assessment of the contamination testing will be undertaken so that the contamination risk associated with the proposed works can be addressed.

2.2 Description of the project

The project involves the proposed construction of a new two-way single carriageway road, approximately 450m in length, to connect the Cottam Link Road, which is currently under construction, with the proposed Cottam Railway Station. The road will connect to the Cottam Link Road at Sidgreaves Lane Roundabout and will run south to cross the Lancaster Canal via a proposed three span bridge with embankments leading up to the bridge. The road then continues, at grade, to a proposed new car park which will serve the railway station. A general overview of the project can be seen in Figure 1. |A site location plan can be found in Appendix A.

A separate GIR report has been produced for the embankments and bridge and therefore this report only covers the highway and car park earthworks.

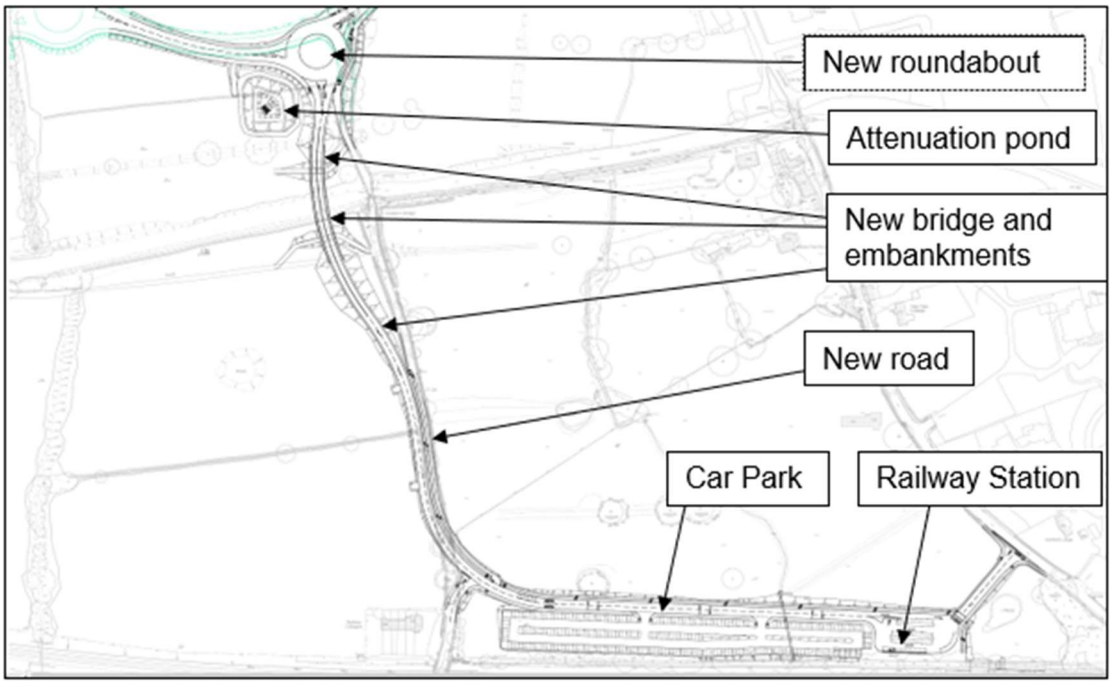


Figure 1: General overview of proposed project.

2.3 Geotechnical Category of the project

This section of the scheme only includes small and relatively simple structures, earthworks and geotechnical activities for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations. Although, as part of the larger Cottam Parkway scheme the project could be specified as a Category 2 project, in line with BS EN 1997-1:2004, 'Eurocode 7: Geotechnical design – Part 1: General rules'.

However, as this is not a Highways England scheme the category 2 only gives an indication of the expected complexity of the scheme.

2.4 Other relevant information

Not used.

3. EXISTING INFORMATION

3.1 Topographical maps (old and recent)

An overview of the historical maps indicates that the majority of the study area has been fields for arable and livestock farming since records began. Most of the surrounding roads were constructed prior to the first mapping in 1845. Sidgreaves Lane and Lea Lane are present on these early maps.

The Preston-Blackpool Railway and Lancaster Canal are both in evidence on the 1845 map.

Railway Cottages are first shown on the First Edition maps from circa 1894.

A Roman Road (Danes Pad) is labelled on several historical maps. It has an east-west orientation and crosses Sidgreaves Lane to the south of the canal at approximately E349083:N431547.

The unnamed watercourse in the eastern field in the area of the proposed car park is shown on the 1845 map. It appears that the culvert beneath the railway has been extended since this earliest map was issued.

The maps show the presence of old clay pits and ponds within fields to the south of the canal, some of which appear to have been infilled.

Current maps indicate the presence of four ponds within 150 metres of the scheme.

3.2 Geological maps and memoirs

Geological information obtained from geological maps of the area and the Geology of Britain viewer found on the British Geological Survey (BGS) website indicates the superficial deposits found to be overlying the scheme are Till, Devensian – Diamicton formed in the Quaternary Period.

The underlying bedrock geology for the area was shown to consist of Sherwood Sandstone Group – Sandstone, a sedimentary bedrock formed in the Triassic and Permian Periods.

3.3 Aerial photographs (old and recent)

Aerial photographs from four sorties (1940s, 1960s, 1980s and 2010s) were examined as part of this study. They confirm the historical development of the scheme as detailed on the published maps.

The aerial photographs confirm the presence of ponds and other water bodies that exist today. The historical photographs also indicate infilled ponds and other depressions that lie within the footprint of the scheme.

3.4 Records of mines and mineral deposits

A review of the geological maps, the Coal Authority Gazetteer of England and Wales and LCC's Mineral Safeguarding Areas indicates that the scheme does not require any special measures in regard to minerals are mine workings.

3.5 Land use and soil survey information

It is indicated in the National Soil Resources Institute Report (NSRI) for the Preston Western Distributor (NSRI, 2015) that the soil across the Cottam Parkway Scheme and surrounding area consists of the Salop 711m Soil Association.

Salop 711m soils are described as slowly permeable seasonably waterlogged reddish fine loamy and clayey soils of moderate fertility. In addition, it is noted in the NSRI report that agriculture on such soils will typically consist of dairying on grassland and some cereal cultivation.

Reference to LCC's MapZone (2021) indicates that the entire route and surrounding land has an Agricultural Land Classification (ALC) of Category 3, which describes good to moderate quality agricultural land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield.

3.6 Archaeological and historical investigation

A Roman Road (Danes Pad) crosses the scheme in an east-west orientation south of Lancaster Canal.

3.7 Existing ground investigations

Preston Western Distributor, 2014-2015.

As part of a large scale ground investigation carried out in 2014 for the Preston Western Distributor scheme, Ian Farmer Associates was contracted by LCC to drill four cable percussion boreholes (BH221 – BH224), to depths of between 20.30mbgl and 22.80mbgl, and one window sample borehole (WS227), to a depth of 5.45mbgl. The boreholes were located to the north of the scheme approximately 35m to 110m west of the proposed bridge alignment. With one window sample borehole (WS227) drilled to a depth of 5.45mbgl within the location of the proposed bridge alignment. Locations of the exploratory holes are shown in Figure 2.

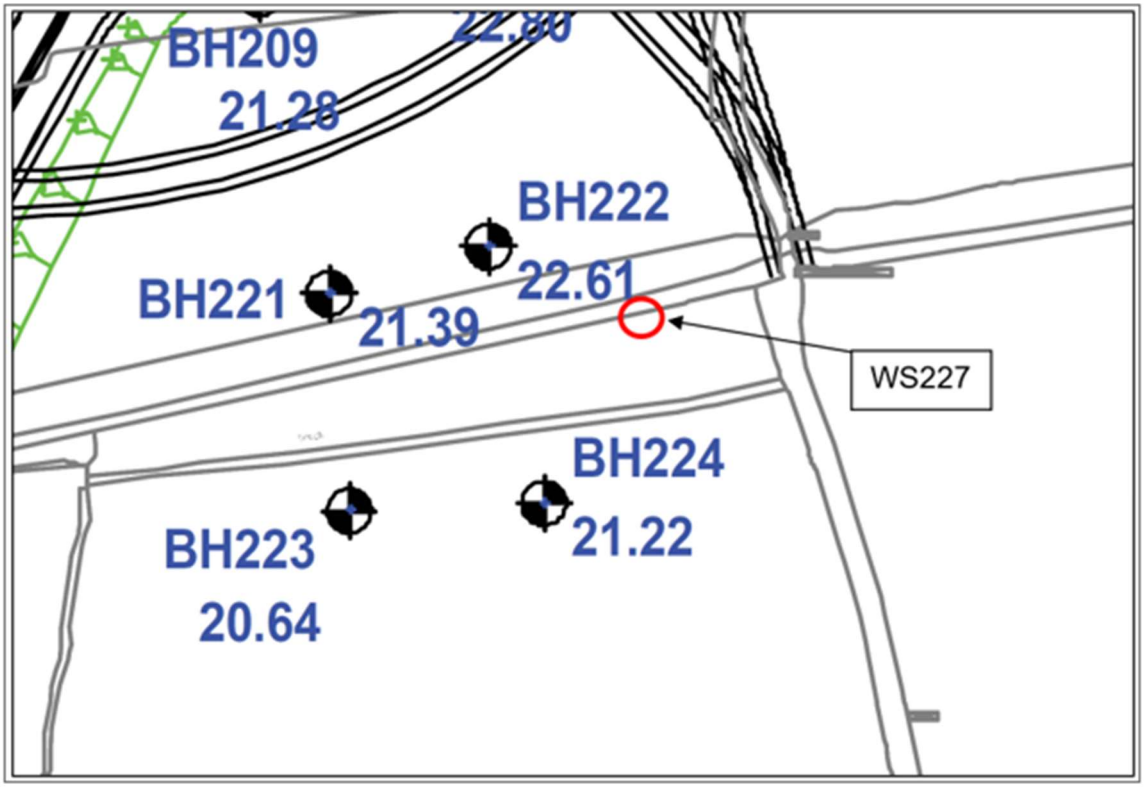


Figure 2: Location of 2014 ground investigation boreholes.

Standard penetration testing was undertaken during the GI and groundwater monitoring standpipes were subsequently installed.

Selected soil samples were taken from the boreholes for laboratory geotechnical and chemical testing. In situ geotechnical testing was also undertaken within each borehole.

The investigation found glacial till deposits comprising layers of firm to stiff clay and medium dense to very dense sands overlying sandstone bedrock at 19.20mbgl.

Further details can be found in the PSSR: Cottam Parkway and Access Bridge and Road.

3.8 Consultation with Statutory Bodies and Agencies

The following statutory bodies and agencies have been consulted as part of the scheme:

- British Geological Survey (BGS);
- Coal Authority Gazetteer;
- Department for Environment, Food and Rural Affairs (DEFRA);
- Environment Agency (EA);
- Lancashire County Council (LCC);
- Multi-Agency Geographic Information for the Countryside (MAGIC); and,
- National Soil Resource Institute.

3.9 Flood Records

Consultation of the Environment Agency website indicates that the land along the line of the new road is in Flood Zone 1. Flood Zone 1 relates to land which has a less than 0.1% (1 in 1,000) annual probability of flooding.

The EA maps indicate that areas along the line of the canal towpath and Sidgreaves Lane are susceptible to surface water flooding. In addition, localised areas of medium risk are shown in the field where the proposed car park is located. Other areas within the scheme that are shown as susceptible to surface water flooding, as would be expected, are associated with ditch lines, watercourses and low-lying areas. These include the unnamed watercourse which crosses the area of the proposed car park, which is shown as medium to high risk, and ponds and infilled clay pits.

The LCC's MapZone facility indicates that the area is not susceptible to groundwater flooding.

3.10 Contaminated land

An initial Conceptual Site Model (CSM) was developed from the available information which has been used to identify potential sources, receptors and pathways present at the site.

Potential Contamination Sources

Potential sources of contamination identified by the desk study process include:

- Old clay pits and ponds infilled with unknown material;
- Contaminants associated with road use at existing crossings; and
- Slurry spreading on agricultural land.

In addition, the presence of the link road may act as a contaminant source for hydrocarbon drainage water and spillages as a result of road traffic collisions.

The principal contaminants of concern associated with the potential contamination sources are presented in Table 1.

Area of site	Metals							Others				Hydrocarbons	
	As	Cd	Cr	Cu	Pb	Ni	Zn	Sulphide	Asbestos	pH	Herbicides /Pesticides	Oil/fuel hydrocarbons	PAHs
Farmland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Highway	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓

Table 1: The principal contaminants of concern. Based on Waste Landfill DEFRA & EA (2002) CLR 8 Priority Contaminants for the Assessment of Land.

Potential Receptors

Potential human receptors were identified as:

- Construction workers involved in the road scheme;
- Maintenance workers associated with the road; and,
- Future public users of the open space associated with the road verges.
- Vegetation and Wildlife.

Potential controlled water receptors were identified as:

- Sherwood Sandstone (Principal aquifer);
- Glacial deposits (Secondary aquifer);
- Unnamed watercourse to be culverted under the proposed car park which is a tributary of Savick Brook; and,
- Run-off to watercourses from attenuated highway drainage.

Potential property receptors were identified as:

- Off-site properties adjacent to the route; and,
- Road structures associated with the existing and proposed highway scheme.

Based on the site's historical use as predominantly agricultural land, it is not considered likely to be affected by widespread or significant contamination. Nevertheless, as there are no records for the type of farming carried out it should be assumed that pesticides and herbicides have been used on the land in the past.

Based on an assessment of the risk posed by ground gas to nearby property receptors it is considered unlikely that significant risks will be present along the scheme route due to the following:

- There is expected to be minimal made ground on site which could represent a potential source of ground gases.
- Although the majority of underlying natural bedrock geology is unlikely to represent a source of ground gases, there is a low possibility that areas with deeper topsoil deposits could contain low levels of biogenic methane and carbon dioxide.

Risks of aggressive ground conditions impacting existing and proposed concrete road infrastructure, including the proposed bridge, are considered to be very low due to the following:

- There is minimal made ground at the site, which could represent a potential source of aggressive chemicals.
- Reference to guidance on assessing aggressive ground risk to concrete (BRE 2005) indicates that the underlying natural geology is unlikely to contain pyrite or sulphate minerals which may lead to attack on buried concrete.

Potential Pollutant Pathways

The following pathways were considered relevant for human receptors:

- Direct dermal contact and/or ingestion; and,
- Ingestion and/or inhalation of dust.
- Inhalation of outdoor vapour

The following pathways were considered relevant for controlled water receptors:

- Unsaturated zone transport of pore-water to groundwater;
- Saturated zone transport of soluble contaminants in groundwater;
- Unsaturated zone transport of soluble contaminants to surface water (i.e. runoff and interflow);
- Preferential contaminant migration along drains, ducts, culverts, pipes and/or associated with bedding material; and,
- Unnamed watercourse (tributary of Savick Brook)

Potential Pollutant Linkages

The initial Conceptual Site Model (CSM) developed during the desk study identified several sources, pathways and receptors and, as such, Potential Pollutant Linkages (PPLs) are considered likely to exist at the site. Following uncertainty analysis of the source, pathway and receptor components, the following key uncertainties were considered to warrant further consideration by way of assessment activities:

- The extent, thickness and chemical quality of made ground present on the site;
- The location, extent, thickness and chemical quality of fill deposits associated with infilled ponds and clay pits on site; and,
- The presence and chemical quality of groundwater within the Secondary aquifer associated with the glacial deposits.

3.11 Other relevant information

As part of the PWD investigation, a series of cores was taken through the existing carriageway to establish the construction, depth and condition of the road pavement where the scheme ties into the current network. Cores C7 to C10 and X3 were located on Sidgreaves Lane, south of Quaker Lodge. The pavement construction was found to have been built up over many years with layers of surface course within the lower bituminous construction. The cores were found to be between 40mm and 135mm thick. In order to determine the presence of any tarbound material, Core X3 was sent for chemical analysis and compared with criteria from the ADEPT Guidance Note 'Managing Reclaimed Asphalt – Highways and Pavements' which showed that the material testing was non-hazardous and can be treated as inert waste. However, as only one core was tested at this location there is the possibility of tarbound material being discovered when the carriageway works are undertaken.

4. FIELD AND LABORATORY STUDIES

4.1 Walkover survey

Several site walkovers have been undertaken along the proposed route. It was noted that during wet weather the fields were waterlogged and several large ponds were identified.

Two trees were identified along the scheme along with hedgerows along the sides of Sidgreaves Lane. In addition, the treeline alongside the railway may affect the scheme.

A large plastic pipe which protrudes from the railway embankment at the south of the eastern field was observed.

The walkover did not identify any visible or olfactory evidence of contamination.

Photographs taken during the walkover can be found in Appendix B.

4.2 Geological mapping

No geological mapping was undertaken as part of the ground investigation.

4.3 Ground Investigation

The intrusive investigation and laboratory testing were undertaken in accordance with Eurocode 7, BS5930 and BS1377.

The aim of the ground investigation was to determine the ground conditions in the scheme area to enable the production of geotechnical design recommendations.

The intrusive investigation was designed to supplement the existing ground investigation information that is available in the vicinity of the scheme and thus enable a ground model for the scheme to be produced.

Geotechnical and chemical testing was undertaken on samples taken from the boreholes.

It may be advantageous to undertake additional investigations once more detailed design information becomes available or should any changes be made to the proposed route.

4.3.1 Description of fieldwork

The intrusive investigation was undertaken by CC Geotechnical Ltd in March 2021. The investigation comprised fifteen window sample boreholes (WS04 to WS18) and six machine dug trial pits (TP01 to TP06) along the line of the proposed scheme:

- Three window sample boreholes (WS04 – WS06) were situated along the proposed route of the road and were drilled to a depth of 4.00mbgl,
- Seven window sample boreholes (WS07 to WS10 and WS15 to WS18) were drilled to 3.00mbgl in the location of the proposed car park.
- Three window sample boreholes around the culverted watercourse (WS11 to WS14) were taken to 6.00mbgl with the exception of WS13 which was terminated at 2.90mbgl on refusal due to a suspected boulder.
- The six trial pits within the proposed car park area were taken to 2.00mbgl.

The borehole location plans and borehole logs are included in Appendix C.

4.3.2 Ground Investigation Report

A copy of the factual report can be found in Appendix D.

4.3.3 Results of in situ tests

The in-situ testing consisted of Standard Penetration Tests (SPT), Dynamic Cone Penetration testing (DCP) and Hand Vane Tests (HVT), the results of which are described further in Section 6.

4.4 Drainage studies

Three Falling Head permeability tests (FH8/9 between WS08 & WS09, FH13/12 between WS13 & WS12 and FH17/18 between WS17 & WS18) were undertaken at locations between the window sample boreholes at the proposed car park site.

4.5 Geophysical surveys

Not used.

4.6 Pile tests

Not used.

4.7 Other field work

Not used.

4.8 Laboratory investigation

Geotechnical laboratory testing was undertaken on soil samples that were recovered during the investigation. Plasticity testing of clay samples and the determination of particle size distribution of granular deposits were undertaken in order to classify the material likely to be encountered during the construction phase, to establish acceptability for re-use.

Chemical analysis was undertaken to determine any need for precautions with regard to disposal of waste material and to inform the acceptability (if required) for re-use within the scheme.

4.8.1 Description of tests

All soil samples were prepared in accordance with BS1377: Part One: 2016 and representative sub-samples were taken for testing. The following tests have been carried out across the road and car park scheme:

- Moisture content;
- Atterberg Limits;
- Particle size distribution (PSD) tests with sedimentation;
- pH and total sulphate: and,
- Chemical soil testing.

pH and Total Sulphate

Testing for pH values and total sulphate content (SO_4) was undertaken on thirteen samples with a further eight samples tested for water soluble sulphate content.

Contamination/Chemical testing

No evidence of contaminated material had been identified during the intrusive investigation or had been entered on the preliminary logs. However, it was decided that chemical testing should be undertaken on selected soil samples with the intention of establishing whether any excavated material would be acceptable for re-use within the scheme as fill to landscaping areas or re-use in open spaces.

Thirteen samples, representative of all surface strata encountered were submitted for laboratory analysis for asbestos, metals, semi-metals and inorganics, and also Polycyclic Aromatic Hydrocarbon (PAH) and Total Petroleum Hydrocarbon (TPH) analysis.

4.8.2 Copies of test results

A full copy of the geotechnical and chemical test results can be found in Appendix E.

5. GROUND SUMMARY

Details and locations of earthworks requirements will be included in the detailed recommendations within the GDR.

The ground conditions discovered in the intrusive investigation comprised predominantly grassed soft grey, slightly sandy, slightly gravelly, silty organic clay topsoil to a depth of between 0.25mbgl and 0.30mbgl overlying brown, firm to stiff, slightly sandy, slightly gravelly, silty clay to the base of the holes between 2.90mbgl and 6.00mbgl.

Stiff clay was encountered within the trial pits at depths of between 0.25mbgl and 2.00mbgl. It was described as stiff (very stiff in TP04) brown mottled grey, slightly sandy, slightly gravelly, silty clay. In TP05 the clay was described as friable and with a low cobble content.

Sand was observed in three boreholes (WS05, WS06 and WS11) and was described as medium dense, brown silty, clayey (gravelly) sand. The sand layers were encountered between 1.00mbgl to 1.40mbgl and 2.90mbgl to 3.10mbgl in WS05, between 0.95mbgl to 1.20mbgl in WS06 and between 0.75mbgl and 1.10mbgl in WS11. A sand lens was also described within the clay in TP02 at a depth of between 1.20mbgl and 1.30mbgl.

The strata recorded within the window sample boreholes and trial pits is summarised in Table 2.

Horizon	Strata Description	Depth to top (mbgl)	Depth to base (mbgl)
Topsoil	Grassed soft grey, slightly sandy, slightly gravelly, silty organic clay	0.00	0.20-0.30
Firm to stiff clay	Brown slightly sandy, slightly gravelly, silty clay	0.20 - 0.30	2.90-6.00
Stiff (very stiff) clay	Brown mottled grey, slightly sandy, slightly gravelly, silty clay	0.25 - 0.30	2.00
Sand	Medium dense, brown silty, clayey sand	0.75 2.90	1.10-1.40 3.10

Table 2: Summary of Ground Conditions.

A copy of the geotechnical ground model can be found in Appendix F.

5.1 Groundwater

Groundwater was encountered in four boreholes (WS05, WS06, WS12 and WS14) In WS05 and WS06 the groundwater was encountered at 1.00mbgl and 0.95mbgl, respectively, at the top of the sand layer. In WS12 and WS14 the entries were recorded at depths of 4.10mbgl and 3.50mbgl, respectively, within the clay and were described as a slight seepage.

Standpipes were installed in four boreholes (WS05, WS09, WS14 and WS18). Monitoring of the standpipes began in April 2021 and monitoring over a period of six months has indicated that the water levels in the standpipes varied by up to 2.30m. Groundwater monitoring will continue for a further six months to acquire data from the autumn and winter months. Table 3 shows a summary of the groundwater monitoring results.

Borehole	Borehole (mAOD)	Response Zone (mbgl)	Response Zone (mbgl)	Strata	Minimum depth (mbgl)	Maximum depth (mbgl)	Difference (m)
					Level (mAOD)	Level (mAOD)	
WS05	21.60	1.00 - 4.00	20.60 - 17.60	Clay and sand	0.27	1.74	1.47
					21.33	19.86	
WS09	20.73	0.50 - 3.00	20.23 - 17.73	Clay	0.33	1.65	1.32
					20.40	19.08	
WS14	16.89	1.00 - 6.00	15.89 - 10.89	Clay	0.46	1.47	1.01
					16.43	15.42	
WS18	19.47	0.50 - 3.00	18.97 - 16.47	Clay	0.58	2.88	2.30
					18.90	16.60	

Table 3: Groundwater Monitoring Results.

6. GROUND CONDITIONS AND MATERIALS PROPERTIES

As outlined in the ground conditions for this section of the scheme the natural horizon comprises of mainly cohesive deposits.

The ground conditions and material properties are based upon in situ and laboratory test results from the ground investigation undertaken in March 2021.

6.1 Topsoil

Topsoil depths were found to be between 0.25mbgl and 0.30mbgl. The topsoil was generally described as grass over a soft grey slightly sandy, slightly gravelly silty organic clay with frequent rootlets. Borehole WS10 was described as containing brick inclusions which may indicate made ground.

6.2 Made ground, including details of any contamination / contaminated areas

Made ground was not encountered in boreholes or trial pits along the route, apart from WS10, which was described as containing brick inclusions in the topsoil.

During the intrusive investigation no evidence of the presence of hazardous substances was noted, however, to mitigate potential risks to construction workers from contamination on site, due consideration should be given to the current best practice and guidance with regards to the use of Personal Protective Equipment (PPE).

It is likely that localised areas of made ground will be present directly alongside and beneath the existing roads that the route crosses.

6.3 Upper Cohesive Glacial Till

Results from the testing classify the majority of the cohesive glacial till as a firm to stiff low plasticity clay with some areas of intermediate plasticity clay. An area of very stiff clay was found to be present in TP4. A summary of the in situ and laboratory testing for the Upper Cohesive Glacial Till is shown in Table 4.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	40	14	32	18
Liquid Limit (%)	25	29	49	35
Plasticity Index (%)	25	14	28	18
SPT (Uncorrected N Value)	49	11	26	16

Table 4: Summary of in situ and laboratory results for Upper Cohesive Glacial Till.

6.3.1 Atterberg limits and Moisture Content

Atterburg testing was performed on samples of the natural cohesive horizon and showed the clay to be mainly low plasticity (CL) with moisture contents ranging between 14% and 19%.

Intermediate plasticity (CI) clays were encountered in WS11, WS12, WS14, TP2 and TP3, with two samples from TP1 and TP5 found to be borderline low/intermediate plasticity (CL/CI). In WS11, WS12, and WS14 the areas of intermediate plasticity correlate with the depths where higher moisture contents were recorded 24% to 32%. In WS14 where the highest moisture content of 32% was recorded, there is a correlation with a water seepage at 3.50mbgl. Moisture content values are shown in Figure 3.

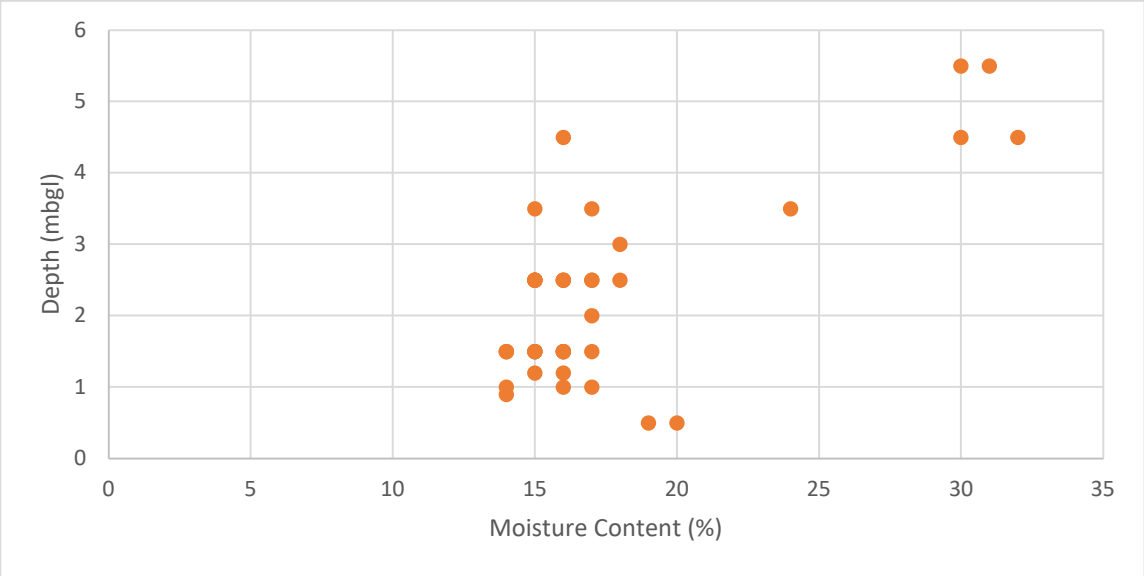


Figure 3: Moisture Content values with depth.

There is also a correlation between moisture content, plasticity index and low N-values (see section 6.6.4).

6.3.2 Bulk Unit Weight

Bulk unit weight testing was not undertaken on samples from the boreholes. BS8002 (2015) gives suggested values for characteristic weight density and so for the firm to stiff clay values of between18kN/m^3 and 22kN/m^3 have been assumed.

6.3.3 Undrained shear strength

The U100 sample recovered during the site investigation were deemed unsuitable for undrained triaxial testing. Therefore, the correlation of c_u and SPT has been used to show the variation in strength with depth, after Stroud (1975), where $c_u=f_1xN$. The constant f_1 is a function of PI. Using the mean Plasticity Index value of 18% an f_1 factor of 5.75 is indicated by Stroud (1975).

SPTs were taken within the cohesive material at a range of depths. The N values ranged from 11 to 26 with an average of 16. Two N values from WS13 of 37 and 50 at 2.00mbgl and 2.90mbgl, respectively, were discounted as these were found to be over a boulder.

Therefore, using Stroud the correlation of c_u and SPT, after Stroud (1975) an average undrained shear strength of 92kN/m^2 is correlated.

However, the logs and the graph in Figure 4 show a variation of N values with depth. The graph and logs appear to indicate that the N values increase slightly to 2.00mbgl, with the majority of the logs indicating a decrease in N values to 3.00 - 5.00mbgl.

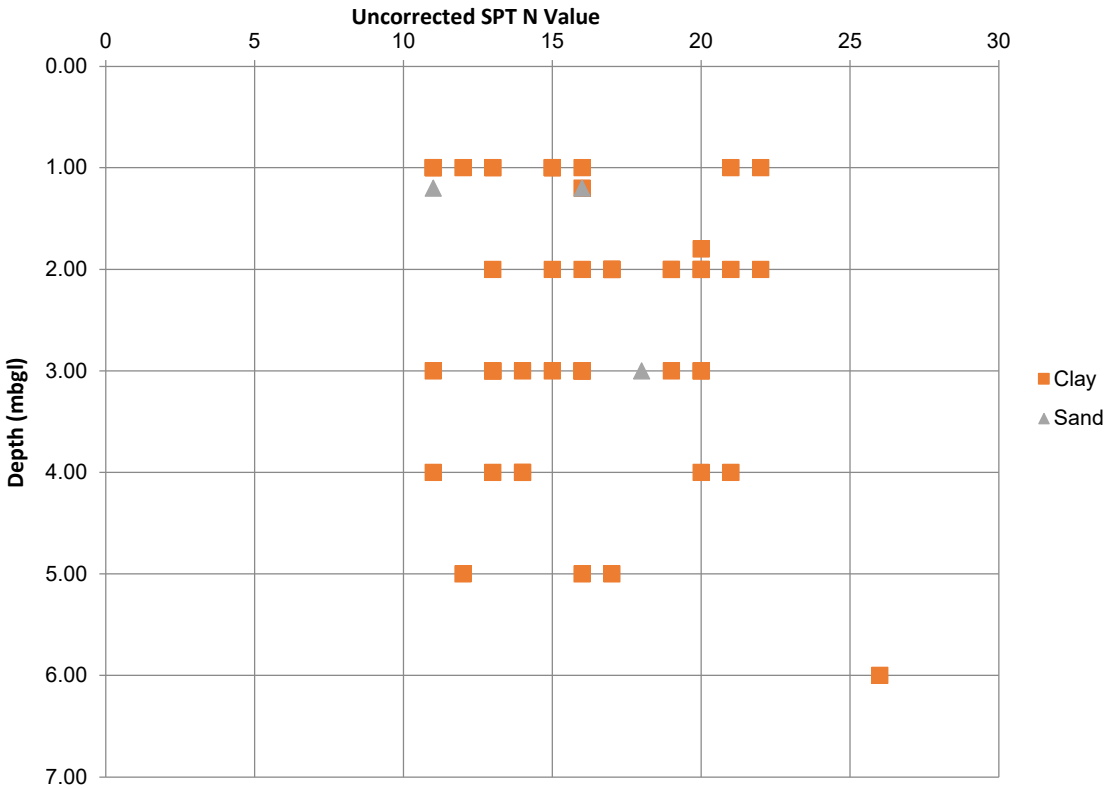


Figure 4: SPT N values with depth.

Using the mean Plasticity Index value of 15% generating an f_1 factor of 7 for the cohesive glacial till above 3.00mbgl, with an average SPT value of 17 blows, this correlates to an undrained shear strength of 119kN/m^2. Below 3.00mbgl the mean Plasticity Index increases to 25% generating an f_1 factor of 4.75 for the cohesive glacial till below 3.00mbgl, which correlates to an undrained shear strength of 62kN/m^2.

Hand Vane testing was undertaken on soil at various depths within the boreholes and trial pits. The testing recorded readings of between 60kPa and >110kPa, generally increasing with depth.

6.3.4 CBR Values

Dynamic Cone Penetrometer (DCP) testing was carried out in Trial Pits TP1 to TP6 and produced equivalent California Bearing Ratio (CBR) results ranging from 2% to 44%, indicating increased strength with depth down to 1.40mbgl. The results are shown in Figure 5.

The average of these tests was 13% with a lower quartile value of 6%. Theoretical equivalent CBR values were also calculated from shear strength (c_u) values derived from the relationship between SPT N-values and Plasticity Index (after Stroud) and assuming 1% CBR = 30kN/m^2. These were found to be between 2% and 4.6%, with all but two of these results being above 3%. Two outliers of 1.7% and 1.9% were found at depths greater than 4.00mbgl.

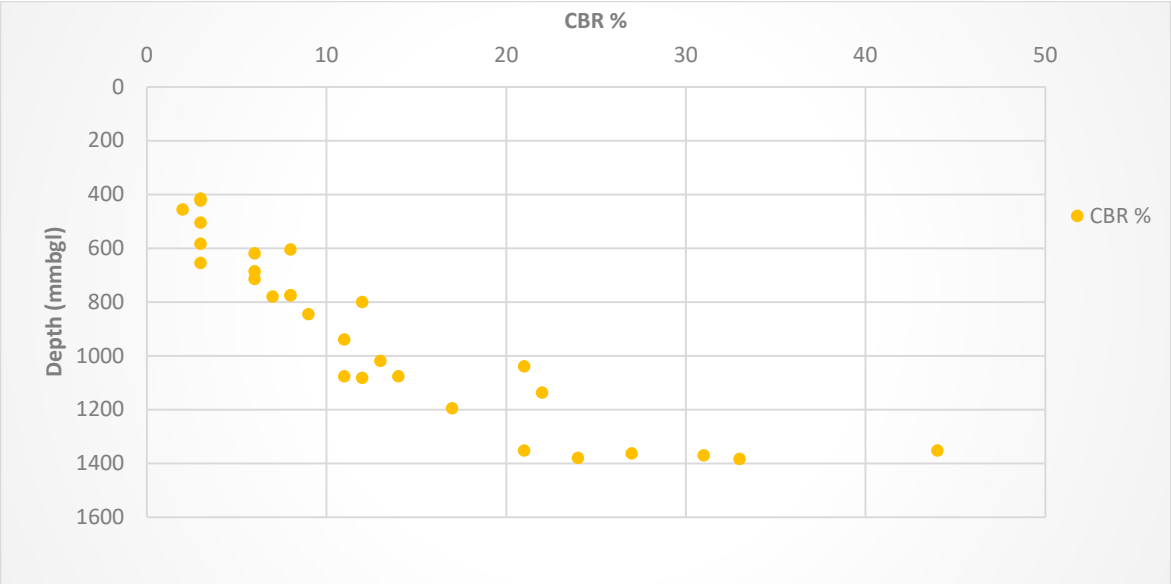


Figure 5: CBR values with depth.

6.3.5 Compressibility

Samples were not available for oedometer testing; therefore, compressibility of the soil has been calculated using the relationship between m_v, PI and SPT values where $m_v=1/f_2N$ and f_2 is a function of Plasticity Index (after Stroud). Using an average Plasticity Index of 18% and an average SPT value of 16, leads to a m_v value of 0.1m^2/MN.

6.3.6 Permeability

The two Falling Head permeability tests were undertaken with the upper cohesive glacial till strata:

- FH8/9 between WS08 & WS09 – within cohesive strata
- FH17/18 between WS17 & WS18) -– within cohesive strata

The tests indicate a coefficient of permeability (k), of 6.23×10^{-8}m/s, and 4.83×10^{-8}m/s respectively.

Observations of groundwater strikes and groundwater monitoring indicate the cohesive layer shows generally a very slow response, this coupled with the results from the falling head tests indicates very low permeability typical of silt and interlaminated silt/sand/clay (CIRIA C750).

6.4 Granular Glacial Till

Borehole log information indicates that medium dense sand layers, ranging between 0.20m and 0.45m in thickness, were discovered, at a depth of between 1.00mbgl and 1.40mbgl, and 2.90mbgl and 3.10mbgl, in WS05, between 0.95mbgl and 1.20mbgl in WS06 and between 0.75mbgl and 1.10mbgl in WS11. A small sand lens was also discovered in TP02 between 1.20mbgl and 1.30mbgl. Table 5 shows a summary of the in situ and laboratory results for the granular Glacial Till.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	1	15	15	15
SPT (Uncorrected N Value)	4	11	18	14

Table 5: Summary of in situ and laboratory results for granular Glacial Till.

6.4.1 Particle Size Distribution

One Determination of Particle Size Distribution test was carried out on a sample of granular material from WS05 at 1.20mbgl. The results found the percentage of dry mass proportions to be Gravel 2%, Sand 64%, Silt 22%, Clay 12%, with a description of brown very silty, clayey, slightly gravelly sand.

6.4.2 Natural Moisture Content

One moisture content analysis was undertaken on the sample recovered from WS05 at 1.20mbgl. This indicated a natural water content of 15%.

6.4.3 Bulk Unit Weight

Bulk unit weight values were not obtained in the ground investigation from the sand bands. In absence of reliable test results, BS8002 (2015) suggests values for a medium dense sand, below the water table, ranging between 18kN/m^3 and 20.5kN/m^3.

6.4.4 Relative density

Standard penetration tests indicate a medium dense granular Glacial Till. The uncorrected SPT N values range between 11 and 18 for the silty, clayey sand. The horizon can generally be classified as a medium dense silty, clayey sand.

6.4.5 Permeability

One Falling Head permeability test was undertaken with the granular glacial till strata:

- FH13/12 between WS13 & WS12

The tests indicated a coefficient of permeability (k) of 1.41x10^{-7}m/s.

Observations of groundwater strikes, and groundwater monitoring indicate the granular layer shows generally a slow response, this coupled with the results from the falling head test indicates very low permeability typical of silt and interlaminated silt/sand/clay (CIRIA C750).

6.5 Ground Model

Table 6 summarises the characteristic geotechnical parameters for the proposed road and car park.

Stratum*	Depth (mbgl)	c_u (kPa)[1]	CBR (%)[2]	φ' (deg)[3]	γ (kN/m^3)[4]	m_v (m^2/MN)[5]
Topsoil	0.20 – 0.30	-	-	-	-	-
Upper Cohesive Glacial Till	0.20 – 6.00	60 – 139	2 – 44	24 – 27	18 – 22	0.108
Granular Glacial Till	0.75 – 3.10	-	-	31	18 – 20.5	-

[1] From in situ hand vane tests and laboratory testing (after Stroud – Tomlinson)
[2] From DCP tests and shear strength correlation
[3] BS8002 (2015) and Tomlinson (2001)
[4] BS8002 (2015)
[5] Laboratory testing (after Stroud – Tomlinson)

Table 6: Characteristic geotechnical parameters from testing and empirical data.

6.6 Groundwater

Groundwater regimes have been established within the superficial and solid deposits in the location of the proposed link road and carpark, by observation of groundwater strikes during drilling and monitoring of four boreholes from the 2021 ground investigation in the period April 2021 to September 2021. The groundwater monitoring information shows that groundwater levels varied by up to 2.88m with the highest water levels, of between 0.27mbgl and 0.58mbgl, found in May. The results indicate that the groundwater is likely localised perched water within the Glacial Till deposits.

It is expected that groundwater levels will fluctuate with seasonal variations and be in hydraulic connectivity with nearby watercourses and monitoring will continue to cover the autumn and winter seasons.

6.7 Concrete

The results from the 13 pH values and total sulphate content (SO_4) tests, and the 8 water soluble sulphate content tests, found that the pH ranged from 5.8 to 8.3, the total sulphate content ranged from <0.02% to 0.05% and the water soluble sulphate content ranged from <0.02g/l to 0.04g/l.

A concrete assessment was carried out for the proposed culvert structure in accordance with BRE Special Digest 1:2005 'Concrete in aggressive ground', Table C1. Based on the assessment, a Design Sulphate Class of DS-1 is required along with an ACEC class of AC-1.

6.8 Carriageway Cores

Information on the materials encountered from the cores taken during the PWD investigation can be found on the core reports in Appendix G.

6.9 Contamination

The results of the analysis of the samples submitted for laboratory analysis for asbestos, metals, semi-metals and inorganics, and also Polycyclic Aromatic Hydrocarbon (PAH) and Total Petroleum Hydrocarbon (TPH) analysis were compared with long-term human health risk assessment criteria derived Category 4 Screening Levels (C4SL) and Suitable for Use Levels (S4UL) for the scenario of a Public Open Space – Public Park.

No asbestos was found within the samples and none of the soil chemical testing results exceeded the screening criteria.

Based on the relatively low soil concentrations recorded and the absence of any identified potential historical sources of contamination, it is considered that the risk to controlled waters posed by the site is low and no remedial measures are considered necessary.

In addition, all the chemical analysis results were compared with waste regulations using HazWasteOnline software and all the samples were found to be non-hazardous. Therefore, it is anticipated that should any material need to be taken off-site it would be classed as non-hazardous.

A copy of the HazWaste Report can be found in Appendix H.

7. GEOTECHNICAL RISK

A risk register has been developed to show potential geotechnical risks associated with the scheme and mitigation measures which are to be put in place to deal with the identified risks.

The risks have been evaluated with reference to the risk evaluation matrix suggested in CD 622 Managing Geotechnical Risk.

Likelihood		Severity				
		1	2	3	4	5
		Minor	Moderate	Serious	Major	Catastrophic
1	Extremely unlikely	1	2	3	4	5
2	Unlikely	2	4	6	8	10
3	Likely	3	6	9	12	15
4	Extremely likely	4	8	12	16	20
5	Almost certain	5	10	15	20	25

Table 7: Geotechnical Risk Register Methodology – Likelihood v Severity.

Potential severity of harm occurring		
1	Minor	Minor damage or loss – (no human injury)
2	Moderate	Moderate damage or loss – (Slight injury or illness)
3	Serious	Substantial damage or loss – (Serious injury or illness)
4	Major	Major damage or loss – (Fatal injury)
5	Catastrophic	Catastrophic loss or damage – (Multiple fatalities)

Table 8: Geotechnical Risk Register Methodology – Potential Severity of Harm Occurring.

Risk Classification	
Low (1-8)	Ensure assumed control measures are maintained and reviewed as necessary
Medium (9-19)	Additional control measures to reduce risk rating to a level that is equivalent to a test of "reasonably required" for
High (20-25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable level.

Table 9: Geotechnical Risk Register Methodology – Risk Classification.

Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Ground variability and made ground/unforeseen ground conditions	• Unacceptable ground movement/settlement. • Safety of workers/disposal costs.	3	4	12	• Ground conditions and geotechnical characteristics have been determined based on the desk studies, ground investigations, factual reports. • Areas of potential contamination have been identified during the desk study and SI. • Supply contractors with all SI information. • Contractors to report unforeseen ground conditions and suspected contamination areas.	2	4	8
Unidentified in-filled ponds or depressions, presenting areas of weak and compressible ground filled with unidentified material	• Potential for areas of weak ground, which may give rise to high and differential settlement over and above that anticipated. • Potential for bearing failures if not treated.	3	2	6	• Should any infilled ponds or peat areas be encountered beneath proposed earthworks then some form of treatment may be required prior to construction i.e. geotextiles/ excavate and replace.	2	2	4
Groundwater during construction.	• Dewatering required during construction causing delays in the programme. • Requirement for drainage measures.	2	3	6	• An in-depth review of piezometer readings has been undertaken in GIR to locate areas of risk of rising groundwater during construction. Fortunately, none of the areas surveyed were found to be at risk. • Contractor to determine acceptable method for dealing with groundwater.	1	3	3

Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Aggressive Ground Soil Chemistry	• Deterioration of Buried Concrete	2	4	8	• Geo-environmental testing has been assessed to determine suitable concrete classification. • Contractor to review chemical testing information	1	4	4
Severing underground services	• Injury/Death of Operatives and Delay to Contract	3	5	15	• Ensure all services are located prior to excavating	1	5	5
Variability of construction material	• Failure of construction elements • Excessive Settlement • Long-term Maintenance Issues	2	4	8	• Contractor to ensure compliance with specification	1	4	4

Table 10: Geotechnical Risk Register.

8. REFERENCES

1. BS 5930:1999, Code of practice for site investigation, 1999, BSI.

2. BS 1377:1990, Methods of test for Soils for Civil engineering purposes, 1990, BSI.

3. BS 8002:2015, Code of practice for earth retaining structures, 2015, BSI.

4. BS EN ISO 14688-1:2002, Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description, 2007, BSI.

5. BS EN ISO 14688-2:2004, Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Principles for a Classification, 2007, BSI.

6. Design Manual for Roads and Bridges – CD 622 Revision 1 (March 2020) – Managing geotechnical risk.

7. Design Manual for Roads and Bridges – CS 641 Revision 0 (March 2020) – Managing the maintenance of highway geotechnical assets.

8. BRE Special Digest 1, Concrete in Aggressive Ground, 3rd Edition, BRE, 2005.

9. Contaminated Land: Applications in Real Environments (CL:AIRE), SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Final Project Report (Revision 2), 2014.

10. LQM and CIEH, The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015.

11. Barnes GE: Soil Mechanics: Principles and Practice (2011).

12. Tomlinson MJ: Foundation Design and Construction 7th ed. (2001).

13. CC Geotechnical Ltd, Cottam Parkway Station, Preston – Factual Report, CCG-C-21-12093, May 2021.

14. Lancashire County Council: Preliminary Sources Study Report (PSSR) No. CLM07, 2021.

15. CIRIA C750 – Groundwater control: design and practice, second edition (2016).

Cottam Parkway Site Location

Lancashire County Council

Author:

Date Created: 16/12/2021

N

0 0.175 0.35 0.7 1.05 1.4 mi

0 0.4 0.8 1.6 2.4 km

Map Scale: 1:15,000

Map Centre: 348,567 431,407

View from the road of the proposed carpark location.

E349121:N431338

Newly installed drain in Sidgreaves Lane

E349118:N431381

First access gate for window samples in eastern fields.

E349116:N431397

Second access gate for window samples in eastern fields.

E349116:N431397

View from the road of the proposed carpark location.

E349121:N431338

View from the road of the proposed carpark location.

E349121:N431338

View from the road of the proposed carpark location.

E349121:N431338

Access gate for window samples in western fields.

E349105:N431413

Secondary gate access to south eastern fields.

E349457:N431415

Pond D.

E349500:N431298

Boggy Ground in south eastern field

E349399:N431300

Trees in south eastern field.

E349259:N431300

Stream in south eastern field.

E349344:N431300

Abandoned fencing and unidentified pipe next to railway embankment.

E349344:N431300

Culvert where stream runs underneath railway. One large crack is noted from the crest of the arch to the top of the bridgework.

E349347:N431303

Shallow ditch orientated east-west.

Approximately E349267:N431318

Distant image of stream.

E349338:N431329

Shallow ditch initially orientated east-west however diverges south towards the railway.

Approximately E349360:N431340

Boggy ground.

E349392:N431315

Shallow ditch orientated north-south towards railway.

Approximately E349275:N431328

Image of stream at the location where it travels underground.

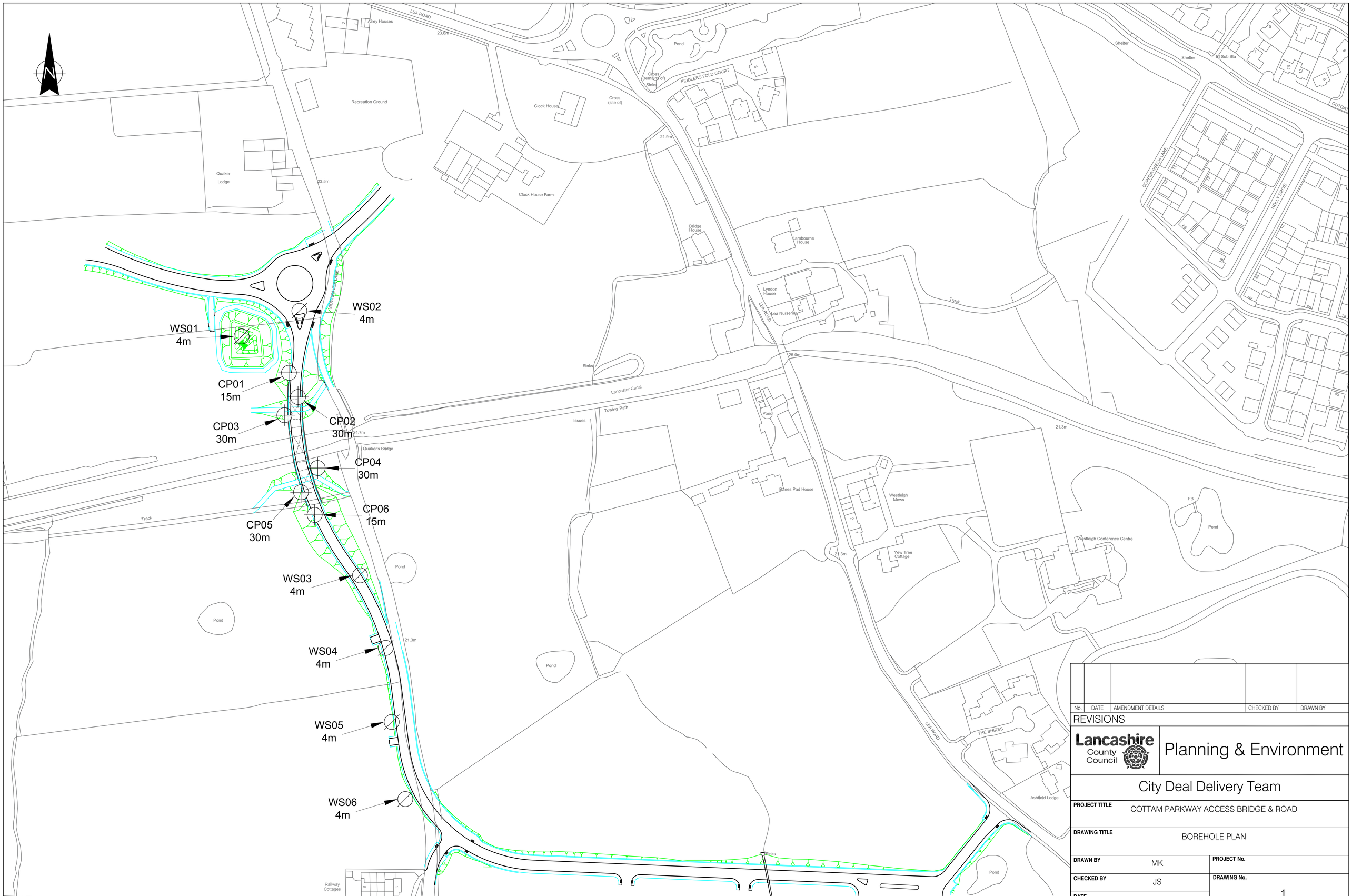
E349339:N431352

Localised depressions close to the location of an unidentified tree.

E349197:N431353

Medium depth dich orientated northeast-southwest between stream and Lea Road.

E349398:N431385



Based upon the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationary Office Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings.

Lancashire County Council. Licence No LA100023320.

No.	DATE	AMENDMENT DETAILS	CHECKED BY	DRAWN BY

REVISIONS

Lancashire County Council

Planning & Environment

City Deal Delivery Team

PROJECT TITLE	COTTAM PARKWAY ACCESS BRIDGE & ROAD		
DRAWING TITLE	BOREHOLE PLAN		
DRAWN BY	MK	PROJECT No.	
CHECKED BY	JS	DRAWING No.	1
DATE	JANUARY 2021		
SCALE @ A1	NTS	SHEET No. 1	REVISION: 0
CLIENT No.			

Car Park Borehole Plan

Lancashire County Council

Author:

Date Created: 01/03/2021

N

0 0.03 0.06 0.12 0.18 0.24 mi

0 0.05 0.1 0.2 0.3 km

Map Scale: 1:2,500

Map Centre: 349,295 431,400

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS04**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	26/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349088.0	431488.4	21.91mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.20	ES		21.71	0.20		Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded mudstone and sandstone.		
		HVP=70						
0.70	ES							
		HVP=65						
1.00 - 2.00	UT							
1.20	ES	SPT(S)N=16 (2,3/4,4,4,4)						
		HVP=110						
2.00 - 3.00	UT	SPT(S)N=17 (2,3/4,4,4,5)		(3.80)				
2.50	D	HVP=110						
3.00 - 4.00	UT	SPT(S)N=20 (4,3/4,4,5,7)						
		HVP=110						
		SPT(S)N=20 (2,3/4,5,5,6) HVP=110	17.91	4.00		End of Borehole at 4.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		BH DRY

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS05**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	26/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349092.1	431438.7	21.60mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.20	ES		21.35	0.25				
						Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium rounded mudstone and sandstone		
		HVP=90						
0.60	ES			(0.75)				
1.00 - 2.00	UT		20.60	1.00		Medium dense brown very silty clayey slightly gravelly SAND with frequent pockets of clay. Gravel is fine to medium subrounded sandstone.		
1.10	ES							
1.20	B	SPT(S)N=11 (1,2/2,3,3,3)		(0.40)				
			20.20	1.40		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded mudstone and sandstone		
		HVP=110						
2.00	D	SPT(S)N=20 (2,3/4,5,6,5)						
2.00 - 3.00	UT			(1.50)				
		HVP=80						
			18.70	2.90		Brown silty clayey SAND.		
3.00 - 4.00	UT	SPT(S)N=18 (2,3/2,5,5,6)						
			18.50	3.10		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium rounded mudstone and sandstone		
		HVP=110		(0.90)				
		SPT(S)N=21 (2,2/3,5,6,7)	17.60	4.00		End of Borehole at 4.00m		

Depth scale: 1, 2, 3, 4, 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	
1.00	4.00	SLOTTED	

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.00			0		

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS06**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	26/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349101.0	431388.0	20.97mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.15	ES		20.72	0.25				
0.40	ES	HVP=110		(0.70)		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
1.00	ES		20.02	0.95		Medium dense brown silty clayey SAND		
1.00 - 2.00	UT	SPT(S)N=16 (2,3/3,4,5,4)	19.77	1.20		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subrounded sandstone.		
1.50	D	HVP=110						
2.00 - 3.00	UT	SPT(S)N=19 (2,2/4,5,4,6)						
		HVP=110		(2.80)				
3.00 - 4.00	UT	SPT(S)N=16 (2,3/3,4,5,4)						
3.50	D	HVP=110						
		SPT(S)N=14 (2,1/3,2,4,5)	16.97	4.00		End of Borehole at 4.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
0.95			0		

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS07**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349139.4	431362.6	20.70mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.20	ES		20.50	0.20		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subrounded to well rounded sandstone.		
		HVP=100						
0.60	ES							
1.00 - 2.00	UT	SPT(S)N=15 (2,3/3,4,4,4) HVP=110				1		
1.10	ES							
1.50	D			(2.80)				
2.00 - 3.00	UT	SPT(S)N=21 (3,3/4,4,6,7) HVP=110				2		
2.50	D							
		SPT(S)N=16 (3,3/3,4,4,5) HVP=110	17.70	3.00		End of Borehole at 3.00m 3		
						4		
						5		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS08**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349201.2	431310.4	20.51mAOD	Dando Terrier Rig	LN	1:25

Weather: | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.10	ES		20.31	0.20		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded sandstone.		
0.50	ES	HVP=110						
1.00	ES	SPT(S)N=21 (2,2/4,5,5,7)						
1.00 - 2.00	UT							
1.50	D	HVP=110		(2.80)				
2.00 - 3.00	UT	SPT(S)N=15 (2,2/3,5,3,4)						
2.50	D	HVP=110						
		SPT(S)N=11 (1,2/2,3,3,3)	17.51	3.00		End of Borehole at 3.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS09**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349202.1	431340.8	20.73mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT		20.53	0.20		Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.25	ES	HVP=60				Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
0.65	ES	HVP=100 HVP=110						
1.00 - 2.00	UT	SPT(S)N=12 (2,3/3,3,3,3)						
1.20	ES							
1.50	D			(2.80)				
2.00 - 3.00	UT	SPT(S)N=13 (2,2/3,3,3,4) HVP=110						
		SPT(S)N=13 (2,2/2,3,4,4) HVP=110	17.73	3.00		End of Borehole at 3.00m		
3.50	D							

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	0.50	PLAIN	19
0.50	3.00	SLOTTED	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS10**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349299.7	431309.4	18.35mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY with inclusions of brick. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.15	ES		18.15	0.20				
0.40	ES	HVP=100				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
0.70	ES							
		HVP=110						
1.00 - 2.00	UT	SPT(S)N=11 (1,2/2,3,3,3)						
1.20	ES							
1.50	D			(2.80)				
2.00 - 3.00	UT	SPT(S)N=20 (5 for 78mm/4,5,6,5) HVP=110						
2.50	D							
		SPT(S)N=16 (2,2/3,4,5,4) HVP=110	15.35	3.00		End of Borehole at 3.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS11**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349333.3	431347.0	17.64mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)			
0.20	ES			(0.35)					
			17.29	0.35		Firm brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.			
0.50	ES	HVP=70		(0.40)					
			16.89	0.75		Greyish brown very clayey gravelly SAND. Gravel is fine to coarse subangular sandstone.			
1.00	ES	SPT(S)N=11 (1,1/2,2,3,4)		(0.35)			1		
1.00 - 2.00	UT	HVP=100	16.54	1.10		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.			
1.50	D								
		SPT(S)N=20 (2,3/4,5,5,6)							
2.00 - 3.00	UT	HVP=110					2		
2.50	D	HVP=110							
3.00 - 4.00	UT	SPT(S)N=13 (1,2/2,3,3,5)		(4.90)			3		
3.50	D	HVP=110							
4.00 - 5.00	UT	SPT(S)N=11 (1,2/3,2,3,3)					4		
4.50	D	HVP=90							
5.00 - 6.00	UT	SPT(S)N=16 (3,4/4,4,4,4)					5		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		Dry

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS11**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 2 of 2
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349333.3	431347.0	17.64mAOD	Dando Terrier Rig	AR/CMG	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		HVP=90				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
		SPT(S)N=26 (4,5/4,6,7,9) HVP=110	11.64	6.00		End of Borehole at 6.00m		

6

7

8

9

10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Remarks:

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		Dry

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS12**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349341.0	431312.0	17.18mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)			
0.20	ES			(0.30)					
			16.88	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to subrounded mudstone and sandstone.			
0.60	ES	HVP=110							
1.00 - 2.00	UT	SPT(S)N=16 (1,2/3,4,4,5)					1		
1.10	ES								
1.50	D								
		HVP=110							
2.00 - 3.00	UT	SPT(S)N=16 (2,3/3,4,4,5)					2		
		HVP=110		(5.70)					
3.00	D	SPT(S)N=19 (2,2/3,4,6,6)					3		
3.00 - 4.00	UT								
		HVP=110							
4.00 - 5.00	UT	SPT(S)N=14 (2,3/3,3,4,4)					4	▼	
4.50	D								
		HVP=80							
5.00 - 6.00	UT	SPT(S)N=17 (2,4/4,5,4,4)					5		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.10			0		Slight seepage

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS12**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 2 of 2
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349341.0	431312.0	17.18mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
5.50	D	HVP=100				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to subrounded mudstone and sandstone.		
		HVP=110	11.18	6.00		End of Borehole at 6.00m		

6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.10			0		Slight seepage

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS13**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	22/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349342.8	431341.3	17.45mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: Refusal on suspected boulder. | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.10	ES			(0.30)				
			17.15	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to subangular sandstone.		
0.45	ES	HVP=110						
0.90	ES							
1.00 - 2.00	UT	SPT(S)N=13 (1,1/3,3,3,4)						
1.50	D	HVP=110		(2.60)				
2.00 - 2.90	UT	SPT(S)N=37 (2,5/5,7,17,8)						
2.50	D							
		HVP=110						
		SPT(S)N=50 (4,9/50 for 275mm)	14.55	2.90		End of Borehole at 2.90m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS14**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349349.2	431307.8	16.89mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT		16.69	0.20		Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.25	ES	HVP=90				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
0.60	ES							
1.00 - 2.00	UT	SPT(S)N=15 (1,3/3,3,4,5) HVP=90						
1.20	ES							
1.50	D							
2.00 - 3.00	UT	SPT(S)N=17 (1,3/3,4,5,5) HVP=110						
2.50	D			(5.80)				
3.00 - 4.00	UT	SPT(S)N=13 (1,3/2,3,4,4) HVP=110						
4.00 - 5.00	UT	SPT(S)N=13 (2,3/3,3,4,3) HVP=80						
4.50	D							
5.00 - 6.00	UT	SPT(S)N=12 (2,2/3,3,3,3)						

Continued next sheet

Remarks:

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	6.00	SLOTTED	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
3.50			0		Slight seepage

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS14**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 2 of 2
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349349.2	431307.8	16.89mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		HVP=100				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
5.50	D							
		HVP=110	10.89	6.00		End of Borehole at 6.00m		

6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	6.00	SLOTTED	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
3.50			0		Slight seepage

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS15**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	22/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349363.0	431336.7	17.70mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.10	ES			(0.30)				
			17.40	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
0.40	ES							
		HVP=110						
1.00	ES	SPT(S)N=22 (1,2/6,8,4,4)						
1.00 - 2.00	UT							
1.50	D	HVP=110						
				(2.70)				
2.00 - 3.00	UT	SPT(S)N=19 (1,2/3,4,6,6)						
2.50	D	HVP=110						
		SPT(S)N=14 (1,3/2,4,4,4)	14.70	3.00		End of Borehole at 3.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS16**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	22/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349419.5	431319.1	19.23mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.15	ES			(0.30)				
			18.93	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subrounded to subangular mudstone and sandstone.		
0.60	ES	HVP=110						
1.00 - 2.00	UT	SPT(S)N=11 (1,2/2,3,3,3) HVP=110						
1.20	ES							
1.50	D							
				(2.70)				
2.00 - 3.00	UT	SPT(S)N=17 (1,3/3,4,4,6) HVP=110						
2.50	D							
		SPT(S)N=20 (1,3/3,5,6,6) HVP=110	16.23	3.00		End of Borehole at 3.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS17**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	22/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349440.5	431319.5	19.36mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dr | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.20	ES			(0.30)				
			19.06	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
0.50	ES	HVP=90						
0.80	ES							
1.00 - 2.00	UT	SPT(S)N=15 (1,2/3,3,4,5) HVP=110						
1.50	D							
				(2.70)				
2.00 - 3.00	UT	SPT(S)N=22 (5 for 78mm/5,5,6,6) HVP=110						
2.50	D							
		SPT(S)N=15 (2,3/3,3,4,5) HVP=110	16.36	3.00		End of Borehole at 3.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Borehole ID:
Cottam Parkway Station	LCC	**WS18**

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	22/03/2021	SP	CB	FINAL	

Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Rig Crew:	Scale:
	349472.9	431353.2	19.47mAOD	Dando Terrier Rig	LN/AS	1:25

Weather: Dry | Termination: As instructed | SPT Hammer: N/R, Energy Ratio: N/R

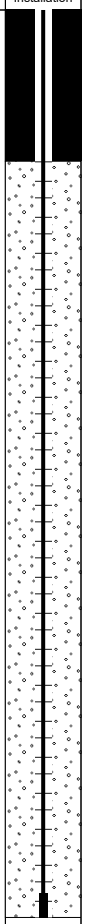
Samples & In Situ Testing

Depth	Sample ID	Test Result
0.00 - 1.00	UT	
0.20	ES	
		HVP=110
0.60	ES	
1.00 - 2.00	UT	SPT(S)N=13 (1,2/3,3,3,4) HVP=110
1.20	ES	
1.50	D	
2.00 - 3.00	UT	SPT(S)N=17 (2,3/3,3,5,6) HVP=110
2.50	D	
		SPT(S)N=16 (2,2/4,3,4,5) HVP=110

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description
	(0.30)		Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone. Frequent rootlets, grassed at surface (TOPSOIL)
19.17	0.30		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subrounded to subangular sandstone.
	(2.70)		
16.47	3.00		End of Borehole at 3.00m

Groundwater: Water Strike | Backfill/ Installation



Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Remarks:

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	0.50	PLAIN	19
0.50	3.00	SLOTTED	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP01

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

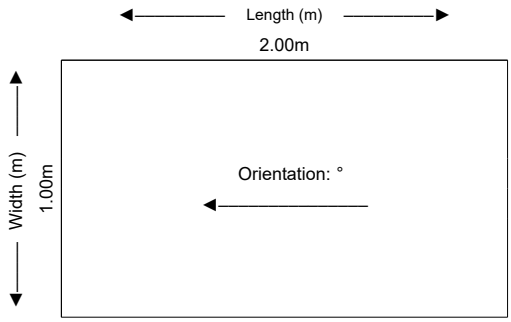
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349157.0	431325.0	20.56mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry	Hole Termination: As instructed	Stability: Stable

Samples & In Situ Testing			Strata Details					
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
0.10	B					Grey slightly sandy slightly gravelly silty CLAY (TOPSOIL)		
0.10	D							
0.20	ES		20.32	0.25				
0.30	D					Stiff brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to rounded mudstone and sandstone		
0.40	B							
0.50	ES	HVP=75kPa						
0.70	D							
1.00	ES	HVP=100kPa					1	
1.20	B			(1.75)				
1.50	B	HVP=110kPa						
1.70	D							
2.00	B	HVP=110kPa	18.57	2.00		End of Trial Pit at 2.00m	2	
							3	

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP02

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

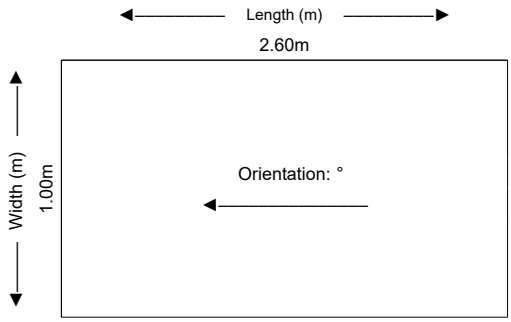
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349247.9	431322.0	19.96mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry	Hole Termination: As instructed	Stability: Stable

Samples & In Situ Testing			Strata Details					
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
0.15	ES			(0.30)		Grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to rounded mudstone and sandstone (TOPSOIL)		
0.20	B							
0.20	D		19.66	0.30		Stiff brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to rounded mudstone and sandstone		
0.50	B	HVP=75kPa						
0.60	ES							
0.70	D							
1.00	B	HVP=110kPa					1	
1.20	D			(1.70)		*Lens of SAND. Not water bearing at 1.20 - 1.30mbgl*		
1.50	ES	HVP=110kPa						
1.80	D							
2.00	B		17.96	2.00		End of Trial Pit at 2.00m	2	
							3	

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP03

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

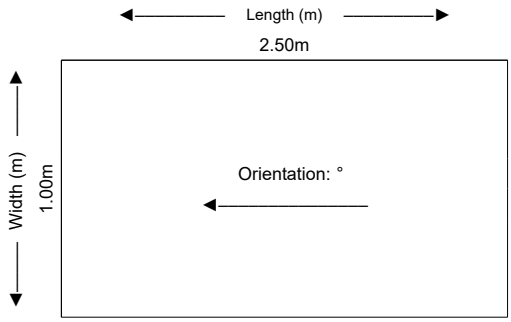
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349285.0	431336.5	19.28mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry	Hole Termination: As instructed	Stability: Stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
0.15	B			(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium sub-rounded to rounded mudstone and sandstone (TOPSOIL)		
0.15	D							
0.25	ES		18.98	0.30				
0.40	ES					Stiff brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to sub-rounded mudstone and sandstone		
0.50	B	HVP=80kPa		(0.40)				
0.60	D							
			18.58	0.70		Stiff dark brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to sub-rounded mudstone, sandstone and granite		
1.00	B	HVP=110kPa					1	
1.30	ES			(1.30)				
1.50	D	HVP=110kPa						
1.90	D							
2.00	B	HVP=110kPa	17.28	2.00		End of Trial Pit at 2.00m	2	
							3	

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP04

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	23/03/2021	SP	CB	FINAL	

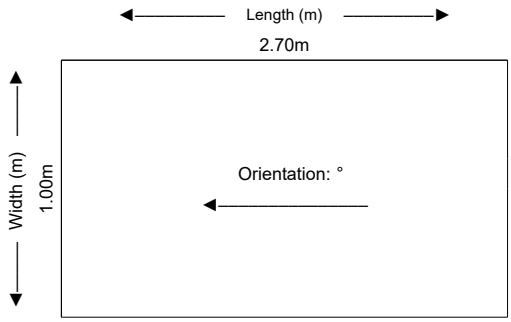
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349324.7	431322.8	17.82mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry	Hole Termination: As instructed	Stability: Stable

Samples & In Situ Testing			Strata Details					
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
				(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium sub-rounded to rounded mudstone and sandstone (TOPSOIL)		
0.20	B							
0.25	ES		17.52	0.30				
0.40	ES					Very stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular mudstone, sandstone and granite		
		HVP=90kPa						
0.60	B							
0.80	D							
1.00	B	HVP=110kPa					1	
				(1.70)				
1.30	ES							
1.50	D							
		HVP=110kPa						
1.90	D							
2.00	B		15.82	2.00		End of Trial Pit at 2.00m	2	
							3	

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP05

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

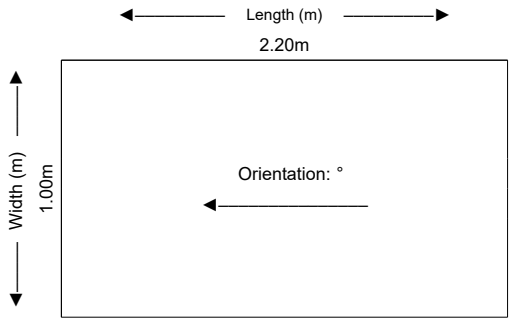
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349381.3	431309.8	17.86mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry | Hole Termination: As instructed | Stability: Stable

Samples & In Situ Testing			Strata Details					Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description			
0.10	ES			(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY with frequent rootlets. Gravel is fine to medium sub-angular to rounded mudstone and sandstone (Grassed TOPSOIL)			
0.20	B		17.56	0.30					
0.40	ES					Stiff brown slightly sandy slightly gravelly silty friable CLAY with a low cobble content. Gravel is fine to coarse sub-rounded to rounded mudstone and sandstone			
0.50	B	HVP=80kPa							
0.70	D								
		HVP=110kPa							
0.90	B								
1.00	ES						1		
				(1.70)					
1.40	D								
		HVP=110kPa							
1.80	D								
2.00	B	HVP=110kPa	15.86	2.00		End of Trial Pit at 2.00m	2		
							3		

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name:	Client:	Trial Pit ID:
Cottam Parkway Station	LCC	TP06

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CCG-C-21-12093	24/03/2021	SP	CB	FINAL	

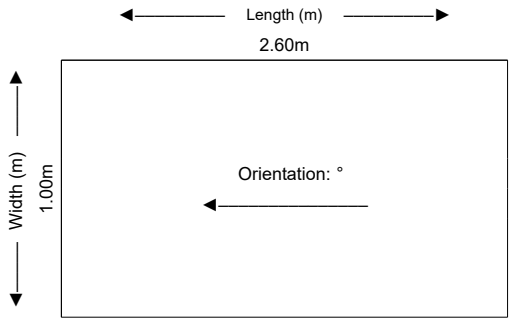
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed:	Scale:
	349425.1	431336.6	19.08mAOD	8T Tracked Machine	26/05/2021	1:25

Weather: Dry | Hole Termination: As instructed | Stability: Stable

Samples & In Situ Testing			Strata Details					Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description			
0.15	B			(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to coarse sub-angular to rounded mudstone and sandstone (TOPSOIL)			
0.25	ES		18.78	0.30					
0.40	B					Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to rounded mudstone, sandstone and granite			
0.50	D								
0.60	ES	HVP=75kPa							
0.70	B								
0.90	ES								
1.00	D	HVP=110kPa					1		
				(1.70)					
1.30	ES								
1.40	B								
		HVP=110kPa							
1.60	D								
		HVP=110kPa							
1.90	D								
2.00	B		17.08	2.00		End of Trial Pit at 2.00m	2		
							3		

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY