Design and Construction

Ground Investigation Report (GIR)

Cottam Parkway: Access Bridge and Embankment

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

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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 Bridges and the Infrastructure Delivery Team 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.

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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.

The layout of the Scheme has been altered since the completion of this report however the information contained within the follow sections remains relevant and correct.

DESIGN AND CONSTRUCTION

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

Cottam Parkway Access Bridge and Embankment

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1. EXECUTIVE SUMMARY

This project involves the proposed construction of a new road to connect the planned Cottam Railway Station with the Cottam Link Road that is currently under construction. The current proposal is for a two-way road, which will cross the Lancaster Canal via a proposed three span bridge with embankments leading up to the bridge. A railway station car park is planned to be built for the railway station on its north side. An attenuation pond is also planned.

The historical information indicates that the land along the line of the proposed scheme was predominantly agricultural. Topographical information indicates that the surrounding fields are typically 20mAOD, with localised depressions.

The objective of the GIR is to identify any geotechnical and geoenvironmental risks to the proposed bridge, embankments and attenuation pond.

Two phases of ground investigation were conducted: in July 2014 and March 2021. Both phases involved drilling of 4 window sample and 10 cable percussive boreholes along or near to the proposed route. The window sample boreholes were drilled to a maximum depth of 4.00 metres below ground level (mbgl) and the cable percussive boreholes were drilled to a maximum depth of 22.80mbgl.

In summary, the proposed route was recorded to be directly underlain by glacial till and glaciofluvial deposits. At the time of writing this report, the main geotechnical risks at the site are considered to be:

- Ground variability and made ground/unforeseen ground conditions.
- Self-settlement of fill in areas of new embankment.
- Instability of proposed embankment.
- Groundwater encountered during construction.

The geotechnical risks to the proposed bridge, embankments and attenuation pond, identified within the GIR, will be considered during preparation of detailed designs, which will be provided within a Geotechnical Design Report (GDR). The proposed bridge will not be included within the GDR since it is understood the bridge will likely be constructed as part of a separate design and build contract.

2. INTRODUCTION

2.1 Scope and objective of the report

This Ground Investigation Report (GIR) has been produced generally in accordance with Design Manual for Roads and Bridges CD 622 'Managing geotechnical risk'. The report is based on intrusive ground investigation works undertaken in 2021, and combine, where necessary, information from historical ground investigations undertaken near to 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 characteristic geotechnical parameters of the strata encountered and the geotechnical risks, which will have to be considered during the design and ultimately the construction of the scheme. 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

This project involves the proposed construction of a new road to connect the planned Cottam Railway Station with the Cottam Link Road that is currently under construction. The current proposal is for a two-way road, approximately 450m in length starting at E349107:N431357 and connecting to a roundabout on the Cottam Link Road at E349039:N431712. The new road will cross the Lancaster Canal at E349043:N431625 via a proposed three span bridge, with embankments leading up to the bridge. Two non-vehicular access tracks have also been designed to travel underneath the bridge on either side of the canal. In addition, an approximate 400m long car park is planned to be built for the railway station on its north side. An attenuation pond is also planned, located at E348993:N431694. A general overview of the project can be seen in Figure 1. Detailed plans of the proposed route are available upon request. The location maps of the site can be viewed in Appendix A.

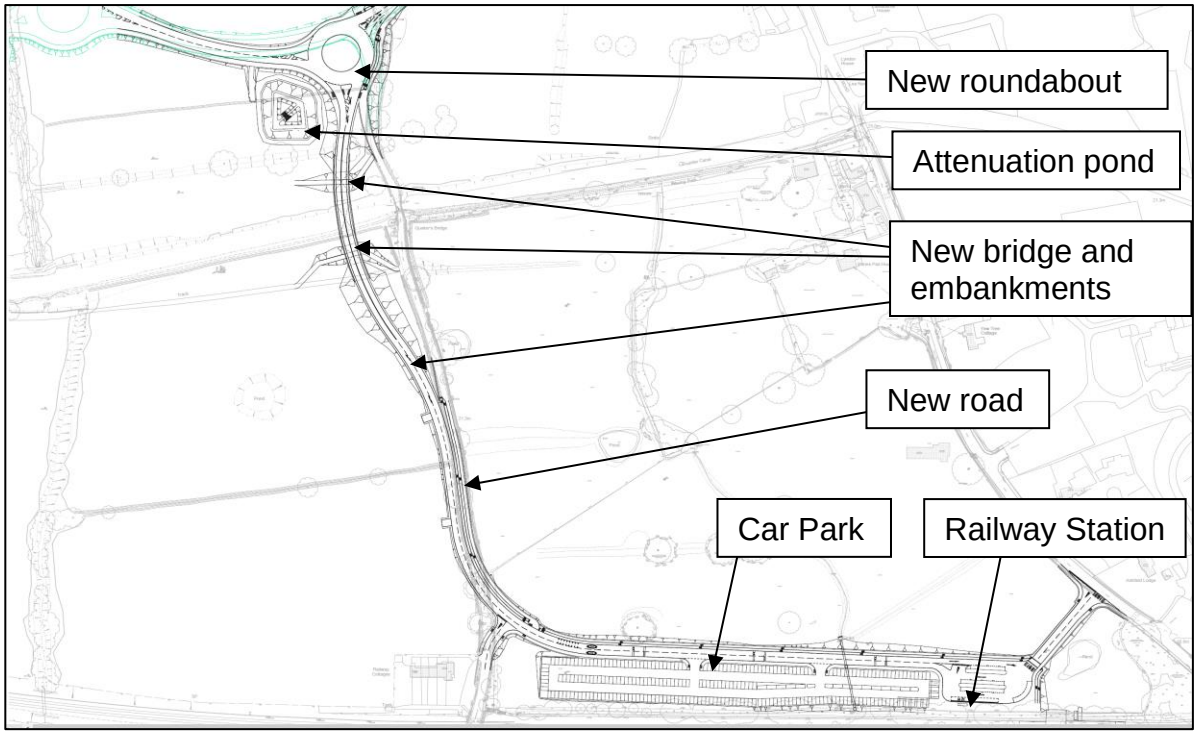

Figure 1: General overview of proposed project.

A separate GIR report has been produced for the road and car park. Therefore, this GIR only covers the proposed bridge, embankments and attenuation pond. The geotechnical risks to the proposed bridge, embankments and attenuation pond, identified within the GIR, will be considered during preparation of detailed designs, which will be provided within a Geotechnical Design Report (GDR). The proposed bridge will not be included within the GDR since it is understood the bridge will likely be constructed as part of a separate design and build contract.

2.3 Geotechnical Category of the project

The scheme is a project which includes a conventional type of structure and foundation with no exceptional risk or difficult ground or loading conditions. Therefore, the scheme could be specified as a Category 2 project, in line with BS EN 1997-1:2004, 'Eurocode 7: Geotechnical design – Part 1: General rules'. Designs for structures in Geotechnical Category 2 should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied. Routine procedures for field and laboratory testing and for design and execution may be used for Geotechnical Category 2 designs.

However, as this is not a Highways Agency scheme the category of 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.

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 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 two ponds in the fields south of the canal, within 150 metres of the proposed bridge and embankments.

Topographical information indicates that Sidgreaves Lane is situated at approximately 21mAOD in the south, rising to 25mAOD at the junction with Lea Road. The surrounding fields are typically 20mAOD, with localised depressions.

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 and 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 precaution boreholes (BH221-224) to depths of between 20.30mbgl and 20.80mbgl.. The boreholes were drilled between approximately 35m and 110m west of the current proposed bridge alignment.

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 below in Figure 2.

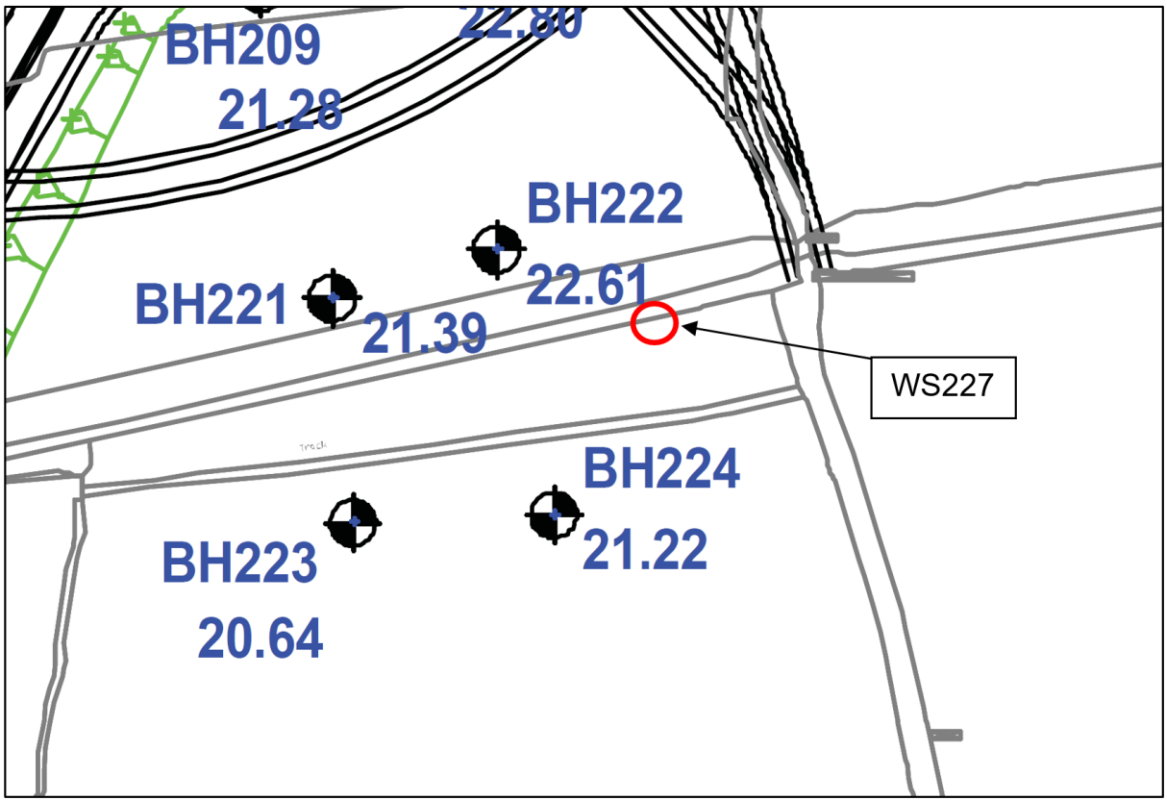

Figure 2: Location of 2014 ground investigation boreholes

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. Insitu geotechnical testing was also undertaken within each

borehole.

In summary, the ground investigation encountered glacial till deposits comprising layers of firm to stiff clay and medium dense to very dense sands, overlying sandstone bedrock at 19.20mbgl. A full summary of the ground investigation findings is detailed in the Preliminary Sources Study Report (PSSR), including logs and laboratory testing information.

The borehole logs are attached as Appendix C.

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. Other areas within the scheme that are shown as susceptible to surface water flooding, as would be expected, are associated with ditch lines and low lying areas. These include the 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) has been 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:

- Previous site uses: herbicides and pesticides used on agricultural land
- Existing road material (risk of tar bound material)
- Contaminants associated with road use (vehicle fuel spillages);

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

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 receptors were identified as:

- Construction workers involved in the development of the scheme.
- Maintenance workers associated with the road.
- Current and future public users of the canal.
- Vegetation and Wildlife.
- Road structures associated with the existing and proposed highway scheme.

Potential controlled water receptors were identified as:

- The Sherwood Sandstone Group (Principle aquifer)
- Lancaster Canal

Potential property receptors were identified as:

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

Potential Pollutant Pathways

The following pathways were considered relevant for human receptors:

- Dermal absorption and/or ingestion
- 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.

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 Linkages

The initial Conceptual Site Model (CSM) has identified that Potential Pollutant Linkages (PPLs) potentially exist at the site. Therefore, an appropriate ground investigation was conducted to confirm whether these PPLs exist.

3.11 Other relevant information

Not used.

4. FIELD AND LABORATORY STUDIES

4.1 Walkover survey

Several site walkovers have been undertaken along the proposed bridge and embankment route. The majority of the proposed scheme is adjacent to the existing Sidgreaves Lane, which is south west of Cottam. The proposed route travels across the Lancaster Canal via a new bridge. Photographs from the site walkovers are included within the PSSR. The following was noted within and adjacent to the proposed bridge and embankment route:

- The surrounding land is mainly agricultural fields and it was noted that the fields were waterlogged during wet weather.
- There are two ponds located within 150m of the proposed scheme, although none are located beneath the development area: Pond A (E348978:N431508), Pond B (E349096:N431541), These ponds are labelled on the location plan in Appendix A.
- Located at E349032:N431665 is a mature oak tree which will need to be removed in order to construct the northern embankment. The removal of this tree is likely to result in localised heaving of the ground. It is anticipated that further vegetation clearance on the banks of Lancaster Canal and along the sides of Sidgreaves Lane will be required in order to allow for the construction of the proposed structures. It is recommended that ecology surveys are undertaken in these areas, and that any trees, hedgerows and vegetation are removed outside of bird nesting season.
- There were no visual or olfactory signs of contamination at the site during the site walkover.
- Quakers Canal Bridge was noted to have a large crack on the underside of the bridge and masonry protruded from the main structure by 10-30mm, which may be indications of structural instability. In addition, Quakers Bridge is quite narrow and has notable scrapes along its parapets, presumably caused by traffic.

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 was undertaken in accordance with Eurocode 7 Part 2, 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

An additional phase of intrusive investigation was undertaken by CC Geotechnical Ltd in March 2021. The investigation was undertaken within the location of the proposed bridge embankment and proposed attenuation pond and comprised the following:

- Three window sample boreholes (WS01 to WS03). WS02 and WS03 were drilled to 4.00mbgl at the northern and southern most edges of the proposed bridge embankment respectively. WS01 was drilled within the location of the proposed attenuation pond.
- Six cable percussion boreholes (CP01 to CP06) were drilled along the route of the proposed bridge embankment to depths of between 17.50mbgl and 19.00mbgl to investigate the ground conditions at the locations of the bridge foundations and embankments. Four piezometers were installed in these

boreholes and the remaining two boreholes were backfilled upon completion.

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

The borehole logs are included within the CC Geotechnical Ltd Factual Report, dated May 2021, enclosed in Appendix B. The borehole location plans are enclosed as Appendix D.

4.3.2 Ground Investigation Report

A copy of the CC Geotechnical Ltd Factual Report, dated May 2021 can be found in Appendix B.

4.3.3 Results of in situ tests

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

4.4 Drainage studies

Not used.

4.5 Geophysical surveys

Not used.

4.6 Pile tests

Not used.

4.7 Other field work

Not used.

4.8 Laboratory investigation

Laboratory geotechnical testing was undertaken on selected soil samples by Ian Farmer Associates Ltd in 2014 and by CC Geotechnical Ltd in 2021 to determine the geotechnical properties of the soil materials and to provide geotechnical parameters for design purposes.

4.8.1 Laboratory Testing

All soil samples were prepared in accordance with BS1377: Part One: 2016 and representative sub-samples were taken for testing. The following geotechnical tests were undertaken on samples taken from across the bridge embankment and attenuation pond scheme:

- Moisture content;
- Atterberg tests;
- Particle size distribution;
- Sedimentation with hydrometer;
- Unconsolidated undrained triaxial compression; and
- One-dimensional consolidation

pH and water soluble sulphate

Testing for pH values and water soluble sulphate was undertaken on fifteen soil samples in order to undertake a concrete classification assessment.

Contamination/Chemical testing

Laboratory chemical testing was undertaken on selected soil samples to determine whether the soils posed any significant risks to sensitive receptors, to assess suitability of excavated soil re-use within the scheme, and to assess the soil for waste classification purposes. The samples were tested for a range of organic and inorganic determinants, including heavy metals, asbestos, speciated Polycyclic Aromatic Hydrocarbons (PAH), speciated Total Petroleum Hydrocarbons (TPH), sulphate and sulphide.

4.8.2 Copies of test results

A full copy of the laboratory geotechnical and chemical test results for the 2021 ground investigation are included within the CC Geotechnical Ltd Factual Report, dated May 2021, enclosed in Appendix B.

5. GROUND SUMMARY

Details and locations of earthworks requirements will be included in the detailed recommendations within the GDR. The 2014 and 2021 ground investigation boreholes were drilled within the location of the existing field, which is largely at grade with the adjacent Sidgreaves Lane. The ground conditions encountered during the 2014 and 2021 intrusive ground investigations is summarised as follows:

- Topsoil - A grassed surface layer of topsoil to between 0.20m and 0.60m thickness across the development area, which is generally described as a soft slightly sandy, slightly gravelly, silty organic clay with frequent rootlets.
- Upper Glacial Till – A predominantly cohesive layer generally consisting of a firm to stiff slightly sandy, slightly gravelly silty clay with occasional to frequent sand and silt laminations was recorded to depths of between 11.30mbgl and 12.80mbgl. There are occasional lenses of silt and gravel (between 0.20m and 0.25m thick) within the clay that appear to be laterally localised to each borehole. A lense of medium dense sand was recorded within CP04, CP05 and CP06 at depths of between 2.20mgl and 3.70mbgl, with a thickness ranging between 0.70m and 1.00m.

WS01, located within the location of the proposed attenuation pond encountered firm to stiff slightly sandy, slightly gravelly silty clay to the full depth of the borehole, indicating the underlying Upper Glacial Till soils are relatively impermeable at this location.

- Upper Glaciofluvial Deposits – A predominantly granular layer generally consisting of layers of medium dense sandy clayey silts, soft slightly sandy slightly gravelly silty clays, and medium dense silty clayey, occasionally gravelly sands. This layer was recorded to depths of between 13.70mbgl and 15.00mbgl, with thicknesses ranging between 0.80m to 3.30m.

Within boreholes BH221 to BH224, drilled between approximately 35m and 110m west of the current proposed bridge alignment, the Upper Glaciofluvial Deposits were more extensive and encountered between 10.00mbgl and 17.00mbgl, with thicknesses ranging between 2.20m and 7.00m.

- Lower Glacial Till – A cohesive layer generally consisting of a typically very stiff slightly sandy, occasionally slightly gravelly, silty clay layer encountered to depths of between 16.30mbgl and 16.50mbgl in CP01 to CP06, with thicknesses ranging between 0.60m and 2.80m. The Lower Glacial Till was encountered between 15.20mbgl and 17.80mbgl in BH221 to BH224. A mudstone boulder was encountered in CP05 between 15.80mbgl and 16.50mbgl.
- Lower Glaciofluvial Deposits - A granular layer generally consisting of very dense, very gravelly, silty, clayey sand was encountered in CP04 and CP05 between 16.30mbgl and 17.90mbgl, just above bedrock. This sand layer is more extensive to the west, where it was recorded in boreholes BH221 to BH224 between depths of 16.90mbgl and at least 20.45mbgl, becoming a very sandy gravel in BH223. This sand layer is unlikely to be weathered sandstone due to the gravel including fine to medium, subangular to subrounded mudstone, and is possibly fluvioglacial in origin.
- Weathered Bedrock - Within boreholes CP01 to CP06 and BH223, weathered bedrock was encountered at depths of between 15.60mbgl and 17.90mbgl (19.20mbgl in BH223). The bedrock comprised very weak weathered sandstone, recovered as either very sandy, silty gravel or very gravelly silty clayey sand, ranging in thickness between 0.05m and 2.50m. Underlying the very weak weathered sandstone was weak weathered sandstone, recorded in CP06 at 17.80mbgl. Bedrock was not encountered in BH221, BH222 and BH224.

A ground model detailing the above is enclosed as Appendix E. The strata recorded within the boreholes is summarised in Table 2.

Horizon	Strata Description	Depth to top (mbgl)	Depth to base (mbgl)
Topsoil	Grassed soft slightly sandy, slightly gravelly, silty organic clay with frequent rootlets	0.00	0.20-0.60

Horizon	Strata Description	Depth to top (mbgl)	Depth to base (mbgl)
Upper Glacial Till	Firm to stiff slightly sandy, slightly gravelly silty clay with occasional to frequent sand and silt laminations	0.20 – 0.60	11.30 - 12.80
Upper Glaciofluvial Deposits	Layers of medium dense sandy clayey silts, soft slightly sandy slightly gravelly silty clays, and medium dense silty clayey, occasionally gravelly sands	11.30 – 12.90	13.70 – 15.00
Lower Glacial Till	Very stiff slightly sandy, occasionally slightly gravelly, silty clay	13.70 – 15.00	16.30 – 17.80
Lower Glaciofluvial Deposits	Very dense, very gravelly, silty, clayey sand	16.30 – 18.20	17.90 – >20.45
Weathered Bedrock	Very weak weathered sandstone, recovered as either very sandy, silty gravel or very gravelly silty clayey sand,	15.60 - 19.20	17.90 – >20.80

Table 2: Summary of Ground Conditions

5.1 Groundwater

Groundwater was encountered in boreholes CP02 to CP06 and WS03 between depths of 1.10mbgl and 13.20mbgl, as shown in Table 3 'Groundwater Strikes During Fieldwork'.

Exploratory Hole Ref.	Ground Level mOD	Water Strike Depth (mBGL)	Water Strike Level (mOD)	Water Strike Geology	Standing Water Depth (mBGL) after 10 to 20 mins	Standing Water Level (mOD) after 10 to 20 mins	Estimated flow
CP02	22.34	13.20	9.14	SAND – UGD	13.2	9.14	Seepage
CP03	22.63	11.70	10.93	SILT - UGD	11.7	10.93	Seepage
CP03	22.63	12.90	9.73	SILT - UGD	12.9	9.73	Seepage

Exploratory Hole Ref.	Ground Level mOD	Water Strike Depth (mBGL)	Water Strike Level (mOD)	Water Strike Geology	Standing Water Depth (mBGL) after 10 to 20 mins	Standing Water Level (mOD) after 10 to 20 mins	Estimated flow
CP04	22.97	2.70	20.27	SAND - UGT	2.7	20.27	Seepage
CP04	22.97	8.30	14.67	SILT – UGT	8.1	14.87	Seepage
CP04	22.97	12.90	10.07	SAND - UGD	12.9	10.07	Seepage
CP04	22.97	16.30	6.67	SAND - LGD	16.30	6.67	Seepage
CP05	22.5	2.20	20.30	SAND - UGT	2.2	20.3	Seepage
CP05	22.5	7.60	14.90	GRAVEL - UGT	7.2	15.3	Seepage
CP05	22.5	12.50	10.00	SAND - UGD	12.5	10	Seepage
CP06	22.25	1.40	20.85	SAND - UGT	1.4	20.85	Seepage
CP06	22.25	2.80	19.45	SAND - UGT	2.5	19.75	Seepage
WS03	21.55	1.10	20.45	SAND - UGT	NR	NR	Seepage

Notes:

UGD – Upper Glaciofluvial Deposits

UGT – Upper Glacial Till

LGD – Lower Glaciofluvial Deposits

Table 3: Groundwater Strikes Encountered During Fieldwork

Four standpipes with 50mm diameter tubes were installed in boreholes CP01, CP03, CP04 and CP06, as described in Table 4 'Groundwater Monitoring Installation Details'. Response zones were generally within natural clay, silt and sand layers, terminating in sandstone bedrock.

Exploratory Hole Ref.	Ground Level (mOD)	Installation Type	Top of Response Zone		Base of Response Zone		Response Stratum
			(mBGL)	(mOD)	(mBGL)	(mOD)	
CP01	22.50	Slotted pipe	1.00	21.50	18.00	4.50	CLAY/SILT/SANDSTONE
CP03	22.63	Slotted pipe	1.00	21.63	16.50	6.13	CLAY/SILT/ SANDSTONE
CP04	22.97	Slotted pipe	1.00	21.97	17.00	5.97	CLAY/SILT/ SAND
CP06	22.50	Slotted pipe	1.00	21.50	17.00	5.50	CLAY/SILT/ SAND/ SANDSTONE

Table 4: Groundwater Monitoring Installation Details

To date, monthly monitoring has been undertaken on 8 occasions between 9th April 2021 and 26th August 2021. Groundwater monitoring is currently ongoing.

A summary of the monitoring results is shown below in Table 5 'Groundwater Monitoring Results'. The groundwater monitoring results can be found in Appendix F.

BH No.	BH AOD (m)	Piezometer Depth (m)	Min. water Depth (m)/ Level (mAOD)	Max. water Depth (m)/ Level (mAOD)	Difference (m)
CP01	22.50	18.00	9.03 (13.47)	11.51 (10.99)	2.48
CP03	22.63	16.50	13.40 (9.24)	13.95 (8.69)	0.55
CP04	22.97	17.00	9.17 (13.80)	13.61 (9.36)	4.44
CP06	22.25	17.00	2.73 (19.52)	7.38 (14.87)	4.65

Table 5: Groundwater Monitoring Details

6. GROUND CONDITIONS AND MATERIAL PROPERTIES

To focus on just the data directly beneath the proposed bridge, embankment and attenuation pond, the ground conditions and material properties are based upon in situ and laboratory test results from the ground investigation undertaken in March 2021, i.e. boreholes CP01 to CP06 and WS01 to WS03.

6.1 Topsoil

Topsoil depths were found to be between 0.20mbgl and 0.60mbgl across the development area. The topsoil was generally described as grass over a soft grey slightly sandy, slightly gravelly silty organic clay with frequent rootlets. Table 6 provides a summary of the topsoil thicknesses encountered during the ground investigations.

Area	Minimum Depth (m)	Maximum Depth (m)	Average Depth (m)	Minimum Thickness (m)	Maximum Thickness (m)	Average Thickness (m)
Proposed Bridge and Embankment	0.20	0.60	0.31	0.20	0.60	0.31

Table 6: Topsoil Summary

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

Made ground was not encountered in boreholes along the route, although it is likely that localised areas of made ground will be present directly alongside and beneath the existing roads that the route crosses.

During the intrusive investigation no visual or olfactory evidence of contamination was noted.

6.3 Upper Glacial Till

The Upper Glacial Till was recorded across the scheme and is predominantly described as a firm to stiff slightly sandy, slightly gravelly silty clay with occasional localised lenses of sand, silt and gravel. The results of in situ and laboratory testing undertaken within this material are summarised in Table 7.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	42	13	30	21
Liquid Limit (%)	31	30	45	36
Plasticity Index	31	15	25	19
SPT (Uncorrected N Value)	46	7	27	17
Undrained shear strength (kPa)	11	33	157	93
Bulk density (kN/m^3)	20	20.40	22.70	21.90

Table 7: Summary of in situ and laboratory results

6.3.1 Particle Size Distribution

A total of 4 Particle Size Distribution (PSD) tests were undertaken on samples taken from the Upper Glacial Till encountered along the proposed scheme, up to a depth of 8.5mbgl. Table 8 provides a breakdown of sample proportions for the natural superficial deposits:

Borehole	Particle Size Distribution (dry mass percentage)							
	Depth	Cobble	Gravel	Sand	Silt	Clay	Fines	Description
CP02	3.6	0	0	30	64	6	70	SILT
CP04	3	0	1	65	31	3	34	SILT
CP04	8.5	0	1	61	35	3	38	SILT
CP06	3.5	0	0	77	19	4	23	SILT

Table 8: Upper Glacial Till - Particle Size Distribution

The PSD tests were undertaken on samples taken from the lenses of silt within the Upper Glacial Till clay. Table 8 confirms that the PSD soil descriptions of these deposits correlate with the borehole log soil descriptions.

6.3.2 Atterberg limits and Moisture Content

Atterburg testing indicates the clay to be a low to intermediate plasticity with moisture contents ranging between 13% and 30%. There is no clear link between plasticity index, moisture content and depth. However, moisture content does appear to decrease from surface level to 2mbgl and then increase with depth towards the base of the Upper Glacial Till, as shown in Figure 3. This may be due to naturally higher levels of moisture content at the surface due to rainwater saturation, which becomes drier with depth. Below circa 2.50mbgl, pockets of perched groundwater are located (see Section 5.1) and the moisture content of the soil will gradually increase with depth as it becomes more saturated.

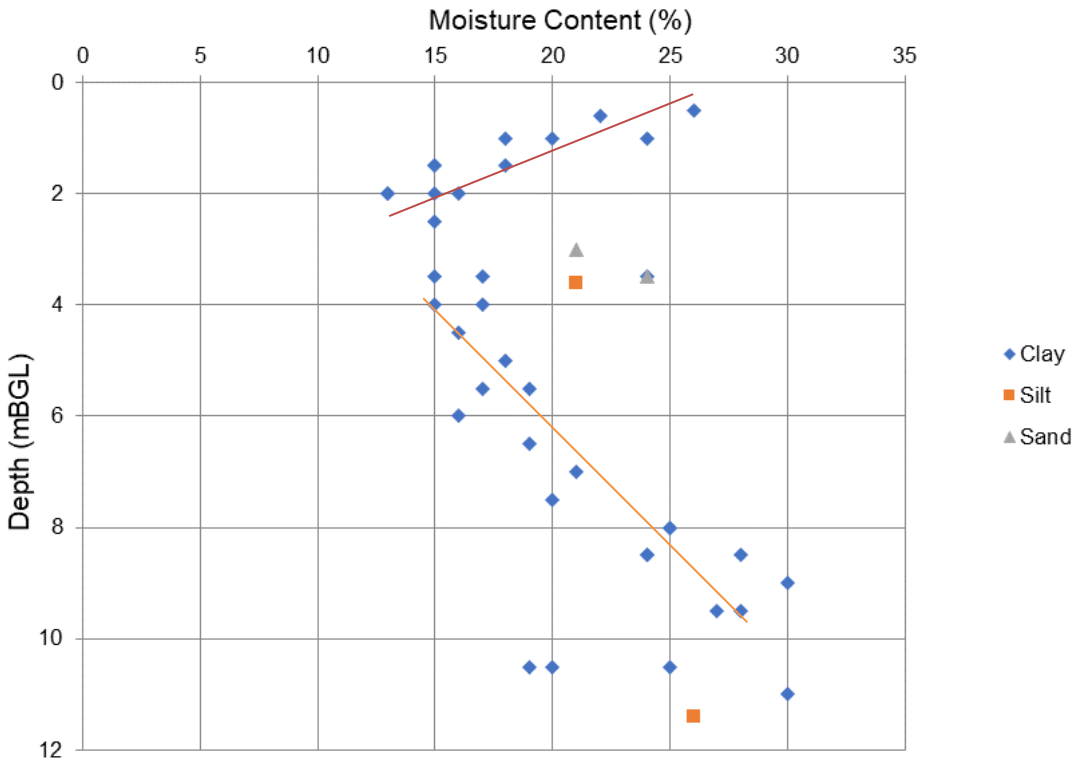

Figure 3: Moisture content values with depth (trend lines are indicative and not for design purposes)

6.3.3 Bulk Density

Bulk density testing was undertaken as part of the one-dimensional consolidation and undrained triaxial testing of the samples taken from the boreholes. Bulk density values between 20.4kN/m^3 and 22.7kN/m^3 were recorded, with an average bulk density value of 21.9kN/m^3

6.3.4 Undrained shear strength and SPT 'N' Values

SPTs undertaken within the cohesive Upper Glacial Till clay between 1.20mbgl and 11.50mbgl typically recorded N values of between 8 and 27, with an average value of 17. SPTs undertaken within the occasional granular sand layers recorded within the Upper Glacial Till typically recorded N values of between 10 and 27, indicating they are medium dense.

A summary of the SPT results for the Upper Glacial Till is provided in Figure 4 below and generally shows a very slight increase in N values with depth:

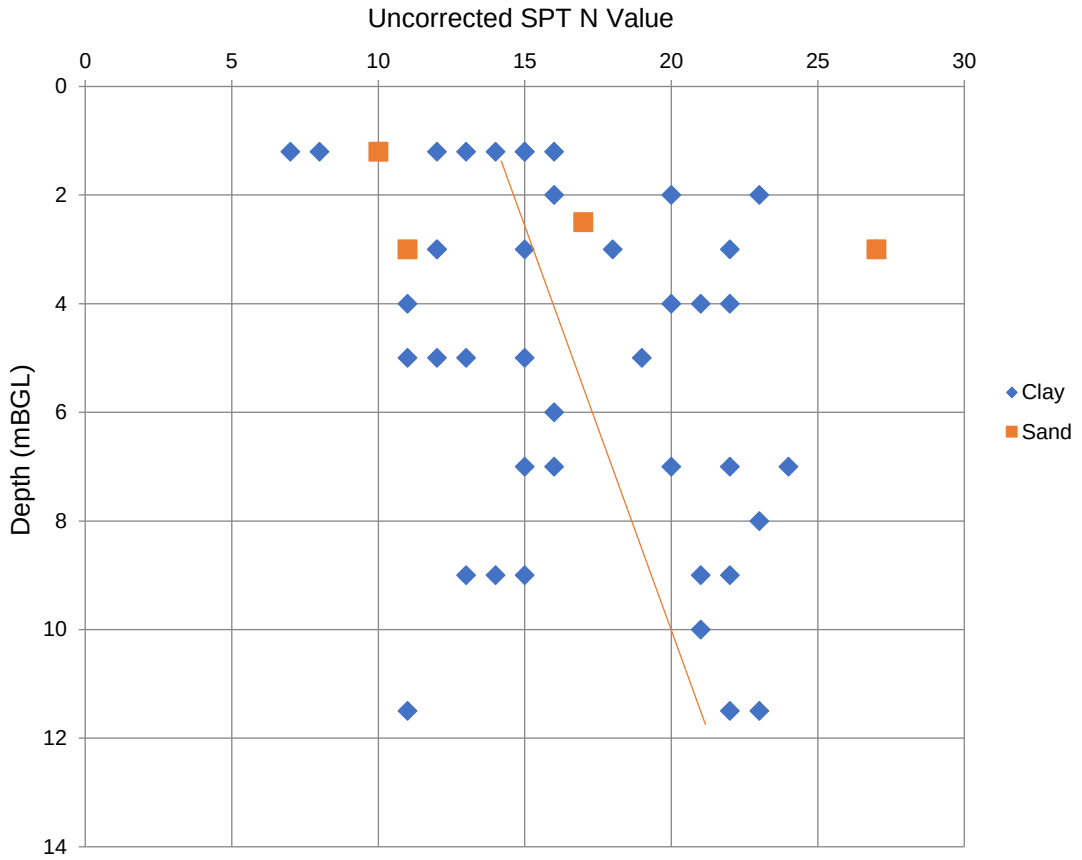

Figure 4: SPT N Values with depth (trend line is indicative and not for design purposes)

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 Plasticity Index. The correlation provides undrained shear strengths ranging between 48kN/m^2 and 189kN/m^2, indicating the clays range in strength between medium and very high. However, one undrained shear strength of 35kN/m^2 was recorded at 1.2m in CP05, indicating the clay is low/medium strength at this depth.

A summary of the correlated shear strengths for the Upper Glacial Till is provided in Figure 5 below and generally shows no clear correlation between shear strength and depth.

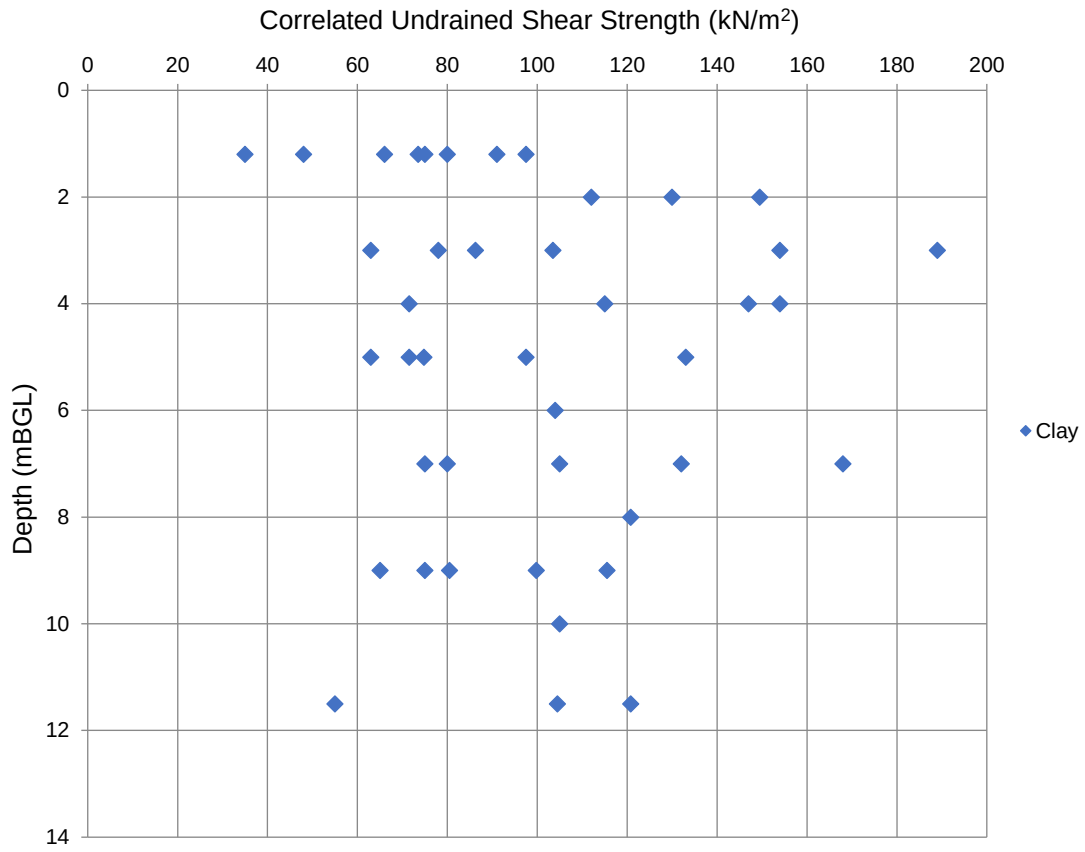

Figure 5: Correlated shear strength with depth (trend line is indicative and not for design purposes)

The triaxial tests undertaken in the Upper Glacial Till between 2.00mbgl and 10.00mbgl recorded undrained shear strength values of typically between 55kN/m² and 157kN/m², confirming the glacial clay is medium to very high strength. However, one shear strength of 33kN/m² was recorded at 8.00m in CP06, indicating the clay is locally low strength at this depth. The average Cu value is 93kN/m², confirming the glacial clay is typically high strength. This range of undrained shear strengths is generally similar with the range of correlated undrained shear strengths described above, although the trends with depth are less similar.

Figure 6 shows undrained strength reducing with depth in the upper glacial till. This seems to correspond with the general trend of increasing moisture content with depth.

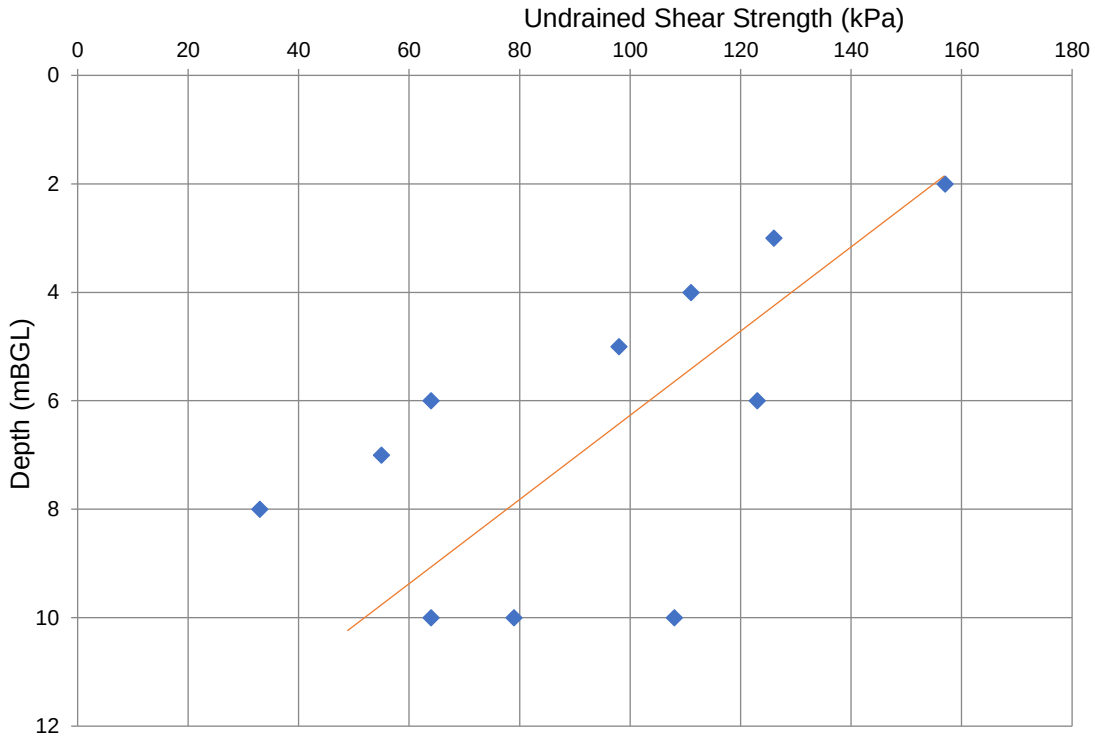

Figure 6: Undrained shear strength with depth (trend line is indicative and not for design purposes)

The shear strength values obtained from in situ hand vane tests undertaken in WS01 to WS03 to depths of up to 4.00mbgl ranged between 70kPa and 110kPa, indicating the Upper Glacial Till clay is medium to high strength. There is no clear correlation with depth.

6.3.5 Compressibility

One dimensional consolidation tests were undertaken on nine samples obtained from glacial till deposits encountered in CP01 to CP06 at depths between 2.00mbgl and 11.50mbgl. Testing was carried out under pressures between 0 and 460kN/m². The consolidation parameters for each pressure are summarised in Table 9.

Borehole No.	Depth (mbgl)	Pressure End (kPa)	Voids Ratio e0	Coefficient of Volume Compressibility Mv (m^2/MN)	Coefficient of Consolidation Cv (m^2/yr)	Bulk Density (Mg/m3)
Overburden						
CP01	4	80	0.38	0.22	2.9	2.19
CP01	10	200	0.39	0.16	1.5	2.16
CP02	2	40	0.37	0.26	3.4	2.2
CP03	6	120	0.39	0.22	1.2	2.16
CP03	8	160	0.46	0.23	1.8	2.11
CP04	4	80	0.34	0.21	2.2	2.23
CP04	8	160	0.45	0.18	2	2.13
CP05	11.5	230	0.52	0.15	1.4	2.04
CP06	6	120	0.35	0.16	2.2	2.21
Half Overburden						
CP01	4	40	0.39	0.3	2.4	2.19
CP01	10	100	0.41	0.22	1.2	2.16
CP02	2	20	0.38	0.27	13	2.2
CP03	6	60	0.41	0.41	0.8	2.16
CP03	8	80	0.49	0.35	1.4	2.11
CP04	4	40	0.35	0.26	1.9	2.23
CP04	8	80	0.47	0.26	1.3	2.13
CP05	11.5	115	0.55	0.25	1.4	2.04
CP06	6	60	0.36	0.22	1.9	2.21
Twice Overburden						
CP01	4	160	0.36	0.14	3.4	2.19
CP01	10	400	0.36	0.1	1.5	2.16
CP02	2	80	0.36	0.19	3	2.2
CP03	8	320	0.43	0.14	2.3	2.11
CP04	4	160	0.33	0.14	2	2.23
CP04	8	320	0.42	0.13	2.5	2.13
CP05	11.5	460	0.49	0.1	1.5	2.04
CP06	6	240	0.33	0.11	2.2	2.21

Table 9: Consolidation Parameters

6.4 Upper Glaciofluvial Deposits

The Upper Glaciofluvial Deposits were recorded across the scheme and is predominantly described as layers of medium dense sandy clayey silts, soft slightly sandy slightly gravelly silty clays, and medium dense silty clayey, occasionally gravelly sands. The Upper Glaciofluvial Deposits are predominantly

granular. The results of in situ and laboratory testing undertaken within this material are summarised in Table 10.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	10	19	28	25
Liquid Limit (%)	1	38	38	38
Plasticity Index	1	20	20	20
SPT (Uncorrected N Value)	9	11	23	16

Table 10: Summary of in situ and laboratory results

6.4.1 Particle Size Distribution

A total of 9 Particle Size Distribution (PSD) tests were undertaken on samples taken from the Upper Glaciofluvial Deposits encountered along the proposed scheme, between depths of 11.40mbgl and 13.50mbgl. Table 11 provides a breakdown of sample proportions for the natural superficial deposits:

Borehole	Particle Size Distribution (dry mass percentage)							
	Depth	Cobble	Gravel	Sand	Silt	Clay	Fines	Description
CP01	12	0	0	29	64	7	71	SILT
CP01	13	0	0	38	54	8	62	SILT
CP02	11.4	0	0	15	77	8	85	SILT
CP02	12.5	0	0	53	43	4	47	SILT
CP03	12	0	1	14	77	8	85	SILT
CP03	14	0	0	43	52	5	57	SILT
CP04	13.5	0	5	62	27	6	33	SAND
CP05	12.8	0	0	70	25	5	30	SAND
CP06	13.5	0	0	37	57	57	6	SILT

Table 11: Particle Size Distribution

The PSD tests were undertaken on samples taken from the layers of sand and silt within the Upper Glaciofluvial Deposits. Table 11 confirms that the PSD soil descriptions of these deposits correlate with the borehole log soil descriptions.

6.4.2 Atterberg limits and Moisture Content

Atterburg testing indicates the clay layers within the Upper Glaciofluvial Deposits to be of intermediate plasticity. Moisture contents range between 19% and 27% and appear to be within the same range as the deepest part of the Upper Glacial Till, continuing the trend of increasing moisture content with depth (see Figure 7). The higher moisture contents in the Upper Glaciofluvial Deposits are likely due to the perched groundwater encountered at this depth (See Section 5.1).

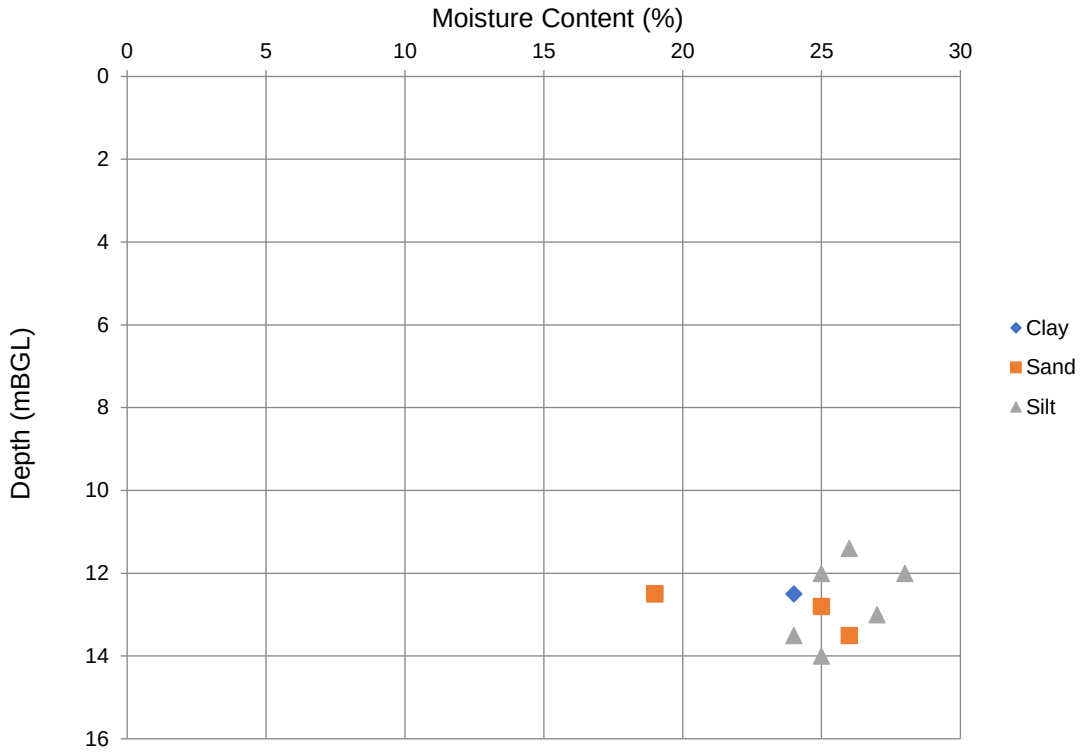

Figure 7: Moisture content values with depth

6.4.3 Undrained shear strength and SPT 'N' Values

SPTs were undertaken within the granular sand and silt layers of the Upper Glaciofluvial Deposits between 11.50mbgl and 14.50mbgl. The sand layers recorded N values between 12 and 23, with an average value of 17, and the silt layers recorded N values between 11 and 15, with an average value of 15. This indicates the silt and sand layers of the Upper Glaciofluvial Deposits are medium dense. A summary of the SPT results for the Upper Glaciofluvial Deposits is provided in Figure 8 below and no shows no clear correlation between N values and depth:

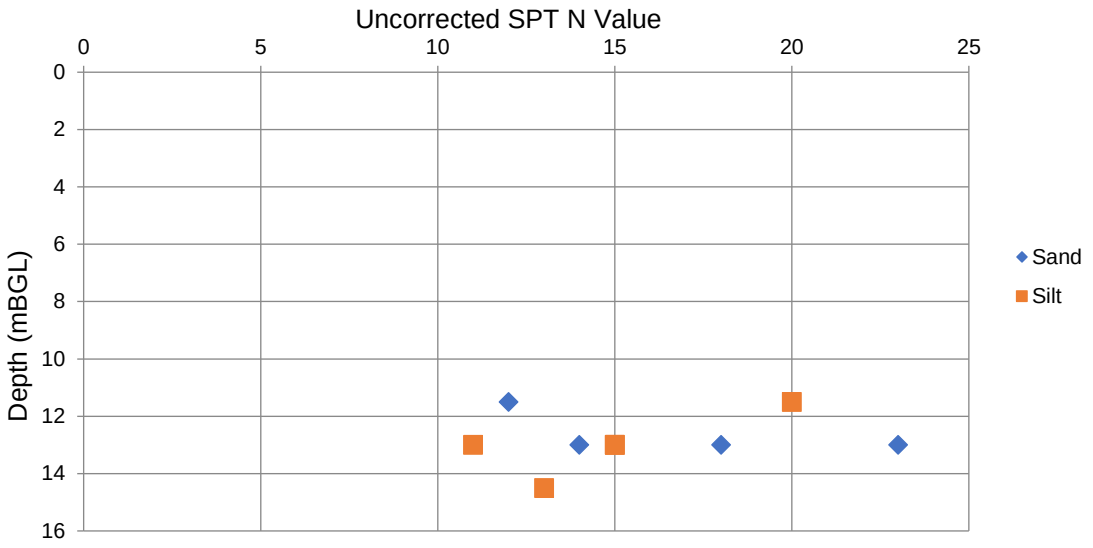

Figure 8: SPT N Values with depth

No SPTs or triaxial testing was undertaken on the occasional clay layers of the Upper Glaciofluvial Deposits. The borehole logs record the clay layers as soft slightly sandy slightly gravelly silty clays. Therefore, it should be assumed that these clay layers have a low undrained shear strength, i.e., less than 40kN/m^2.

6.4.4 Bulk Density

Bulk density testing of the samples taken from the Upper Glaciofluvial Deposits was not undertaken. In absence of reliable test results, BS8002 (2015) suggests values below the water table for a medium dense sand ranging between 18kN/m^3 and 20.5kN/m^3, values for a medium dense silt between 18kN/m^3 and 21.5kN/m^3, and values for a low strength clay ranging between 15kN/m^3 and 19kN/m^3.

6.5 Lower Glacial Till

The Lower Glacial Till was recorded across the scheme and is predominantly described as a typically very stiff slightly sandy, occasionally slightly gravelly, silty clay layer. The results of in situ and laboratory testing undertaken within this material are summarised in Table 12.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	4	13	25	20

Test Type	Number of Results	Results		
		Min	Max	Mean
Liquid Limit (%)	5	30	40	33
Plasticity Index	5	14	22	17
SPT (Uncorrected N Value)	1	>50	>50	>50
Undrained shear strength (kPa)	2	141	179	160
Bulk density (Mg/m^3)	4	2.17	2.21	2.19

Table 12: Summary of in situ and laboratory results

6.5.1 Atterberg limits and Moisture Content

Atterburg testing indicates the clay to be a low to intermediate plasticity with moisture contents ranging between 13% and 25%. There is no clear link between plasticity index, moisture content and depth. However, moisture content does appear to increase with depth towards the base of the Lower Glacial Till, as shown in Figure 9.

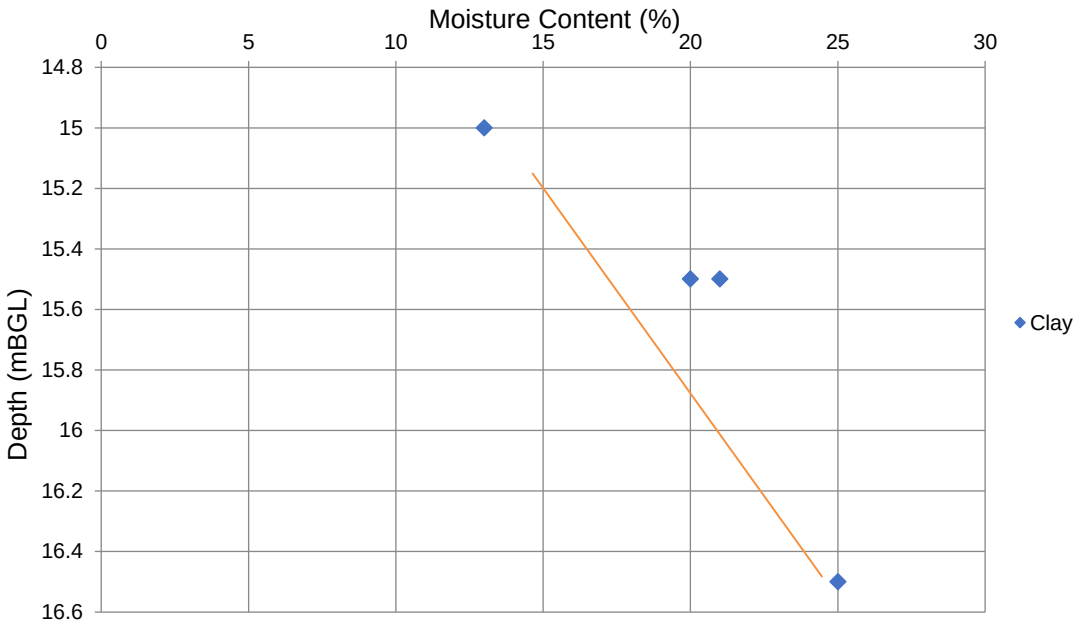

Figure 9: Moisture content values with depth (trend line is indicative and not for design purposes)

6.5.2 Bulk Density

Bulk density testing was undertaken as part of the one-dimensional consolidation and undrained triaxial testing of the samples taken from the boreholes. Bulk

density values between 21.7kN/m^3 and 22.1kN/m^3 were recorded, with an average of bulk density value of 21.9kN/m^3.

6.5.3 Undrained shear strength and SPT 'N' Values

An SPT undertaken within the cohesive Lower Glacial Till clay at 16.00mbgl recorded a refusal N value of greater than 50. However, since this SPT was undertaken at a depth was close to the horizon of the weathered bedrock (16.50mbgl), it is considered than this N value is not likely representative of the Lower Glacial Till.

The two triaxial tests undertaken in the Lower Glacial Till in boreholes CP01 and CP04 at 14.50mbgl recorded undrained shear strength values of 179kN/m² and 141kN/m² respectively, confirming the glacial clay is high to very high strength.

6.5.4 Compressibility

One dimensional consolidation tests were undertaken on two samples obtained from the Lower Glacial Till encountered in CP02 to CP05 at depths of 14.00mbgl and 14.50mbgl. Testing was carried out under pressures between 0 and 580kN/m². The consolidation parameters for each pressure are summarised in Table 13.

Consolidation Testing						
Borehole No.	Depth (mbgl)	Pressure End (kPa)	Voids Ratio e0	Coefficient of Volume Compressibility Mv (m2/MN)	Coefficient of Consolidation Cv (m2/yr)	Bulk Density (Mg/m3)
Overburden						
CP02	14	280	0.35	0.1	2	2.19
CP05	14.5	290	0.39	0.1	1.5	2.18
Consolidation Testing - Half Overburden						
CP02	14	140	0.36	0.15	1.6	2.19
CP05	14.5	145	0.41	0.12	1.8	2.18
Consolidation Testing - Twice Overburden						
CP02	14	560	0.32	0.06	2.2	2.19
CP05	14.5	580	0.36	0.07	1.4	2.18

Table 13: Consolidation Parameters

6.6 Lower Glaciofluvial Deposits

The Lower Glaciofluvial Deposits are a granular layer generally consisting of very dense, very gravelly, silty, clayey sand, which were encountered just above bedrock in CP04 and CP05 between 16.30mbgl and 17.90mbgl. The results of in situ and laboratory testing undertaken within this material are summarised in Table 14.

Test Type	Number of Results	Results		
		Min	Max	Mean
Natural Moisture content (%)	2	16	17	17
SPT (Uncorrected N Value)	3	>40	>50	>47

Table 14: Summary of in situ and laboratory results

6.6.1 Particle Size Distribution

A total of 2 Particle Size Distribution (PSD) tests were undertaken on samples taken from the Lower Glaciofluvial Deposits encountered in CP04 and CP05 at depths of 16.50mbgl and 17.50mbgl. Table 15 provides a breakdown of sample proportions for the Lower Glaciofluvial Deposits:

Borehole	Particle Size Distribution (dry mass percentage)							
	Depth	Cobble	Gravel	Sand	Silt	Clay	Fines	Description
CP04	16.5	0	31	50	12	7	19	SAND
CP05	17.5	0	26	68			6	SAND

Table 15: Particle Size Distribution

The PSD tests were undertaken on samples taken from the Lower Glaciofluvial sand layer. Table 15 confirms that the PSD soil descriptions of these deposits correlate with the borehole log soil descriptions.

6.6.2 SPT 'N' Values

Three SPTs were undertaken within the granular sand layer of the Lower Glaciofluvial Deposits between 16.00mbgl and 17.50mbgl, and recorded refusal N values of greater than 40 and 50, indicating the sand is very dense.

6.6.3 Bulk Density

Bulk density testing of the samples taken from the Lower Glaciofluvial Deposits was not undertaken. In absence of reliable test results, BS8002 (2015) suggests values below the water table for a very dense sand ranging between 20kN/m^3 and 22.5kN/m^3.

6.7 Ground Model

Table 16 summarises the characteristic geotechnical parameters for the proposed bridge and embankment.

Stratum*	Depth (mbgl)	c_u (kPa)[1]	φ' (deg)[2]	γ (kN/m^3)[3]	m_v (m^2/MN)[4]	c_v (m^2/year)[5]	e0[6]
Topsoil	0.20 – 0.60	-	-	-	-	-	-
Cohesive Upper Glacial Till	0.20 – 12.80	33 - 157	25 - 27	20.4 – 22.7	0.15 – 0.26	1.2 – 3.4	0.34 – 0.52
Granular Upper Glaciofluvial Deposits	11.30 – 15.00	-	30 - 34	18.0 – 21.5	-	-	-
Cohesive Lower Glacial Till	13.70 – 16.50	141 - 179	25 - 27	21.7 – 22.1	0.1	1.5 – 2.0	0.35 – 0.39
Granular Lower Glaciofluvial Deposits	16.30 – 17.90	-	39 - 41	20.0 – 22.5	-	-	-

[1] From in situ hand vane tests, laboratory testing, and correlation of Cu and SPT after Stroud (1975) (Tomlinson)
[2] BS8002 (2015) and Tomlinson (2001)
[3] BS8002 (2015)
[4] Laboratory testing – value varies with applied pressure. The value range given is considered representative of effective overburden pressure.
[5] Laboratory testing – value varies with applied pressure. The value range given is considered representative of effective overburden pressure.
[6] Laboratory testing – value varies with applied pressure. The value range given is considered representative of effective overburden pressure.

Table 16: Characteristic geotechnical parameters from testing and empirical data.

6.8 Groundwater

As shown in Table 3, groundwater entries were recorded during the ground investigation within the majority of boreholes at depths of between 1.10mbgl and 16.30mbgl. All groundwater entries recorded within the boreholes were seepages associated with granular strata. The seepages were encountered within the following layers:

- Localised lenses of sand, gravel and silt within the Upper Glacial Till, at depths of between 1.10mbgl and 8.30mbgl
- Sand and silt layers of the Upper Glaciofluvial Deposits, at depths of between 11.70mbgl and 13.20mbgl.
- Sand layer of the Lower Glaciofluvial Deposits, at a depth of between 16.30mbgl

Overall, groundwater levels have varied over the monitoring period, with no overall trend identified linking the boreholes. This variation is possibly related to periods of rainfall and localised pockets of perched groundwater within the glacial till that are not in hydraulic connectivity with each other.

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.

Shallow groundwater was not encountered during drilling of WS01, which was located within the location of the proposed attenuation pond. However, due to seasonal variations, the possibility of encountering shallow groundwater during construction cannot be discounted. The soils encountered beneath the location of the proposed attenuation pond were a firm to stiff slightly sandy, slightly gravelly silty clay to the full depth of the borehole, indicating the underlying Upper Glacial Till soils are relatively impermeable at this location. Therefore, lining of the attenuation pond is unlikely to be required, although this will need to be confirmed in the GDR.

6.9 Concrete

In accordance with Box 10 of BRE Special Digest 1, 2:1 aqueous extract chemical analysis was undertaken on fifteen soil samples taken from the boreholes at depths of between 0.50mbgl and 17.00mbgl.

The results are summarised in Table 17 Summary of Chemical Testing Results for Concrete Classification.

Chemical Test	Value		
	Minimum	Maximum	Average
pH	6.4	8.8	7.5
Soluble Sulphate (g/l)	<0.02	0.04	0.03

Table 17: Summary of the Results of Chemical Testing for Concrete Classification

A concrete assessment was carried out for the proposed bridge 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.

6.10 Contamination

Laboratory chemical testing was undertaken on 12 selected soil samples to determine whether the soils posed any significant risks to sensitive receptors, and to assess the soil for waste classification purposes. The samples were tested for a range of organic and inorganic determinants, including heavy metals, asbestos, speciated Polycyclic Aromatic Hydrocarbons (PAH), speciated Total Petroleum Hydrocarbons (TPH), sulphide and sulphate.

Human Health

The results of the testing were compared with the following published assessment criteria:

- Category 4 Screening Levels (C4SL) produced by the Department for Environment, Food and Rural Affairs (DEFRA); and,
- Suitable for Use Levels (S4UL) produced by the Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH).

It is considered that a Public Open Space – Public Park end use is the most representative of this site. As a conservative measure, a soil organic matter (SOM) content of 1% has been assumed for this site.

The concentrations of all the samples were below these guideline values and no asbestos fibres were recorded. This indicates that the soils beneath the scheme route do not pose a significant risk to human health.

In order 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).

The laboratory chemical test results are enclosed in Appendix B.

Controlled Waters

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.

Waste Classification

To determine the waste classification of any materials that may be disposed offsite as part of the proposed development, the laboratory chemical test results of all soil samples taken during the ground investigation were compared with waste regulations using the HazWasteOnline software. The Waste Classification Report (enclosed as Appendix G) indicates that all of the samples were found to be non-hazardous.

Any tarmac hardstanding excavated as waste will potentially contain coal tar and could potentially be treated as hazardous for disposal purposes. This will be dependent on waste classification of the results of sampling and testing of the tarmac material.

7. GEOTECHNICAL RISK

7.1.1 Current Assessment of Geotechnical Risks

A risk register has been developed to show mitigation measures which are to be put in place, in light of this report, to deal with identified geotechnical risks.

Reference has been made to the publication CD622 Managing Geotechnical Risk. The risks have been evaluated using the risk evaluation matrix suggested in CD 622.

Table 18: Geotechnical Risk Register Methodology – Likelihood vs Severity

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 19: Geotechnical Risk Register Methodology – Potential severity of harm occurring

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 20: Geotechnical Risk Register Methodology – Risk Classification

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
High (20-25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable level.

Table 21: Geotechnical Risk Register

Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Ground variability and made ground/unforeseen ground conditions	• Unacceptable ground movement/settlement. • Differential settlement between new embankment and adjacent road construction resulting in deterioration of pavement and longitudinal cracking. • 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
Weak founding stratum of bridge structure.	• Foundation failure. • Damage to bridge. • Potential cost and time implications of remedial works	3	4	12	• Ground conditions and geotechnical characteristics have been based on the existing site investigation. • Ensure the pile foundations are founded on suitable founding horizon and suitably designed. • Ensure appropriate construction materials and processes are specified.	1	4	4
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

Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Self-settlement of fill in areas of new embankment	Differential settlement between new embankment and adjacent road construction resulting in deterioration of pavement and longitudinal cracking.	3	4	12	• SI information has been assessed to determine ground conditions beneath the new embankments. • Assess likely settlement during detailed design. • Ensure appropriate construction materials and compaction processes are specified.	1	4	4
Instability of proposed embankment	• Undermining / damage to carriageway and roadside equipment. • Encroachment of slipped debris onto land at the toe	4	3	12	• SI information has been assessed to determine ground conditions beneath the new embankments. • Assess likely settlement, slope stability and allowable bearing capacity during detailed design. • Ensure appropriate construction materials and compaction processes are specified.	1	3	3
Groundwater during construction.	• Rising groundwater encountered during bridge piling works causing delays in the programme. • Dewatering required during construction causing delays in the programme. • Requirement for drainage measures.	2	3	6	• An in-depth review of groundwater monitoring results 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 significant risk. However, this is subject to confirmation in the GDR.	1	3	3

Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
					• Contractor to review GIR and GDR and determine acceptable method for dealing with groundwater.			
High groundwater table at location of attenuation pond	• Dewatering required during construction causing delays in the programme. • Requirement for drainage measures.	2	3	6	• Shallow groundwater was not encountered during drilling of WS01, although the possibility of encountering shallow groundwater cannot be discounted. If encountered during excavation, contractor will need to determine acceptable method for dealing with groundwater.	1	3	3
Aggressive Ground Soil Chemistry	• Deterioration of Buried Concrete • Failure of Lime/Cement Stabilisation	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

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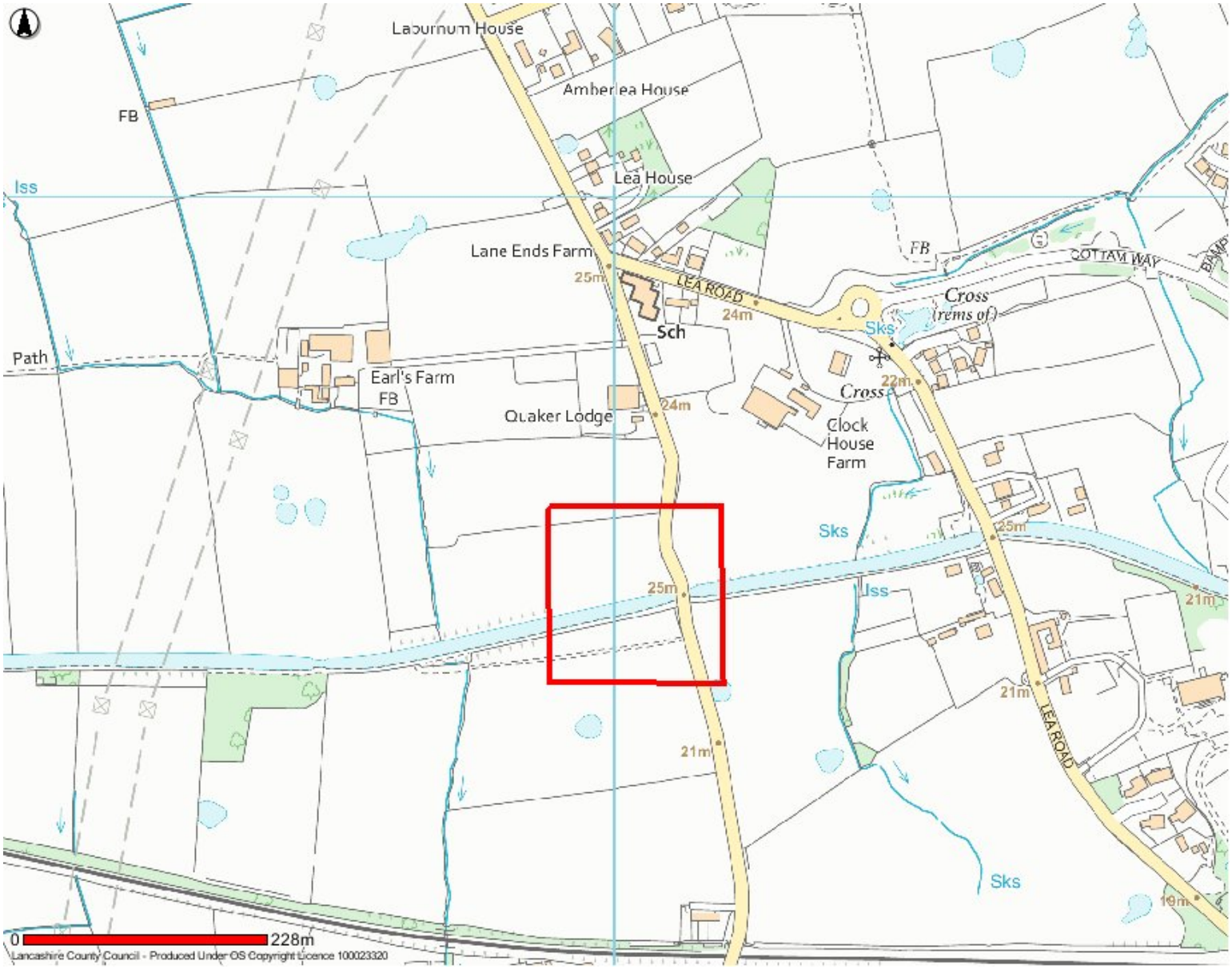
Appendix A

Site location



Districts

- Other District/Unitary Authority
- Lancashire Districts

Cottom Parkway Access Bridge Proposed Location

Lancashire County Council

Date: 13/11/2020

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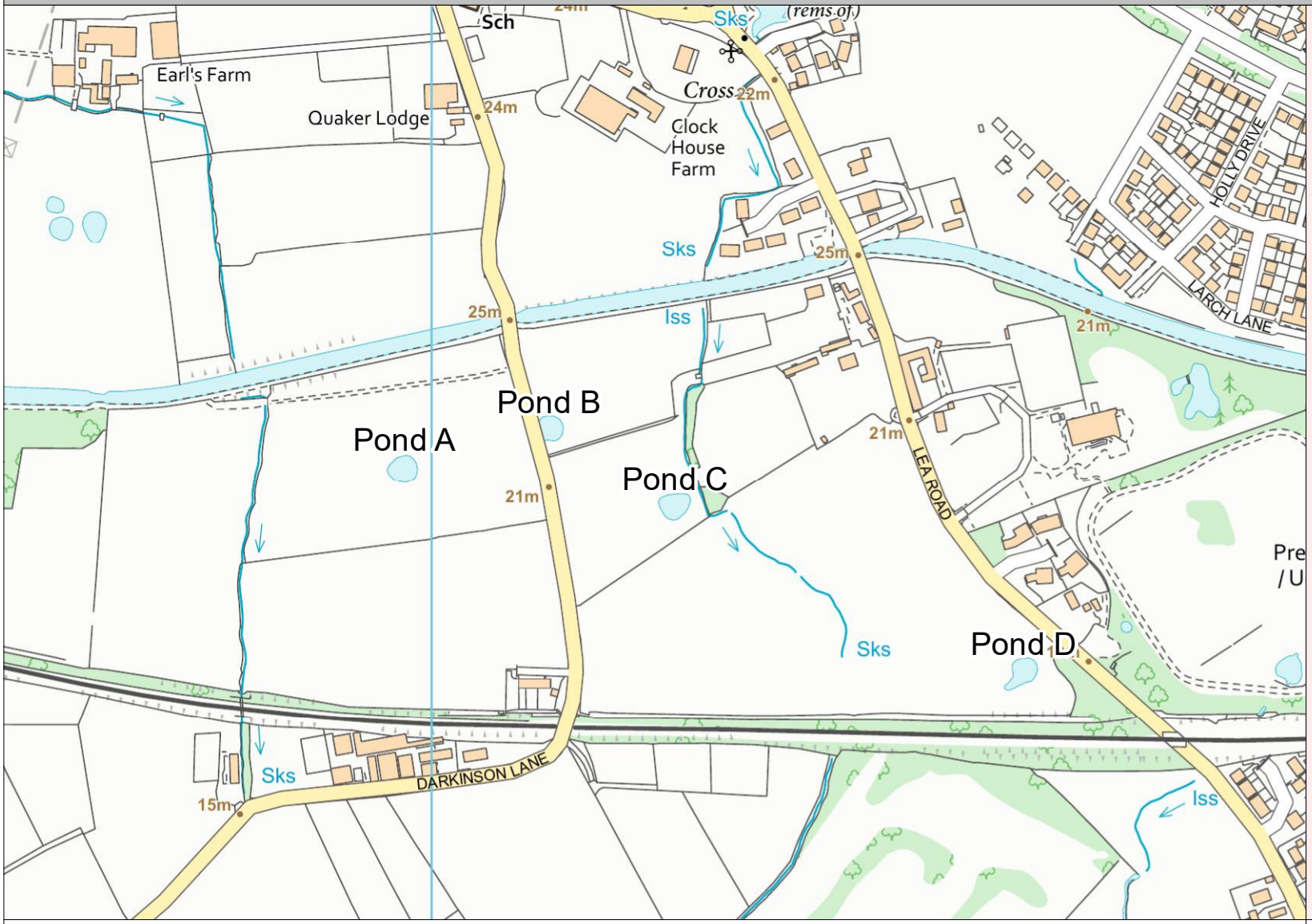
Centre of map: 349001:431732

Location Map

Lancashire County Council

Author:

Date Created: 25/02/2021



0 0.05 0.1 0.2 0.3 0.4 mi

0 0.125 0.25 0.5 0.75 km

N

Map Scale: 1:5,000

Map Centre: 349,185 431,512

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Appendix B

CC Geotechnical Ltd – Factual Report, May 2021

CCG-C-21-12093

COTTAM PARKWAY STATION, PRESTON

FACTUAL REPORT

MAY 2021

Prepared by:

CC GEOTECHNICAL LIMITED

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Liverpool
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L33 7BU

Tel: 0151 545 2750

Prepared for:

LANCASHIRE COUNTY COUNCIL

County Hall
Fishergate
Preston
PR1 8XB

DOCUMENT CONTROL FORM	
Client:	Lancashire County Council
Project Title:	Site Investigation at Cottam Parkway Station
Reference Number:	CCG-C-21-12093
Main Author:	Samuel Parry BSc(Hons)
Signature:	
Reviewed by:	Chris Bolan MSc CEng MICE CEnv
Signature:	
Approved for Issue by:	Chris Bolan MSc CEng MICE CEnv
Signature	
For and behalf of CC GEOTECHNICAL LTD	
Date:	May 2021
Revision Number:	0
Comments:	
Status:	Final
Distribution:	Lancashire County Council

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The findings and opinions provided in this document are made in good faith and are subject to the limitations imposed by employing site assessment methods and techniques, appropriate to the time of investigation and within the limitations and constraints defined in this document. The findings and opinions are relevant to the dates when the assessment was undertaken but should not necessarily be relied upon to represent conditions at a substantially later date. In particular, seasonal groundwater levels, with the effects of precipitation, may affect the conditions found during the investigation.

Where opinions expressed in this report are based on current available guidance and legislation, no liability can be accepted by ***CCG*** for the effects of any future changes to such guidelines and legislation. Additional information, improved practices, new guidance, changes in legislation, or amendments to design proposals, may necessitate this report having to be reviewed in whole or in part after that date.

Factual data has largely been obtained from enquiries with third parties, the results of which are relied on unless indicated to be inaccurate by contradictory information. Further assessment, investigation, construction activities, could not have been taken into account in the preparation of the report. Where such information might impact upon stated opinions, ***CCG*** reserves the right to modify such opinions expressed herein.

The findings and opinions conveyed, via this report, are based on information obtained from a variety of sources as detailed in this report, and which *CCG* assumes to be reliable, but has not been independently confirmed. Therefore, ***CCG*** cannot and does not guarantee the authenticity or reliability of third-party information it has referred to.

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TABLE OF CONTENTS

1.0 INTRODUCTION

CC GEOTECHNICAL LTD (CCG) was commissioned by ***LANCASHIRE COUNTY CONCIL*** (The Client) to provide geotechnical fieldwork and laboratory testing services in connection with a proposed construction project at Cottam Parkway Station, Preston, PR4 0RE.

The Client has indicated the proposed works include the construction of a carpark with an adjoining road and bridge crossing the Lancaster Canal.

The investigation was required to provide geotechnical properties of the underlying strata insofar as they relate to permanent and temporary design works and construction of the proposed bridge foundations, road and carpark.

2.0 SITE LOCATION & DESCRIPTION

The proposed Cottam Parkway Station is located approximately 5km west-northwest of Preston City centre and approximately 3km east of 'Salwick' railway station.

Presently, the site is privately owned farmland with multiple access gates. The planned carpark development runs parallel with the existing railway whereas the planned road and bridge runs perpendicular to the existing railway.

The sites topography is relatively flat with an average elevation across the site being 20.17mAOD.

3.0 PURPOSE & AIMS OF THE INVESTIGATION

The purpose of this investigation was to determine the geological sequence below ground level and the engineering properties of encountered strata.

The scope and extent of this investigation was determined by The Client.

The data reported herein provides geotechnical information on the ground conditions underlying the site and is presented as a factual compilation. No interpretations have been placed on the findings.

This report must be read in conjunction with the Notes on Limitations, presented in Appendix I.

4.0 FIELDWORK

4.1 Introduction

The fieldwork element of the investigation was carried out during the period 01st March – 26th March 2021, and comprised the following:

- Mobilisation of plant and personnel
- Surveying of borehole locations and elevations by GPS (Leica GS15)
- Sinking of 6nr boreholes by cable percussion methods (CP01-CP06)
- Advancement of each cable percussion borehole into the bedrock by chiselling
- Sinking of 18nr window sample holes up to 6.00mbgl

- Installation of 8nr groundwater and gas monitoring piezometer standpipes (CP01, 03, 04, 06) (WS05, 09, 14, 18)
- The mechanical excavation of 6nr trial pits up to 2.00mbgl (TP01 - TP06)
- Conducting 3nr falling head permeability tests. (FH 8/9, FH 12/13, FH 18/17)
- The recovery of small disturbed and bulk disturbed soil samples for geotechnical laboratory testing
- The recovery of undisturbed soil samples in cohesive strata for geotechnical laboratory testing

The fieldwork was carried out in accordance with the UK Specification for Ground Investigation: 2nd Edition: 2015, and BS10175:2011 +A2 2017, BS5930:2015 +A1 2020, and BS EN 1997-2:2007 Eurocode 7, insofar as they related to the scope of the investigation.

The locations of the exploratory positions were instructed by The Client and set out by ***CCG***.

The layout of the investigation is as annotated on The Clients Drawings , provided in Appendix A.

4.1 Cable Percussion Boreholes

All boreholes were positioned clear of recorded buried services and the locations were scanned using a Cable Avoidance Tool (CAT) prior to the hand excavation of a starter pit extending to a typical depth of 1.2mbgl.

6nr boreholes (CP01-CP06) were advanced through superficial/drift deposits using cable percussion methods using a Dando 150 drilling rig deploying 150mm diameter tools and casings. All drill arisings were logged in detail, and bulk disturbed, and small disturbed samples were recovered at regular incremental depths.

In-situ SPT's and U100 sampling was carried out at alternating 1m depth intervals up to 10mbgl. Below 1ombgl alternating SPT and U100 tests were undertaken at 1.50m depth intervals with U100 samples recovered in suitable cohesive soils.

All cable percussion boreholes were terminated upon proving bedrock.

Logs of the boreholes annotated with position co-ordinates, elevation, sampling records, SPT 'N' values and undrained cohesion values are provided in Appendix B.

The SPT hammer calibration certificate is provided in Appendix D.

4.2 Dynamic Sampling Boreholes

All boreholes were positioned clear of recorded buried services and the locations were scanned using a Cable Avoidance Tool (CAT) prior to the hand excavation of a starter pit extending to a typical depth of 1.2mbgl.

3nr window sample boreholes were sunk to 6mbgl (WS11, WS12, WS14). WS13, scheduled for 6mbgl, refused at 2.9mbgl on a suspected boulder.

A further 8nr window sample boreholes were sunk to 3mbgl (WS07-WS10 and WS15-WS18) with 6nr window sample boreholes sunk to 4mbgl (WS01 - 06)

All window sample boreholes were advanced through superficial/drift deposits using dynamic sampling methods using a Dando terrier dynamic sampling rig. In this method of investigation, relatively “undisturbed” soil profile samples are recovered in 1m long Perspex liners. The Perspex tubes are split and carefully logged and subsampled. Subsamples for analysis are removed at appropriate depths from the profile and transferred to chilled amber glass jars and vials for laboratory analysis.

In-situ SPT’s were carried out at regular 1 m intervals to termination depth.

Logs of the boreholes, annotated with sampling details and SPT `N’ values are given in Appendix B.

All boreholes, excluding WS13, were terminated at The Clients instructed depth.

4.3 Trial Pit Excavations

6nr trial pit excavations were positioned clear of recorded buried services and were scanned using a Cable Avoidance Tool (CAT). All excavations were undertaken with an 8-tonne rubber tracked excavator and extended to a maximum termination depth of 2mbgl as instructed by The Client.

The exposures were carefully logged and sampled, and the arisings then returned to the excavations in the reverse sequence of their excavation to preserve, insofar as was possible, the original lithology.

Logs of the pits annotated with details of sub-sampling and hand shear vane test data are given in Appendix B.

Photographs of the trial pit exposures and arisings are provided at Appendix E.

Dynamic Cone Penetration (DCP) results are provided in Appendix H

4.4 Falling Head Permeability Tests

3nr falling head permeability tests (FH 8/9, 13/12 & 17/18) were conducted in accordance with the method described in BS5930. The FH 8/9 indicates the WS boreholes it was positioned between. Similarly for the other tests. This test involved the sinking of a 1m borehole, logging the arisings and casing off the borehole to 1mbgl. An

87mm Perspex liner was used to case off the borehole. The hole was then filled with water and monitored over a period of up to 2.5 hours.

Results are presented in Appendix C.

5.0 LABORATORY TESTING

5.1 Soil Engineering Testing

Selected samples of soils recovered from the intrusive investigation were subjected to the following program of engineering testing, undertaken at the UKAS accredited laboratory of ***CCG***:

- 103nr soil samples were subjected to the determination of Moisture Content in accordance with BS1377: Part 2: 1990
- 63nr soil samples were subjected to the determination of Liquid & Plastic Limits BS 1377-2:1990
- 19nr Particle Size Distributions BS 1377-2:1990
- 3nr U100 soil samples were subjected to the determination of Unconsolidated Undrained Triaxial Compression in accordance with BS 1377: Part 7: 1990
- 10nr U100 soil samples were subjected to the determination of Unconsolidated Undrained Triaxial Compression (multi-stage) in accordance with BS 1377: Part 7: 1990
- 11nr One-dimensional Consolidation Test in accordance with BS 1377-5:1990
- 16nr Sedimentation by Hydrometer in accordance with BS 1377-2:1990

The soil engineering test results are presented in Appendix F.

5.2 LCC Framework Suites Chemical Testing.

Selected subsamples of soil and rock were subjected to a suite of chemical testing derived from LCC Framework suites. All testing was undertaken at a subcontract UKAS / MCERTS accredited laboratory.

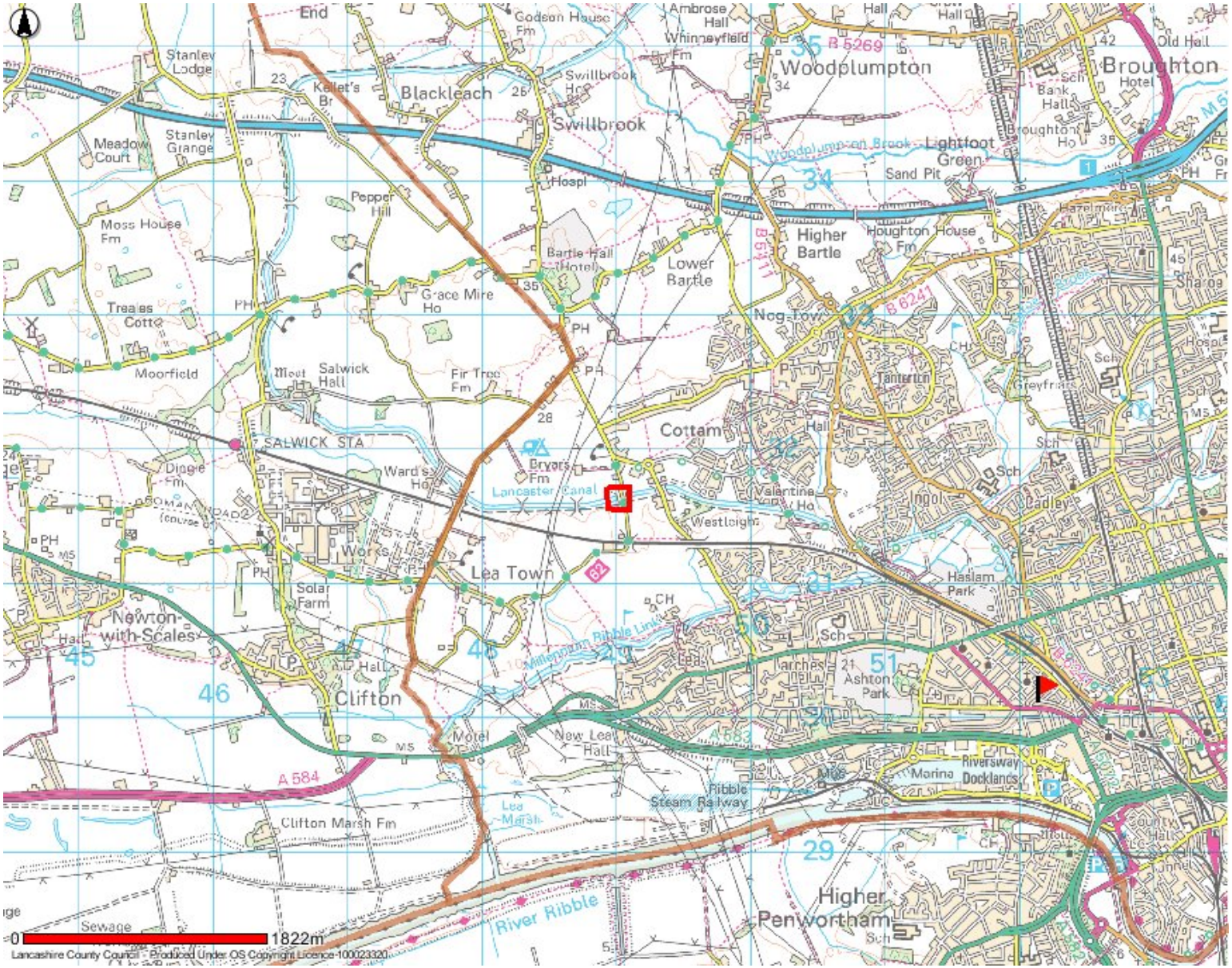
The following programme of testing was undertaken on selected soil samples:

- 27nr Standard Soil Suites
- 27nr Asbestos Screen Tests
- 27nr Speciated TPH Tests
- 27nr Speciated PAH Tests
- 23nr Sulphate content of acid extract from soil tests
- 23nr Sulphate content of water extracted from soil tests.
- 2nr pH Test

The results of the chemical analyses are presented in Appendix G.

APPENDIX A

DRAWINGS



Cottom Parkway Access Bridge Proposed Location Map 2

Lancashire County Council

Date: 13/11/2020

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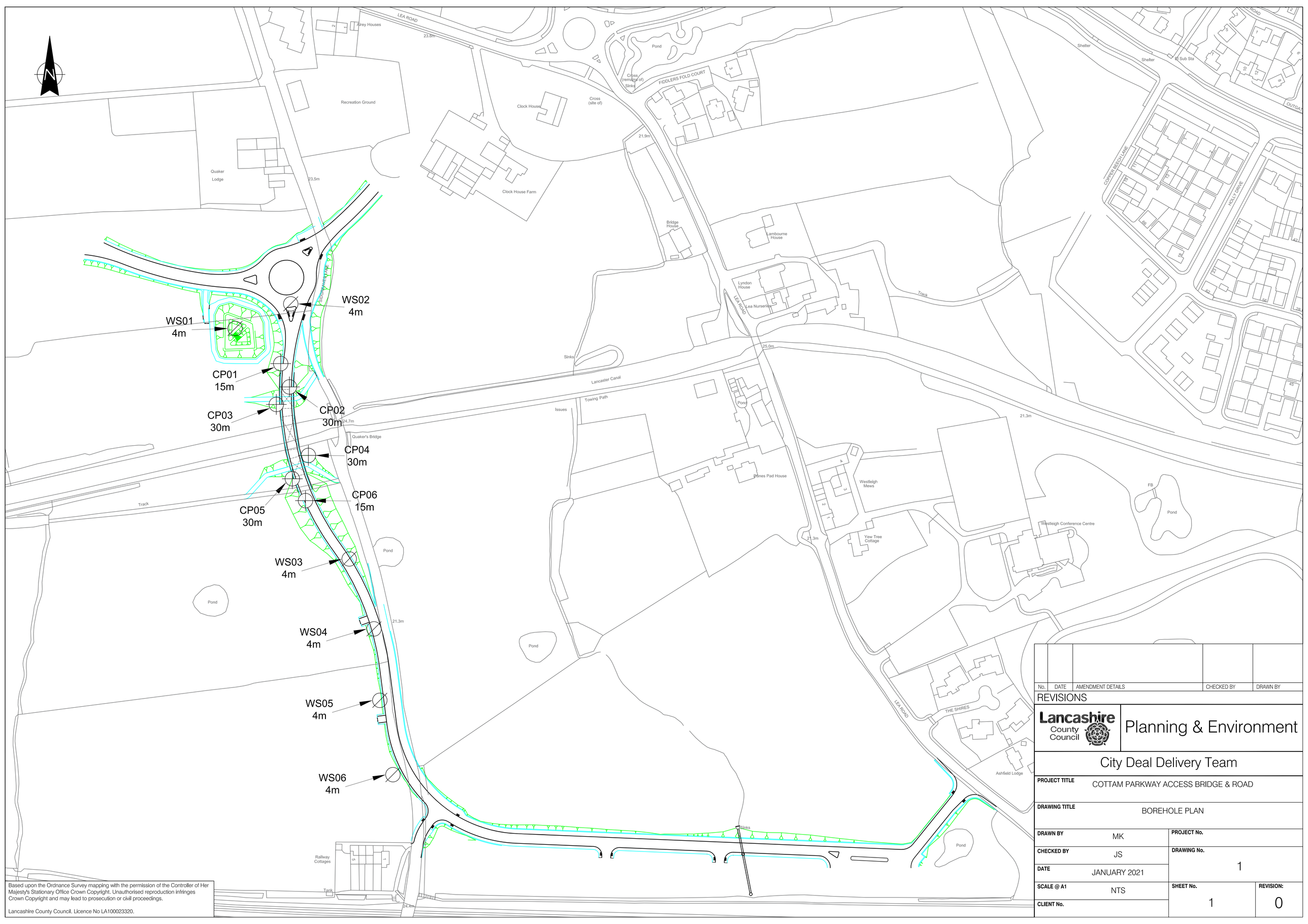

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No.	DATE	AMENDMENT DETAILS	CHECKED BY	DRAWN BY

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
CLIENT No.		**REVISION:**	0

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

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APPENDIX B

BOREHOLE AND TRIAL PIT LOGS

Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **CP01**
Contract Number: CCG-C-21-12093	Date Started: 12/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Cable Percussion Borehole Log	Easting: 349023.9	Northing: 431670.3	Ground Level: 22.50mAOD	Plant Used: Dando 150
Rig Crew: AR/CMG	Scale: 1:50	Sheet 1 of 2		
Weather:	Termination: As instructed	SPT Hammer: CCG6 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.15	D					Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular mudstone and sandstone (TOPSOIL)		
0.20	ES			(0.60)				
0.30	B		21.90	0.60				
0.70	B					Firm to stiff brown slightly sandy slightly gravelly silty CLAY of medium undrained shear strength with frequent silt and sand laminations. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
0.80	ES					*Soft and frequent rootlets at 0.60 - 1.00mbgl*		
1.00	D					*Firm CLAY @ 1.00 - 2.00mbgl*		
1.30	ES	SPT(S) 1.20m, N=15 (2,2/4,3,3,5)						
1.50	B							
2.00	D					*Firm to stiff CLAY @ >2.00mbgl*		
2.00	ES							
2.00 - 2.45	U							
2.50	B							
3.00	D	SPT(S) 3.00m, N=12 (2,3/3,3,3,3)						
3.00	ES							
3.50	B							
3.70	ES							
4.00	D							
4.00 - 4.45	U							
4.50	B							
5.00	D	SPT(S) 5.00m, N=11 (2,2/2,2,3,4)						
5.50	B			(11.20)				
6.00	D							
6.00 - 6.45	U							
6.50	B							
7.00	D	SPT(S) 7.00m, N=15 (3,3/3,4,4,4)						
7.50	B							
8.00	D							
8.00 - 8.45	U							
8.50	B					*Clay becomes soft at 8.50 - 11.80mbgl*		
9.00	D	SPT(S) 9.00m, N=13 (2,3/2,3,4,4)						
9.50	B							
10.00	D					Continued next sheet		

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
12-03-2021	16:00	5.50	5.50	
13-03-2021	08:30	5.50	5.50	5.30
13-03-2021	16:00	16.00	16.00	
15-03-2021	00:00	16.00	16.00	15.70

Borehole Diameter

Depth (m)	Dia (mm)
19.00	150

Casing Diameter

Depth (m)	Dia (mm)
18.00	150

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	20
1.00	18.00	SLOTTED	20

Remarks:
1 hour hand excavated service avoidance pit.

Water Strikes

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

Contract Name: Cottam Parkway Station			Client: LCC		Borehole ID: **CP01**
Contract Number: CCG-C-21-12093	Date Started: 12/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 2 of 2
Cable Percussion Borehole Log	Easting: 349023.9	Northing: 431670.3	Ground Level: 22.50mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50
Weather:	Termination: As instructed		SPT Hammer: CCG6 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 10.45	U					Firm to stiff brown slightly sandy slightly gravelly silty CLAY of medium undrained shear strength with frequent silt and sand laminations. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
10.50	B							
11.00	D							
		SPT(S) 11.50m, N=11 (2,3/2,3,2,4)						
			10.70	11.80				
11.90	ES			(0.30)		Brown slightly sandy clayey SILT.		
12.00	B		10.40	12.10				
12.00	D					Soft brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
				(0.50)				
			9.90	12.60		Medium dense brown sandy clayey SILT.		
13.00	D	SPT(S) 13.00m, N=11						
13.00	ES	(3,2/2,3,3,3)		(1.10)				
13.50	B							
			8.80	13.70		Stiff brown slightly sandy slightly gravelly silty CLAY of very high undrained shear strength. Gravel is fine to medium well rounded mudstone and sandstone.		
14.50 - 14.95	U							
15.00	B							
				(2.80)				
15.50	D							
		SPT(S) 16.00m, 50 (10,15/50 for 105mm)						
16.50	B		6.00	16.50		Reddish brown very weak highly weathered SANDSTONE recovered as very sandy silty fine to coarse subangular to subrounded GRAVEL		
17.00	D							
		SPT(S) 17.50m, 50 (25 for 85mm/50 for 160mm)						
				(2.50)				
18.00	B							
		SPT(S) 19.00m, 50 (25 for 85mm/50 for 190mm)	3.50	19.00		End of Borehole at 19.00m		

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
12-03-2021	16:00	5.50	5.50	
13-03-2021	08:30	5.50	5.50	5.30
13-03-2021	16:00	16.00	16.00	
15-03-2021	00:00	16.00	16.00	15.70

Borehole Diameter

Depth (m)	Dia (mm)
19.00	150

Casing Diameter

Depth (m)	Dia (mm)
18.00	150

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	20
1.00	18.00	SLOTTED	20

Remarks:
1 hour hand excavated service avoidance pit.

Water Strikes

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

Contract Name:		Client:			Borehole ID:
Cottam Parkway Station		LCC			**CP02**
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	19/03/2021	SP	CB	FINAL	
Cable Percussion Borehole Log	Easting: 349029.4	Northing: 431656.7	Ground Level: 22.34mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50

Weather: | Termination: Refusal on sandstone bedrock | SPT Hammer: CCG6 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.15	ES			(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone. Grassed at surface (TOPSOIL)		
0.20	B		22.04	0.30		Firm to stiff light brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone		
0.20	D							
0.50	B							
0.50	D							
0.60	ES			(1.10)				
0.90	D							
1.00	B							
1.20	ES	SPT(S) 1.20m, N=16 (1,3/4,4,4,4)						
1.50	B		20.94	1.40		Firm to stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone		
1.70	ES							
2.00	D							
2.00 - 2.45	U							
2.50	B			(2.05)				
2.70	ES							
3.00	D	SPT(S) 3.00m, N=15 (2,3/4,3,4,4)						
3.50	ES		18.89	3.45		Brown slightly sandy clayey SILT.		
3.60	B		18.64	3.70		Firm to stiff brown slightly sandy slightly gravelly silty CLAY with frequent sand and silt laminations. Gravel is fine to medium subangular to well rounded mudstone and sandstone.		
4.00	D							
4.00 - 4.45	U							
4.50	B							
5.00	D	SPT(S) 5.00m, N=13 (2,2/3,3,3,4)						
5.50	B							
6.00	D							
6.00 - 6.45	U							
6.50	B							
7.00	D	SPT(S) 7.00m, N=20 (3,4/4,5,5,6)		(7.60)				
7.50	B					*Soft between 7.50 - 8.70mbgl*		
8.00	D							
8.00 - 8.45	U							
8.50	B							
9.00	D	SPT(S) 9.00m, N=14 (2,3/3,3,4,4)						
9.50	B							
10.00	D							

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
21-03-2021	08:00	5.00	5.00	
21-03-2021	16:00	16.00	16.00	
22-03-2021	08:00	16.00	16.00	15.50
22-03-2021	15:00	18.80	18.80	18.50

Borehole Diameter

Depth (m)	Dia (mm)
18.80	150

Casing Diameter

Depth (m)	Dia (mm)
18.80	150

Chiselling

From (m)	To (m)	Duration	Remarks
17.50	18.80	01:00	Chiseling through sandstone bedrock

Installation

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

Remarks:
1 hour hand excavated service avoidance pit.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
13.20	13.20	13.70	0		Slight seepage

Contract Name:		Client:			Borehole ID:
Cottam Parkway Station		LCC			**CP02**
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 2 of 2
CCG-C-21-12093	19/03/2021	SP	CB	FINAL	
Cable Percussion Borehole Log	Easting: 349029.4	Northing: 431656.7	Ground Level: 22.34mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50

Weather: | Termination: Refusal on sandstone bedrock | SPT Hammer: CCG6 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 10.45	U					Firm to stiff brown slightly sandy slightly gravelly silty CLAY with frequent sand and silt laminations. Gravel is fine to medium subangular to well rounded mudstone and sandstone.		
10.50	B							
11.00	D							
			11.04	11.30				
11.40	B			(0.30)		Medium dense brown slightly sandy clayey SILT.		
11.50	ES	SPT(S) 11.50m, N=12 (2,3/2,4,3,3)	10.74	11.60				
			10.54	11.80		Soft brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone.		
12.00	ES					Medium dense brown silty clayey fine to medium SAND.		
12.50	B							
				(1.90)				
13.00	D	SPT(S) 13.00m, N=14 (4,3/4,3,3,4)					▼	
			8.64	13.70		Firm to stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to well rounded mudstone and sandstone.		
14.00	B			(0.70)				
14.00 - 14.45	U							
			7.94	14.40		Very stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse angular to subrounded sandstone and mudstone.		
14.50	D					*340mm of U100 sample recovered. Sampler impacted cobble at 14.84mbgl.*		
15.00	B							
15.40	D			(1.90)				
16.00	B	SPT(S) 16.00m, 50 (25 for 105mm/50 for 200mm)						
			6.04	16.30		Weak highly weathered reddish brown SANDSTONE recovered as brown very gravelly silty clayey SAND. Gravel is fine to coarse subrounded sandstone.		
16.50	B							
17.00	D							
		SPT(S) 17.50m, 50 (25 for 95mm/50 for 155mm)		(2.50)				
18.00	B							
18.50	D							
		SPT(S) 18.80m, N=100 (25 for 90mm/100 for 285mm)	3.54	18.80		End of Borehole at 18.80m		

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)
21-03-2021	08:00	5.00	5.00	
21-03-2021	16:00	16.00	16.00	
22-03-2021	08:00	16.00	16.00	15.50
22-03-2021	15:00	18.80	18.80	18.50

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18.80	150	18.80	150

Remarks:
1 hour hand excavated service avoidance pit.

Chiselling			
From (m)	To (m)	Duration	Remarks
17.50	18.80	01:00	Chiseling through sandstone bedrock

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

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
13.20	13.20	13.70	0		Slight seepage

	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **CP03**
	Contract Number: CCG-C-21-12093	Date Started: 17/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
					Sheet 1 of 2
Cable Percussion Borehole Log	Easting: 349019.8	Northing: 431641.8	Ground Level: 22.63mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG
					Scale: 1:50
Weather:		Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%	

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.15	ES			(0.30)		Soft grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular mudstone and sandstone. Frequent rootlets, Grassed at surface (TOPSOIL)		
0.20	B		22.33	0.30		Soft to firm light brown mottled grey slightly sandy silty CLAY.		
0.20	D					*CLAY is soft at 0.30 - 1.00mbgl*		
0.40	B							
0.50	ES			(1.00)				
0.60	D							
1.00	B					*CLAY is firm at 1.00 - 1.30mbgl*		
1.10	ES							
1.20	D	SPT(S) 1.20m, N=12 (1,2/3,3,3,3)	21.33	1.30		Firm to stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength and occasional lamination of sand. Gravel is fine to coarse subangular to subrounded mudstone and sandstone.		
1.50	B							
1.80	ES							
2.00	D							
2.00 - 2.45	U							
2.50	B							
2.60	ES							
3.00	D	SPT(S) 3.00m, N=12 (2,2/3,3,3,3)						
3.50	B							
3.60	ES							
4.00	D							
4.00 - 4.45	U							
4.50	B							
5.00	D	SPT(S) 5.00m, N=12 (2,3/2,3,3,4)						
5.50	B			(10.40)				
6.00	D							
6.00 - 6.45	U							
6.50	B							
7.00	D	SPT(S) 7.00m, N=16 (2,4/4,4,4,4)						
7.50	B							
8.00	D							
8.00 - 8.45	U							
8.50	B							
9.00	D	SPT(S) 9.00m, N=15 (3,2/5,3,3,4)						
9.50	B							
10.00	D							

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
17-03-2021	16:00	11.00	11.00	
18-03-2021	08:30	11.00	11.00	

Borehole Diameter

Depth (m)	Dia (mm)
17.50	150

Casing Diameter

Depth (m)	Dia (mm)
17.00	150

Chiselling

From (m)	To (m)	Duration	Remarks
16.00	17.50	01:00	Chiseling through sandstone bedrock

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	16.50	SLOTTED	19

Remarks:

1 hour hand excavated service avoidance pit.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
11.70	11.70	12.20	10	11.70	Slightly wet sands
12.90	12.90	15.00	15	12.90	Slightly wet sands

Contract Name: Cottam Parkway Station		Client: LCC			Borehole ID: **CP03**
Contract Number: CCG-C-21-12093	Date Started: 17/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 2 of 2
Cable Percussion Borehole Log	Easting: 349019.8	Northing: 431641.8	Ground Level: 22.63mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50
Weather:	Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 10.45	U					Firm to stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength and occasional lamination of sand. Gravel is fine to coarse subangular to subrounded mudstone and sandstone.		
10.50	B							
11.00	D							
		SPT(S) 11.50m, N=20 (3,4/5,5,5,5)						
			10.93	11.70				
11.80	ES			(0.40)		Brown slightly sandy slightly gravelly clayey SILT. Gravel is fine to medium subrounded sandstone and mudstone.		
12.00	B							
12.00	D		10.53	12.10		Soft brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
12.50	B			(0.80)				
12.50	D							
			9.73	12.90				
		SPT(S) 13.00m, N=15 (2,4/3,5,4,3)				Medium dense brown sandy clayey SILT.		
13.50	B							
13.60	ES							
14.00	D			(2.10)				
		SPT(S) 14.50m, N=13 (2,4/3,3,3,4)						
			7.63	15.00				
15.10	B			(0.60)		Firm to stiff brown slightly sandy silty CLAY with frequent laminations if silt and sand.		
15.50	D							
			7.03	15.60		Reddish brown very weak highly weathered SANDSTONE recovered as very sandy silty fine to coarse subangular to subrounded GRAVEL.		
		SPT(S) 16.00m, 50 (10,14/50 for 295mm)						
16.50	B			(1.90)				
17.00	D							
		SPT(S) 17.20m, N=100 (11,14/100 for 230mm)						
			5.13	17.50		End of Borehole at 17.50m		

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)
17-03-2021	16:00	11.00	11.00		17.50	150	17.00	150
18-03-2021	08:30	11.00	11.00					

Chiselling			
From (m)	To (m)	Duration	Remarks
16.00	17.50	01:00	Chiseling through sandstone bedrock

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	16.50	SLOTTED	19

Remarks:
1 hour hand excavated service avoidance pit.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
11.70	11.70	12.20	10	11.70	Slightly wet sands
12.90	12.90	15.00	15	12.90	Slightly wet sands

Contract Name:		Client:			Borehole ID:
Cottam Parkway Station		LCC			**CP04**
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	04/03/2021	SP	CB	FINAL	
Cable Percussion Borehole Log	Easting: 349042.5	Northing: 431606.4	Ground Level: 22.97mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50
Weather: Dry	Termination: Refusal on sandstone bedrock	SPT Hammer: CCG6 Energy Ratio: 64%			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			22.77	0.20		Grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular sandstone and mudstone. Frequent rootlets, grassed at surface (TOPSOIL)		
0.40	B					Stiff brown slightly sandy slightly gravelly silty CLAY of very high undrained shear strength. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
0.50	ES							
		SPT(S) 1.20m, N=8 (2,2/1,2,2,3)						
1.50	B			(2.50)				
2.00	D							
2.00 - 2.45	U							
2.50	B							
2.50	ES		20.27	2.70		Medium dense brown very silty slightly clayey slightly gravelly SAND. Gravel is fine to medium subrounded sandstone.		
3.00	D	SPT(S) 3.00m, N=11 (3,2/2,3,3,3)		(1.00)				
3.50	B							
3.50	ES		19.27	3.70		Firm to stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength. Gravel is fine to medium subangular to rounded mudstone and sandstone.		
4.00	D							
4.00 - 4.45	U							
4.50	B							
4.50	ES							
5.00	D	SPT(S) 5.00m, N=19 (2,4/4,5,5,5)						
5.50	B							
5.50	ES							
6.00	D			(4.60)				
6.00	U							
6.50	B							
6.50	ES							
7.00	D	SPT(S) 7.00m, N=24 (4,4/5,6,6,7)						
7.50	B							
7.50	ES							
8.00	D							
8.00 - 8.45	U							
			14.67	8.30		Brown sandy slightly gravelly slightly clayey SILT. Gravel is fine to medium subrounded sandstone.		
8.50	B		14.47	8.50		Firm brown slightly sandy slightly gravelly silty CLAY of medium undrained shear strength. Gravel is fine to medium subangular to rounded mudstone and sandstone.		
8.50	ES							
9.00	D	SPT(S) 9.00m, N=22 (3,5/4,6,5,7)						
9.50	B							
9.50	ES							
10.00	D							

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
04-03-2021	16:00	11.00	11.00	
05-03-2021	08:30	11.00	11.00	
05-03-2021	16:00	18.00	18.00	16.90

Borehole Diameter

Depth (m)	Dia (mm)
18.00	150

Casing Diameter

Depth (m)	Dia (mm)
18.00	150

Remarks:

1 hour hand excavated service avoidance pit.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	20
1.00	17.00	SLOTTED	20

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.70	2.70	3.90	20	2.70	Water strike
8.30	8.30	8.60	20	8.10	Water strike
12.90	12.90	13.80	10	12.90	Water strike

Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **CP04**
Contract Number: CCG-C-21-12093	Date Started: 04/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Cable Percussion Borehole Log	Easting: 349042.5	Northing: 431606.4	Ground Level: 22.97mAOD	Plant Used: Dando 150
Rig Crew: AR/CMG	Scale: 1:50			Sheet 2 of 2
Weather: Dry	Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%	

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 10.45	U					Firm brown slightly sandy slightly gravelly silty CLAY of medium undrained shear strength. Gravel is fine to medium subangular to rounded mudstone and sandstone.		
10.50	B							
11.00	D							
		SPT(S) 11.50m, N=23 (3,5/5,6,6,6)		(4.40)				
12.00	B							
12.50	D							
		SPT(S) 13.00m, N=23 (5,4/4,6,6,7)	10.07	12.90		Medium dense brown very silty clayey gravelly SAND. Gravel is fine to medium subrounded sandstone.		
13.50	B			(0.80)				
			9.27	13.70		Stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength. Gravel is fine to medium subangular to rounded mudstone and sandstone.		
14.00	D							
14.50 - 14.95	U							
15.00	B			(2.60)				
15.50	D							
		SPT(S) 16.00m, 50 (3,5/50 for 160mm)						
			6.67	16.30		Very dense brown very gravelly silty clayey SAND. Gravel is fine to coarse subangular to subrounded mudstone and sandstone.		
16.50	B							
17.00	D			(1.60)				
17.50	B	SPT(S) 17.50m, 40 (11,12/40 for 170mm)						
		SPT(S) 18.00m, 100 (25 for 85mm/100 for 190mm)	5.07 4.97	17.90 18.00		Very weak slightly weathered brown SANDSTONE End of Borehole at 18.00m		

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
04-03-2021	16:00	11.00	11.00	
05-03-2021	08:30	11.00	11.00	
05-03-2021	16:00	18.00	18.00	16.90

Borehole Diameter

Depth (m)	Dia (mm)
18.00	150

Casing Diameter

Depth (m)	Dia (mm)
18.00	150

Remarks:
1 hour hand excavated service avoidance pit.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	20
1.00	17.00	SLOTTED	20

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.70	2.70	3.90	20	2.70	Water strike
8.30	8.30	8.60	20	8.10	Water strike
12.90	12.90	13.80	10	12.90	Water strike

Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **CP05**
Contract Number: CCG-C-21-12093	Date Started: 01/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Cable Percussion Borehole Log	Easting: 349034.0	Northing: 431589.7	Ground Level: 22.50mAOD	Plant Used: Dando 150
Rig Crew: AR/CMG	Scale: 1:50			Sheet 1 of 2
Weather: Dry	Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%	

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			22.50	(0.50)		Dark brown slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular mudstone and sandstone. Frequent rootlets grassed at surface (TOPSOIL)		
0.20	ES							
0.30	B							
0.30	D		22.00	0.50		Soft to firm brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone.		
0.60	B							
0.70	ES					*Occasional rootlets at 0.50 - 1.00mbgl*		
1.00	B							
1.20	ES	SPT(S) 1.20m, N=7 (1,2/1,2,2,2)		(1.70)				
1.50	B							
1.80	D							
2.00 - 2.45	U					*U100 Sample at 2.00mbgl sandy. Possibly failed.*		
			20.30	2.20		Medium dense brown clayey silty SAND.		
2.50	ES	SPT(S) 2.50m, N=17 (2,4/4,5,4,4)		(0.70)				
2.50	EW							
			19.60	2.90		Stiff becoming firm slightly sandy slightly gravelly silty CLAY of high becoming medium undrained shear strength. Gravel is fine to medium subrounded mudstone.		
3.00	B							
3.00 - 3.45	U							
3.50	B							
4.00	D	SPT(S) 4.00m, N=11 (2,3/2,3,3,3)						
4.50	B							
5.00 - 5.45	U			(4.70)				
5.50	D							
5.50	ES							
6.00	B	SPT(S) 6.00m, N=16 (1,4/3,4,5,4)						
6.50	D							
7.00 - 7.45	U							
7.50	B							
			14.90	7.60		Brown sandy silty clayey GRAVEL. Gravel is fine to medium angular to subangular mudstone and sandstone.		
			14.70	7.80		Firm to stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone.		
		SPT(S) 8.00m, N=23 (4,3/4,5,7,7)						
8.50	B							
9.00	D							
9.50	B							
10.00	D							
						Continued next sheet		

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
01-03-2021	16:00	4.50	4.50	
02-03-2021	08:30	4.50	4.50	
03-03-2021	08:30	15.60	15.80	15.60

Borehole Diameter

Depth (m)	Dia (mm)
18.20	150

Casing Diameter

Depth (m)	Dia (mm)
18.20	150

Chiselling

From (m)	To (m)	Duration	Remarks
15.80	18.20	03:00	Chiseling through mudstone boulder

Installation

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

Remarks:
1 hour hand excavated service avoidance pit.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.20	2.20	2.90	30	2.20	Water Strike
7.60	7.60	7.80	5	7.20	Water Strike
12.50	12.50	14.00	10	12.50	Water Strike

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **CP05**
	Contract Number: CCG-C-21-12093	Date Started: 01/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 2 of 2
Cable Percussion Borehole Log	Easting: 349034.0	Northing: 431589.7	Ground Level: 22.50mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG — Scale: 1:50
Weather: Dry	Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(S) 10.00m, N=21 (3,3/4,5,6,6)				Firm to stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone.		
10.50	B					*Occasional small pockets of fine to medium SAND at 10.00-10.50mbgl*		
11.00	D			(4.70)				
11.50 - 11.95	U							
12.00	B							
12.40	D		10.01	12.50		Medium dense brown very silty clayey SAND.	▼	
12.80	B							
		SPT(S) 13.00m, N=18 (3,4/4,5,4,5)		(1.50)				
13.50	D							
			8.51	14.00		Firm to stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone.		
14.50	B							
14.50	D							
14.50 - 14.95	U			(1.80)				
15.00	D							
15.50	B							
		SPT(S) 15.80m, 50 (37 for 145mm/50 for 160mm)	6.70	15.80		Brown MUDSTONE (possibly a boulder)		
				(0.70)				
			6.00	16.50		Very dense brown very gravelly silty SAND. Gravel is fine to medium subangular to subrounded mudstone and sandstone.	▼	
17.00	B							
				(1.65)				
17.50	B	SPT(S) 17.50m, 50 (25 for 5mm/50 for 10mm)						
17.50	D							
		SPT(S) 18.20m, 100 (25 for 5mm/100 for 20mm)	4.36 4.30	18.15 18.20		Weak moderately weathered reddish brown SANDSTONE		
						End of Borehole at 18.20m		

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)
01-03-2021	16:00	4.50	4.50	
02-03-2021	08:30	4.50	4.50	
03-03-2021	08:30	15.60	15.80	15.60

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18.20	150	18.20	150

Remarks:
1 hour hand excavated service avoidance pit.

Chiselling			
From (m)	To (m)	Duration	Remarks
15.80	18.20	03:00	Chiseling through mudstone boulder

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

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.20	2.20	2.90	30	2.20	Water Strike
7.60	7.60	7.80	5	7.20	Water Strike
12.50	12.50	14.00	10	12.50	Water Strike

Contract Name:		Client:			Borehole ID:
Cottam Parkway Station		LCC			**CP06**
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 2
CCG-C-21-12093	09/03/2021	SP	CB	FINAL	
Cable Percussion Borehole Log	Easting: 349046.7	Northing: 431570.2	Ground Level: 22.25mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50

Weather:

Termination: Refusal on sandstone bedrock

SPT Hammer: CCG6 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.15	ES		22.05	0.20		Soft grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium subangular mudstone. Grassed at surface (TOPSOIL).		
0.50	B					Soft becoming stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
0.60	D							
0.70	ES							
1.00	B					*Becomes firm at 1.00mbgl*		
		SPT(S) 1.20m, N=14 (2,2/3,3,3,5)						
1.40	D					*Lens of water bearing brown silty clayey SAND at 1.40 - 1.50mbgl.*		
1.50	ES			(2.60)				
2.00	B					*Becomes stiff at 2.00mbgl*		
2.00 - 2.45	U							
2.40	D							
2.50	B							
2.50	ES							
			19.45	2.80		Medium dense brown silty slightly clayey SAND.		
3.00	D	SPT(S) 3.00m, N=27 (2,3/5,6,7,9)						
3.40	ES			(0.90)				
3.50	B							
3.60	D		18.55	3.70		Firm to stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength with frequent pockets of sand and silt laminations. Gravel is fine to medium subangular to well rounded mudstone sandstone and granite.		
3.70	EW							
4.00 - 4.45	U							
4.50	B							
5.00	D	SPT(S) 5.00m, N=15 (1,2/3,4,4,4)						
5.50	B							
6.00	D							
6.00 - 6.45	U							
6.50	B							
				(9.10)				
7.00	D	SPT(S) 7.00m, N=22 (3,3/4,6,6,6)						
7.50	B							
8.00	D					*CLAY has low undrained shear strength at 8.00 - 8.45mbgl.*		
8.00 - 8.45	U							
8.50	B							
9.00	D	SPT(S) 9.00m, N=21 (4,4/5,5,5,6)						
9.50	B							
10.00	D							

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
09-03-2021	16:00	9.50	9.50	
11-03-2021	08:00	9.50	9.50	8.70
11-03-2021	16:00	18.00	18.00	

Borehole Diameter

Depth (m)	Dia (mm)
18.00	150

Casing Diameter

Depth (m)	Dia (mm)
18.00	150

Chiselling

From (m)	To (m)	Duration	Remarks
16.00	18.00	01:00	Chiseling in sandstone bedrock.

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	17.00	SLOTTED	19

Remarks:

1 hour hand excavated service avoidance pit.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.40	1.40	1.60	10	1.40	Water strike in sand lens
2.80	2.80	3.70	10	2.50	Water strike

Contract Name: Cottam Parkway Station			Client: LCC		Borehole ID: **CP06**
Contract Number: CCG-C-21-12093	Date Started: 09/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 2 of 2
Cable Percussion Borehole Log	Easting: 349046.7	Northing: 431570.2	Ground Level: 22.25mAOD	Plant Used: Dando 150	Rig Crew: AR/CMG	Scale: 1:50
Weather:	Termination: Refusal on sandstone bedrock		SPT Hammer: CCG6 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.00 - 10.45	U					Firm to stiff brown slightly sandy slightly gravelly silty CLAY of high undrained shear strength with frequent pockets of sand and silt laminations. Gravel is fine to medium subangular to well rounded mudstone sandstone and granite.		
10.50	B							
11.00	D							
		SPT(S) 11.50m, N=22 (4,4/5,5,5,7)						
12.00	B							
12.50	D							
			9.45	12.80		Medium dense brown sandy clayey SILT.		
		SPT(S) 13.00m, N=15 (1,2/3,4,4,4)						
13.50	B			(1.40)				
14.00	D							
			8.05	14.20		Firm to stiff brown slightly sandy silty CLAY.		
14.50 - 14.95	U							
				(1.60)				
15.50	B							
15.50	D							
			6.45	15.80		Very weak brown weathered SANDSTONE recovered as a very sandy silty GRAVEL. Gravel is fine to coarse subangular sandstone.		
		SPT(S) 16.00m, N=50 (4,7/50 for 275mm)						
16.50	B							
				(2.00)				
17.00	D	SPT(S) 17.00m, 50 (12,13/50 for 200mm)						
			4.45	17.80		Weak reddish brown weathered SANDSTONE		
			4.25	18.00		End of Borehole at 18.00m		

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)
09-03-2021	16:00	9.50	9.50	
11-03-2021	08:00	9.50	9.50	8.70
11-03-2021	16:00	18.00	18.00	

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18.00	150	18.00	150

Remarks:
1 hour hand excavated service avoidance pit.

Chiselling			
From (m)	To (m)	Duration	Remarks
16.00	18.00	01:00	Chiseling in sandstone bedrock.

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	19
1.00	17.00	SLOTTED	19

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.40	1.40	1.60	10	1.40	Water strike in sand lens
2.80	2.80	3.70	10	2.50	Water strike

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS01**
	Contract Number: CCG-C-21-12093	Date Started: 25/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 348992.5	Northing: 431694.5	Ground Level: 22.35mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMC — Scale: 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		22.15	0.20		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subangular to subrounded mudstone and sandstone.		
0.50	ES	HVP=110						
1.00	ES							
1.00 - 2.00	UT							
		SPT(S)N=13 (1,2/3,3,3,4)						
1.50	D	HVP=110						
2.00 - 3.00	UT	SPT(S)N=16 (3,3/3,4,4,5) HVP=110		(3.80)				
2.50	D	HVP=110						
3.00 - 4.00	UT	SPT(S)N=22 (3,3/5,5,6,6) HVP=110						
		HVP=110						
		SPT(S)N=21 (3,3/4,5,6,6) HVP=110	18.35	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)

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
			0		BH DRY

Contract Name: Cottam Parkway Station			Client: LCC	Borehole ID: **WS02**
Contract Number: CCG-C-21-12093	Date Started: 26/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting: 349030.9	Northing: 431711.0	Ground Level: 22.88mAOD	Plant Used: Dando Terrier Rig
Rig Crew: AR/CMG	Scale: 1:25	Sheet 1 of 1		
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		22.62	0.25		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					Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subangular to subrounded mudstone and sandstone.		
		HVP=110						
0.65	ES							
1.00 - 2.00	UT	HVP=110						
1.20	ES	SPT(S)N=15 (2,2/3,3,4,5)						
1.50	D	HVP=110						
2.00 - 3.00	UT	SPT(S)N=23 (3,5/5,6,6,6) HVP=110		(3.75)				
		HVP=110						
3.00 - 4.00	UT	SPT(S)N=27 (3,5/5,7,7,8) HVP=110						
3.50	D	HVP=110						
		SPT(S)N=22 (4,4/4,5,6,7) HVP=110	18.88	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)

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
			0		BH DRY

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS03**
	Contract Number: CCG-C-21-12093	Date Started: 26/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349071.0	Northing: 431536.1	Ground Level: 21.55mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG — Scale: 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		21.30	0.25		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	ES	HVP=90		(0.85)		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
		HVP=110						
0.90	ES							
1.00 - 2.00	UT	SPT(S)N=10 (1,2/2,2,2,4)	20.45	1.10		Medium dense brown clayey silty fine to medium SAND with frequent pockets of clay. *Slight seepage at 1.10mbgl* *Limited recovery at 1.10-1.65mbgl*		
				(0.55)				
		HVP=70	19.90	1.65		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subangular to subrounded mudstone and sandstone.		
2.00	D	SPT(S)N=20 (2,2/2,5,6,7)						
2.00 - 3.00	UT	HVP=90						
		HVP=110		(2.35)				
3.00 - 4.00	UT	SPT(S)N=18 (3,3/4,4,4,6) HVP=90						
3.50	D	HVP=100						
		SPT(S)N=20 (2,2/4,4,5,7) HVP=110	17.55	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)

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
1.10			0		Slight seepage

Contract Name: Cottam Parkway Station			Client: LCC		Borehole ID: **WS04**
Contract Number: CCG-C-21-12093	Date Started: 26/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349088.0	Northing: 431488.4	Ground Level: 21.91mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG	Scale: 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				
		HVP=70				Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded mudstone and sandstone.		
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		

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)

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
			0		BH DRY

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS05**
	Contract Number: CCG-C-21-12093	Date Started: 26/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
					Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349092.1	Northing: 431438.7	Ground Level: 21.60mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG
					Scale: 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		21.35	0.25		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					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		

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)
0.00	1.00	PLAIN	
1.00	4.00	SLOTTED	

Remarks:

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

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS06**
	Contract Number: CCG-C-21-12093	Date Started: 26/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349101.0	Northing: 431388.0	Ground Level: 20.97mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG — Scale: 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		

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
0.95			0		

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS07**
	Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
					Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349139.4	Northing: 431362.6	Ground Level: 20.70mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG
					Scale: 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		20.50	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)		
0.20	ES					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						
1.10	ES							
1.50	D			(2.80)				
2.00 - 3.00	UT	SPT(S)N=21 (3,3/4,4,6,7) HVP=110						
2.50	D							
		SPT(S)N=16 (3,3/3,4,4,5) HVP=110	17.70	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)

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

Contract Name: Cottam Parkway Station			Client: LCC	Borehole ID: **WS08**
Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting: 349201.2	Northing: 431310.4	Ground Level: 20.51mAOD	Plant Used: Dando Terrier Rig
Rig Crew: LN	Scale: 1:25	Sheet 1 of 1		
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		20.31	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)		
0.10	ES					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		

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: Cottam Parkway Station			Client: LCC	Borehole ID: **WS09**
Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting: 349202.1	Northing: 431340.8	Ground Level: 20.73mAOD	Plant Used: Dando Terrier Rig
Rig Crew: AR/CMG	Scale: 1:25	Sheet 1 of 1		
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)

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

Remarks:

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

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS10**
	Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349299.7	Northing: 431309.4	Ground Level: 18.35mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG — Scale: 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		18.15	0.20		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							
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		

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: Cottam Parkway Station			Client: LCC	Borehole ID: **WS11**
Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting: 349333.3	Northing: 431347.0	Ground Level: 17.64mAOD	Plant Used: Dando Terrier Rig
Rig Crew: AR/CMG	Scale: 1:25	Sheet 1 of 2		
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)				
1.00 - 2.00	UT		16.54	1.10		Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
		HVP=100						
1.50	D							
		SPT(S)N=20 (2,3/4,5,5,6)						
2.00 - 3.00	UT	HVP=110						
2.50	D	HVP=110						
3.00 - 4.00	UT	SPT(S)N=13 (1,2/2,3,3,5)		(4.90)				
3.50	D	HVP=110						
4.00 - 5.00	UT	SPT(S)N=11 (1,2/3,2,3,3)						
4.50	D	HVP=90						
5.00 - 6.00	UT	SPT(S)N=16 (3,4/4,4,4,4)						

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

CCG	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS11**
	Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 2 of 2
Dynamic Sampling Borehole Log	Easting: 349333.3	Northing: 431347.0	Ground Level: 17.64mAOD	Plant Used: Dando Terrier Rig	Rig Crew: AR/CMG — Scale: 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				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
			0		Dry

	Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS12**
	Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 2
Dynamic Sampling Borehole Log	Easting: 349341.0	Northing: 431312.0	Ground Level: 17.18mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS — Scale: 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							
0.20	ES			(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)		
			16.88	0.30				
0.60	ES	HVP=110				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to subrounded mudstone and sandstone.		
1.00 - 2.00	UT	SPT(S)N=16 (1,2/3,4,4,5)						
1.10	ES							
1.50	D							
		HVP=110						
2.00 - 3.00	UT	SPT(S)N=16 (2,3/3,4,4,5)						
		HVP=110		(5.70)				
3.00	D	SPT(S)N=19 (2,2/3,4,6,6)						
3.00 - 4.00	UT							
		HVP=110						
4.00 - 5.00	UT	SPT(S)N=14 (2,3/3,3,4,4)						
4.50	D							
		HVP=80						
5.00 - 6.00	UT	SPT(S)N=17 (2,4/4,5,4,4)						
						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: Cottam Parkway Station		Client: LCC		Borehole ID: **WS12**
	Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 2 of 2
Dynamic Sampling Borehole Log	Easting: 349341.0	Northing: 431312.0	Ground Level: 17.18mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS — Scale: 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: Cottam Parkway Station			Client: LCC		Borehole ID: **WS13**
Contract Number: CCG-C-21-12093	Date Started: 22/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349342.8	Northing: 431341.3	Ground Level: 17.45mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS	Scale: 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)

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

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: 349349.2	Northing: 431307.8	Ground Level: 16.89mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS	Scale: 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

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)

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: Cottam Parkway Station		Client: LCC		Borehole ID: **WS14**
	Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 2 of 2
Dynamic Sampling Borehole Log	Easting: 349349.2	Northing: 431307.8	Ground Level: 16.89mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS — Scale: 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)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)
				0.00	1.00	PLAIN	19
				1.00	6.00	SLOTTED	19

Remarks:

Water Strikes

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

Contract Name: Cottam Parkway Station		Client: LCC			Borehole ID: **WS15**
Contract Number: CCG-C-21-12093	Date Started: 22/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349363.0	Northing: 431336.7	Ground Level: 17.70mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS	Scale: 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				
0.40	ES					Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium subrounded to well rounded mudstone and sandstone.		
		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)

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

Contract Name: Cottam Parkway Station			Client: LCC		Borehole ID: **WS16**
Contract Number: CCG-C-21-12093	Date Started: 22/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349419.5	Northing: 431319.1	Ground Level: 19.23mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS	Scale: 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)

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

Contract Name: Cottam Parkway Station			Client: LCC		Borehole ID: **WS17**
Contract Number: CCG-C-21-12093	Date Started: 22/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349440.5	Northing: 431319.5	Ground Level: 19.36mAOD	Plant Used: Dando Terrier Rig	Rig Crew: LN/AS	Scale: 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)

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

Contract Name: Cottam Parkway Station		Client: LCC		Borehole ID: **WS18**
Contract Number: CCG-C-21-12093	Date Started: 22/03/2021	Logged By: SP	Checked By: CB	Status: FINAL — Sheet 1 of 1
Dynamic Sampling Borehole Log	Easting: 349472.9	Northing: 431353.2	Ground Level: 19.47mAOD	Plant Used: Dando Terrier Rig — Rig Crew: LN/AS — Scale: 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			(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)		
0.20	ES		19.17	0.30				
		HVP=110				Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse subrounded to subangular sandstone.		
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			(2.70)				
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	16.47	3.00		End of Borehole at 3.00m		

1 2 3 4 5

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

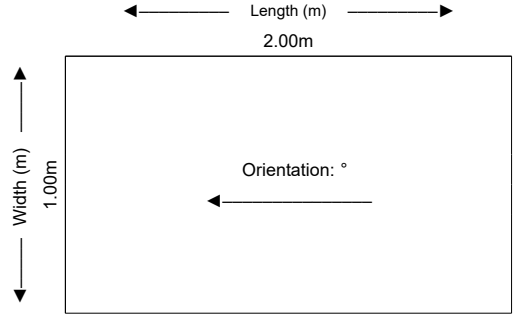
Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP01
Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349157.0	Northing: 431325.0	Ground Level: 20.56mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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	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

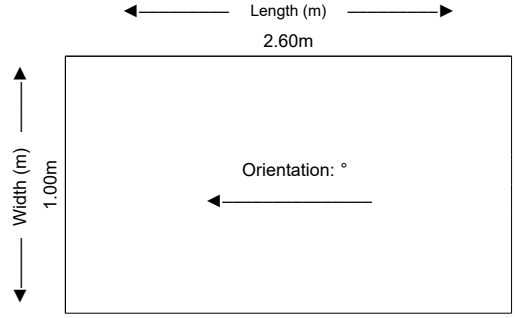
Contract Name: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP02
Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349247.9	Northing: 431322.0	Ground Level: 19.96mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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	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				
0.50	B	HVP=75kPa				Stiff brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular to rounded mudstone and sandstone		
0.60	ES							
0.70	D							
1.00	B	HVP=110kPa						
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		

1 2 3

Dimensions:

Final Depth: 2.00m



Inclination: °

General Remarks:

Water Strikes

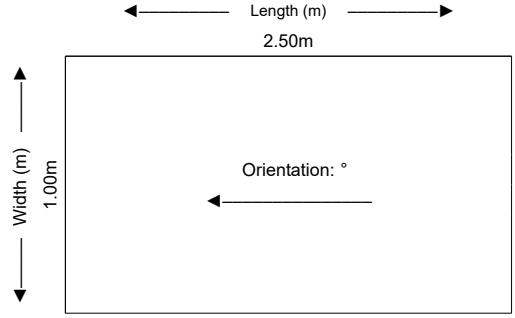
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP03
Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349285.0	Northing: 431336.5	Ground Level: 19.28mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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:

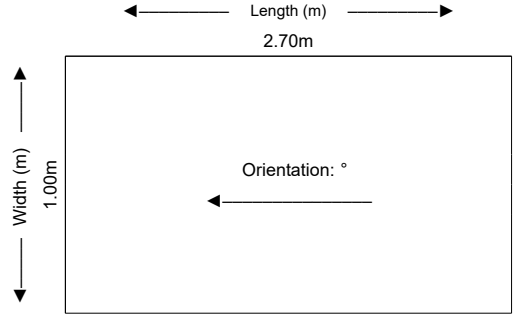
Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP04
Contract Number: CCG-C-21-12093	Date Started: 23/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349324.7	Northing: 431322.8	Ground Level: 17.82mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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		
0.20	B			(0.30)		Grey slightly sandy slightly gravelly silty organic CLAY. Gravel is fine to medium sub-rounded to rounded mudstone and sandstone (TOPSOIL)		
0.25	ES		17.52	0.30				
0.40	ES	HVP=90kPa				Very stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular mudstone, sandstone and granite		
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:

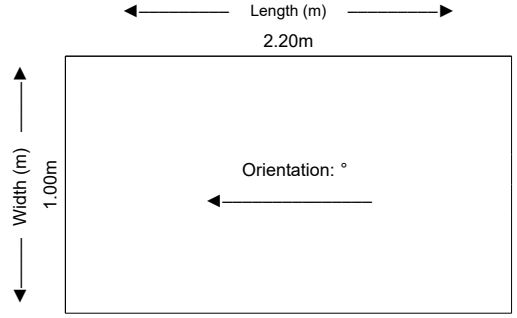
Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0		TP DRY

Contract Name: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP05
Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349381.3	Northing: 431309.8	Ground Level: 17.86mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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			(1.70)			1	
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: Cottam Parkway Station		Client: LCC			Trial Pit ID: TP06
Contract Number: CCG-C-21-12093	Date Started: 24/03/2021	Logged By: SP	Checked By: CB	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 349425.1	Northing: 431336.6	Ground Level: 19.08mAOD	Plant Used: 8T Tracked Machine	Date Printed: 26/05/2021	Scale: 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	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						
				(1.70)				
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		

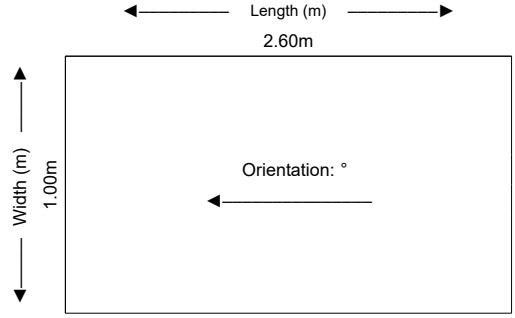
1

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

APPENDIX C

FALLING HEAD TEST WORKSHEETS

FALLING HEAD TEST

CCG-C-21-12093: Cottam Parkway Station: FH 8/9

CC GEOTECHNICAL LTD

Details of test Section	Situation B - BS5930	Ground Level (mAOD)	20.505
Height of standpipe	N/A	Filter Length	N/A
Depth below top of standpipe to response zone	N/A	Casing Elevation (mAOD)	20.505
		Borehole Diameter (m)	0.100
Initial depth to water (mbgl)	N//A	Standpipe Diameter:	N/A
Depth of Casing (mbgl)	0.920	Casing Diameter	85mm

Ref: BS5930:2015

Strata:
0.25: Grassed TOPSOIL
1.00: Brown slightly sandy slightly gravelly silty CLAY

Time Elapsed t (mins)	Depth at Time t From top of casing (m)	Head at Time t	Head Ratio (H/Ho)
0	0.025	0.980	1.000
2	0.055	0.950	0.969
4	0.100	0.905	0.923
6	0.140	0.865	0.883
8	0.170	0.835	0.852
10	0.170	0.835	0.852
30	0.185	0.820	0.837
60	0.185	0.820	0.837
90	0.190	0.815	0.832
120	0.190	0.815	0.832
150	0.190	0.815	0.832

Permeability:

K= A/FT

K= 6.23E-08 m/s

Where:

A= Cross sectional area of FH1 (m2)
0.00567

F= Intake Factor (m) see BS5930
0.275

T= Basic time Lag (s)
331200

Notes:

Test carried out under Test B of Section 4 - BS 5930:2015

Basic lag time extrapolated for H/Ho to equal 0.370

Client:	**LCC**	**Calcs by:**	**Checked by:**	**Job Number:**
		SP	**CB**	**21 -12093**

FALLING HEAD TEST

CCG-C-21-12093: Cottam Parkway Station: FH 13/12

CC GEOTECHNICAL LTD

Details of test Section	Situation B - BS5930	Ground Level (mAOD)	17.466
Height of standpipe	N/A	Filter Length	N/A
Depth below top of standpipe to response zone	N/A	Casing Elevation (mAOD)	17.466
		Borehole Diameter (m)	0.100
Initial depth to water (mbgl)	N//A	Standpipe Diameter:	N/A
Depth of Casing (mbgl)	0.980	Casing Diameter	85mm

Ref: BS5930:2015

Strata:
0.25: Grassed TOPSOIL
0.84: Brown slightly sandy slightly gravelly silty CLAY
1.00: Brown silty clayey SAND

Time Elapsed t (mins)	Depth at Time t From top of casing (m)	Head at Time t	Head Ratio (H/Ho)
0	0.000	0.980	1.000
1	0.200	0.780	0.796
2	0.200	0.780	0.796
3	0.210	0.770	0.786
4	0.210	0.770	0.786
6	0.210	0.770	0.786
8	0.215	0.765	0.781
10	0.215	0.765	0.781
30	0.215	0.765	0.781
60	0.220	0.760	0.776
90	0.220	0.760	0.776
120	0.220	0.760	0.776

Permeability:

K= A/FT

K= 1.41E-07 m/s

Where:

A= Cross sectional area of FH1 (m2)
0.00567

F= Intake Factor (m) see BS5930
0.275

T= Basic time Lag (s)
145800

Notes:

Test carried out under Test B of Section 4 - BS 5930:2015

Basic lag time extrapolated for H/Ho to equal 0.370

Client:	**LCC**	**Calcs by:**	**Checked by:**	**Job Number:**
		SP	**CB**	**21 -12093**

FALLING HEAD TEST

CCG-C-21-12093: Cottam Parkway Station: FH 17/18

CC GEOTECHNICAL LTD

Details of test Section	Situation B - BS5930	Ground Level (mAOD)	19.388
Height of standpipe	N/A	Filter Length	N/A
Depth below top of standpipe to response zone	N/A	Casing Elevation (mAOD)	19.388
		Borehole Diameter (m)	0.100
Initial depth to water (mbgl)	N//A	Standpipe Diameter:	N/A
Depth of Casing (mbgl)	0.985	Casing Diameter	85mm

Ref: BS5930:2015

Strata:
0.25: Grassed TOPSOIL
1.00: Brown slightly sandy slightly gravelly silty CLAY

Time Elapsed t (mins)	Depth at Time t From top of casing (m)	Head at Time t	Head Ratio (H/Ho)
0	0.000	0.985	1.000
1	0.000	0.985	1.000
2	0.005	0.980	0.995
3	0.005	0.980	0.995
4	0.005	0.980	0.995
6	0.010	0.975	0.990
8	0.010	0.975	0.990
10	0.015	0.970	0.985
30	0.030	0.955	0.970
60	0.035	0.950	0.964
90	0.035	0.950	0.964
120	0.035	0.950	0.964

Permeability:

K= A/FT

K= 4.83E-08 m/s

Where:

A= Cross sectional area of FH1 (m2)
0.00567

F= Intake Factor (m) see BS5930
0.275

T= Basic time Lag (s)
426600

Notes:
Test carried out under Test B of Section 4 - BS 5930:2015

Basic lag time extrapolated for H/Ho to equal 0.370

Client:	**LCC**	**Calcs by:**	**Checked by:**	**Job Number:**
		SP	**CB**	**21 -12093**

APPENDIX D

SPT HAMMER CALIBRATION CERTIFICATES

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

James Fisher Testing Services
40a Ruby House
Warrington
WA1 4RF

SPT Hammer Ref: CCG6
Test Date: 12/05/2020
Report Date: 12/05/2020
File Name: CCG6.spt
Test Operator: MVAABM

Instrumented Rod Data

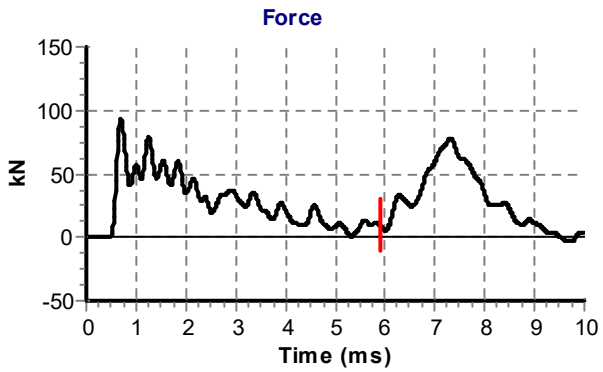
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.5
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 11855
Accelerometer No.2: 9983

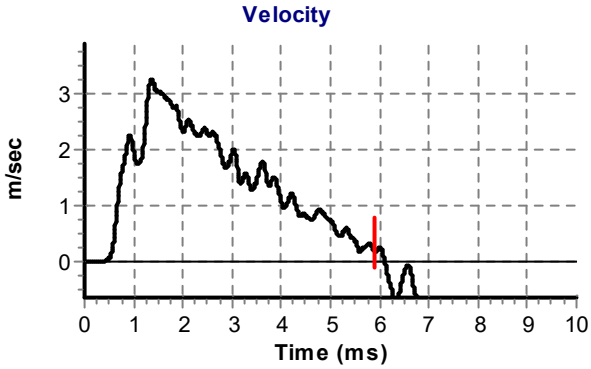
SPT Hammer Information

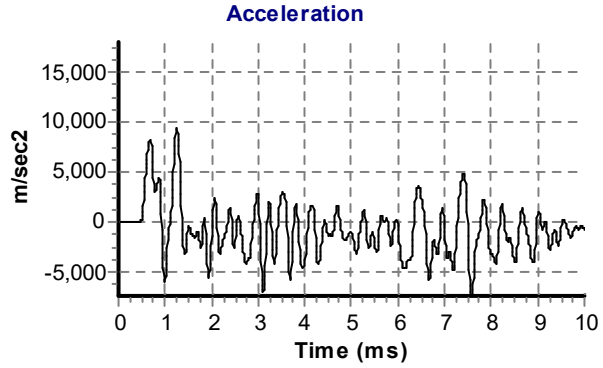
Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 14.5

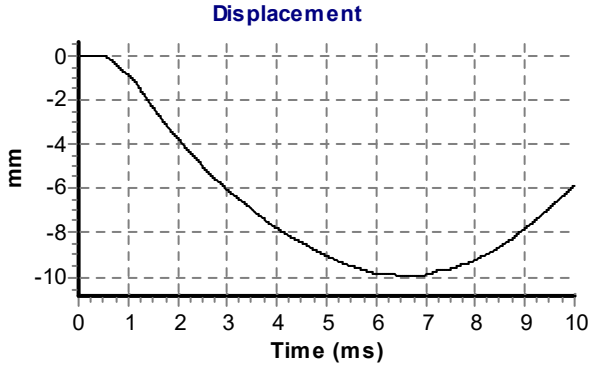
Comments / Location

Location: JFTS Laboratory
Client: CCG
SPT Refernece: CCG6









Calculations

Area of Rod A (mm2): 970
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 301

Energy Ratio E_r (%): 64

Signed: M.Valentine
Title: Technician

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APPENDIX E

TRIAL PIT PHOTOGRAPHS

Site	**Cottam Parkway Station**
Job Number:	**CCG-C-21-12093**
Trial Pit Number:	**TP01**
Plate Number	**1**