

The background is a vibrant yellow. It is decorated with several abstract geometric shapes in shades of blue, teal, and white. These include circles, semi-circles, and rounded rectangular shapes, some of which are partially cut off by the edges of the page. The shapes are arranged in a non-repeating, organic pattern.

Appendix A14.2

Ground Investigation Report



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Ground Investigations Ireland
Bus Connect Detailed Stage 1 Lot 1
Route 11
National Transport Authority
Ground Investigation Report
July 2021





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DOCUMENT CONTROL SHEET

| | |
|----------------|---|
| Project Title | Bus Connect Detailed Stage 1 Lot 1 – Route 11 |
| Engineer | Roughan & O'Donovan Consulting Engineers |
| Client | National Transport Authority |
| Project No | 9754-07-20 R11 |
| Document Title | Ground Investigation Report |

| Rev. | Status | Author(s) | Reviewed By | Approved By | Office of Origin | Issue Date |
|------|--------|------------|-------------|--------------|------------------|--------------|
| A | Draft | P. Cochran | M. Sutton | A. McDonnell | Dublin | 14 June 2021 |
| B | Final | P. Cochran | M. Sutton | A. McDonnell | Dublin | 23 July 2021 |

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client. The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.



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GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

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1.0 Preamble

On the instructions of Roughan & O'Donovan Consulting Engineers (ROD), a site investigation was carried out by Ground Investigations Ireland Ltd., between September 2020 and May 2021 at the site of the proposed bus corridor along Route 11: Kimmage to City Centre.

2.0 Overview

2.1. Background

It is proposed to construct a new Bus Connects Core Bus Corridor on several commuter routes into Dublin City Centre. Route 11 is proposed to run between Kimmage to City Centre.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 3 No. Window Sample Boreholes to recover soil samples
- Carry out 2 No. Cable Percussion boreholes to a maximum depth of 8.70m BGL
- Carry out 2 No. Rotary Core Boreholes to a maximum depth of 12.50 BGL
- Installation of 5 No. Groundwater monitoring wells
- Geotechnical & Environmental Laboratory testing
- Factual Report

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Window Sampling

The window sampling was carried out at the locations shown in the location plan in Appendix 1 using a Tecopsa SPT Tec 10 percussion drilling rig. The window sampling consists of a 1m long steel tube with a cutting edge and an internal plastic liner which is mechanically driven into the ground utilising a 50kg weight falling a height of 500mm. Upon completion of the 1m sample, the tube is withdrawn and the plastic liner removed and sealed for logging and sub sampling by a Geotechnical Engineer/Engineering Geologist. The tube is replaced in the borehole and a subsequent 1m sample can be recovered. Occasionally outer casing or a reduced diameter tube is utilised to enable the window sample to progress in difficult drilling conditions. Geotechnical or environmental soil samples can be recovered from each of the liners following logging. The window sample records are provided in Appendix 2 of this Report.

3.3. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non-cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata. Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing

63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60° cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 3 of this Report.

3.4. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 3 of this Report.

3.5. Surveying

The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.6. Groundwater Installations

Groundwater Installations were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists

of a 50mm uPVC/HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. The standpipe is finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.7. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.

Environmental & Chemical testing as required by the specification, including Suite E testing, pH and organic matter content were carried out by Element Materials Technology Laboratory or Chemtech Laboratory in the UK.

Geotechnical testing consisting of moisture content, Atterberg limits, Particle Density, Particle Size Distribution (PSD) and hydrometer and shear box testing were carried out in NMTL's Geotechnical Laboratory in Carlow or Pro Soils Laboratory in the UK.

Rock strength testing including Unconfined Compressive Strength (UCS) testing were carried out in Pro Soils Laboratory in the UK

The available results of the laboratory testing are included in Appendix 4 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were variable across the site and are generally comprised;

- Topsoil/Surfacing
- Made Ground
- Cohesive Deposits
- Granular Deposits
- Bedrock

TOPSOIL: Topsoil was encountered in some of the exploratory holes and was present to a maximum depth of 0.20m BGL. Tarmac surfacing was present in R11-CP01 to a depth of 0.10m BGL. Concrete surfacing was present in R11-CP03 to a depth of 0.30m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to depths of between 1.50m and 3.70m BGL. These deposits were described generally as *brown, dark brown, grey, dark grey or greyish brown slightly sandy slightly gravelly Clay with occasional cobbles or grey sandy subangular to subrounded fine to coarse Gravel with occasional cobbles and contained occasional fragments of ceramic, concrete, glass, metal, mortar, plastic, red brick and wood.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground or interbedded with Granular Deposits and were described typically as *brown, grey, brownish grey or greyish brown sandy gravelly CLAY or greyish brown slightly sandy gravelly SILT.* The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits typically increased with depth and was stiff below 3.70m BGL in the majority of the exploratory holes. These deposits had rare, occasional, some or frequent cobble and boulder content where noted on the exploratory hole logs.

GRANULAR DEPOSITS: Granular deposits were encountered interbedded with cohesive deposits in R11-CP04 and were typically described as *greyish brown sandy angular to rounded fine to coarse GRAVEL.*

BEDROCK: The rotary core boreholes recovered medium strong to strong thinly laminated to thickly bedded grey/dark grey fine grained LIMESTONE locally interbedded with medium strong dark grey fine grained laminated Mudstone.

The depth to rock varies from 4.40m BGL in R11-CP03 to a maximum of 8.90m BGL in R11-CP03. The total core recovery is good, typically 100% with some of the uppermost runs dropping to 20% or 51%. The SCR and RQD both are relatively poor in the upper weathered zone, however both indices show an increase with depth in each of the boreholes.

4.2. Groundwater

Groundwater was noted during the investigation however we would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed to allow the equilibrium groundwater level to be determined. The groundwater monitoring is included in Appendix 5 of this Report.

4.3. Laboratory Testing

4.3.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on cohesive soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 25.1% and 33.8% generally with fines contents of 31.20 to 45.30%.

The Particle Size Distribution tests confirm that generally the made ground deposits are well-graded with percentages of sands and gravels ranging between 23.5% and 38% generally with fines contents of 35% to 45%.

The Particle Size Distribution test carried out on a sample from R11-CP04 show the granular deposits are well-graded with percentages of silt/clay of 27%, a sand content of 32% and a gravel content of 41%.

Shear box tests were carried out on disturbed samples from R11-WS02 and R11-CP04. The results from a cohesive sample from R11-WS02 gave the angle of shearing resistance of 33 degrees and the effective cohesion of 4 kPa. The results from the test carried out on a granular sample from R11-CP04 gave an angle of shearing resistance 47 degrees and the effective cohesion of 5 kPa.

Triaxial undrained shear strength tests were undertaken on 3 remoulded disturbed samples for RC11-CP01 and gave maximum cohesion / Shear strength of between 11.7 and 24.5 kPa.

4.3.2. Environmental Laboratory Testing

A total of 9 samples will be analysed for a Suite of testing specified by ROD based on Suite E according to Engineers Ireland.

The possibility of contamination, not revealed by the testing undertaken should be borne in mind particularly where Made Ground deposits are present, or the previous site use or location indicate a risk of environmental variation.

4.3.3. Rock Laboratory Testing

The rock testing carried out on a sample recovered from the R11-CP01A and R11CP03 reported Unconfined Compressive Strength (UCS) values of 31.3 MPa and 49.5 MPa.

The available results from the completed laboratory testing are included in Appendix 4 of this report.

APPENDIX 1 - Site Location Plan



714750E

714900E



715050E

732600N

732450N

732300N



-  Cable Percussion with Rotary Core Follow On
-  Window Sample



Client:



Project Code:

9754-07-20

Project Title:

Bus Connect Route 11

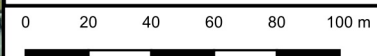
Drawing Title:

Figure 1 Site Location



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Drawn By:
PC

Date:
24/05/2021

714750E

714900E

715050E

713700E

713850E

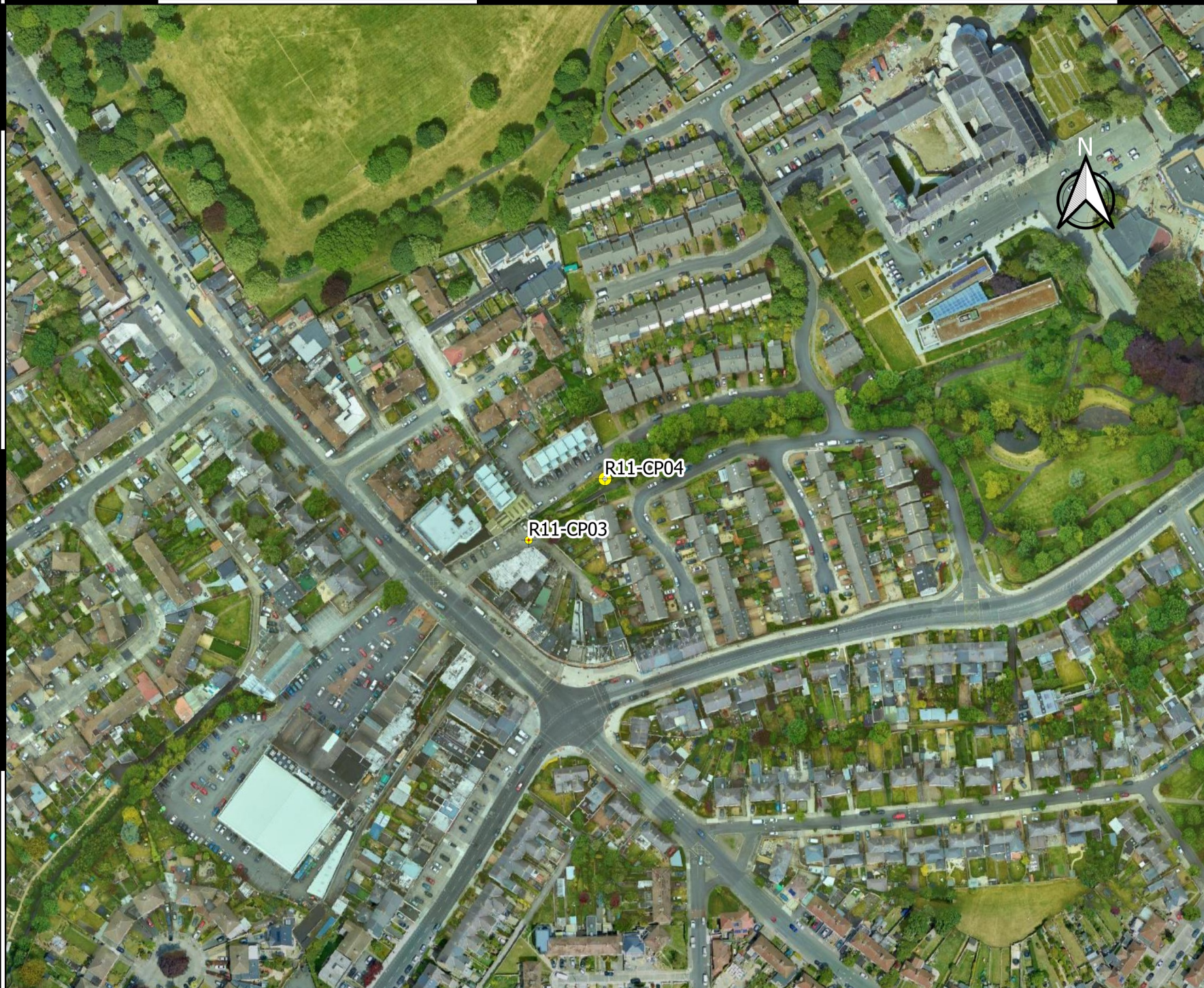
714000E



714150E

731550N

731400N

731250N



-  Cable Percussion with Rotary Core Follow On
-  Window Sample



Client:



Project Code:

9754-07-20

Project Title:

Bus Connect Route 11

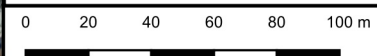
Drawing Title:

Figure 2 Site Location



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Drawn By:
PC

Date:
24/05/2021

713700E

713850E

714000E

714150E

APPENDIX 2 – Window Sample Records





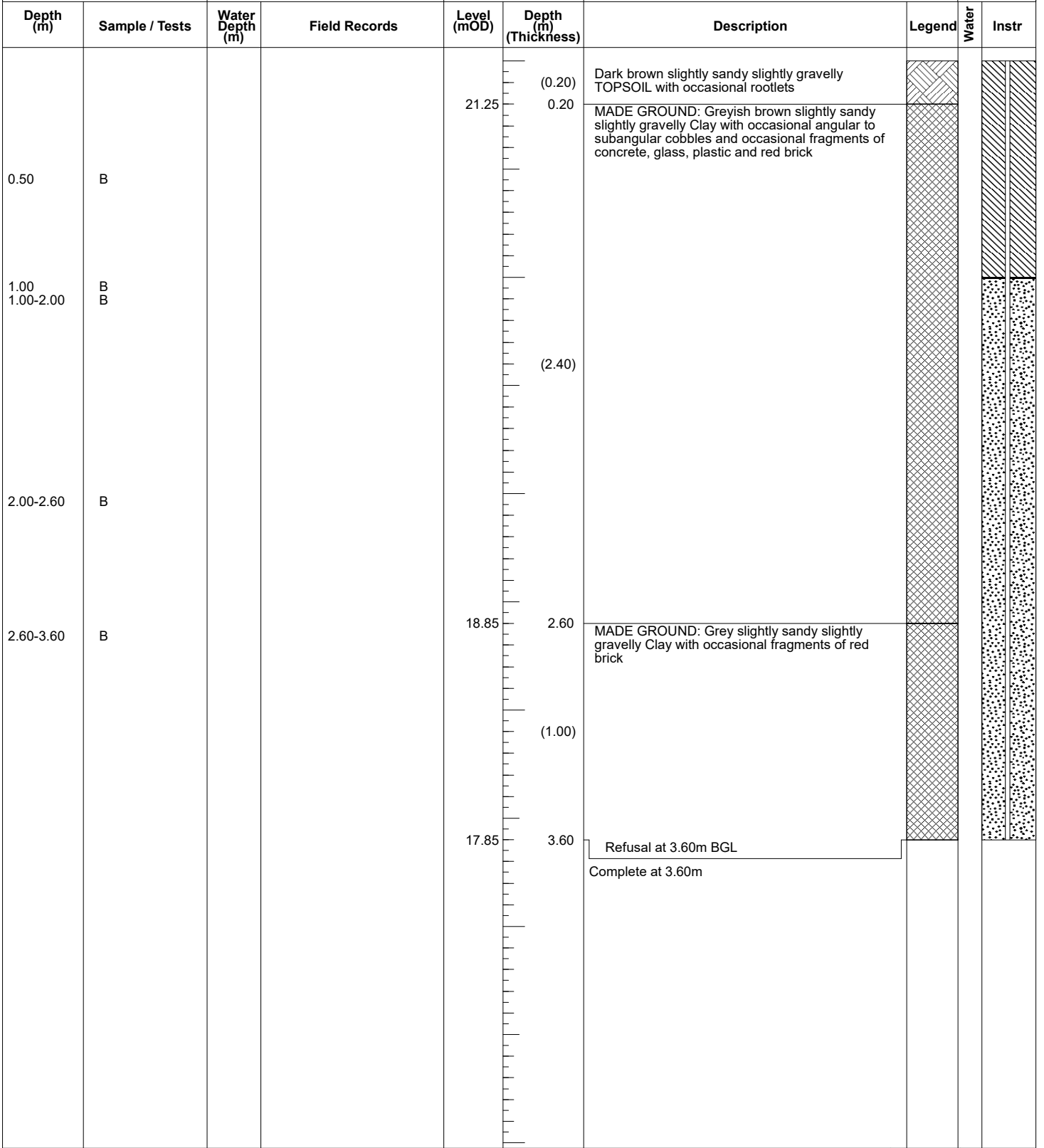
| | | | | |
|--------------------------------------|-----------------------------------|-----------------------------|---|--------------------------|
| Machine : Geotech 10 | Dimensions 100mm to 2.90m | Ground Level (mOD) 35.93 | Client National Transport Authority | Job Number 9754-07-20 |
| Method : Drive-in Windowless Sampler | Location 713909.5 E 731386.4 N | Dates 10/05/2021 | Project Contractor Ground Investigations Ireland | Sheet 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|---|-----------------------------|-----------------|---------------|-------------------------|--------------------------------|--|--------|-------|-------|
| 0.50 0.50 | B EN | | | 35.73 | (0.20) 0.20 | Brown slightly sandy slightly gravelly TOPSOIL | | | |
| 1.00-1.45 1.00 1.20-1.50 | SPT(C) N=10 EN B | | 2,1/2,1,2,5 | | (1.30) | MADE GROUND: Brown slightly sandy slightly gravelly silty Clay. Gravel is an angular to sub rounded fine to coarse with occasional fragments of brick and concrete. | | | |
| 1.50-1.80 | B | | | 34.43 | 1.50 (0.30) | Greyish brown sandy angular to rounded fine to coarse GRAVEL. | | | |
| 2.00-2.45 2.00 2.20-2.40 2.40-2.70 | SPT(C) N=27 EN B B | | 3,4/6,5,9,7 | 34.13 33.83 | 1.80 (0.30) 2.10 | Soft greyish brown slightly sandy gravelly SILT. gravel is sub angular to rounded fine to coarse. | | | |
| 2.60 2.70-2.96 2.70-2.90 | EN SPT(C) 50/105 B | | 17,12/11,39 | 33.38 33.13 33.03 | 2.55 (0.25) 2.80 2.90 | Medium dense greyish brown sandy sub angular to rounded fine to coarse GRAVEL Firm brownish grey slightly sandy gravelly CLAY. Gravel is angular to sub rounded fine to coarse. Grey clayey angular medium to coarse GRAVEL of mudstone. (Possible weathered rock) | | | |
| | | | | | | Refusal at 2.90m | | | |

| | | |
|--|-----------------------------------|-----------|
| Remarks Refusal at 2.9m BGL due to obstruction. Possible rock or boulder. 50mm Standpipe Installed with slotted section with gravel filter from 2.9m to 1.0m, plain pipe with bentonite seal from 1.0m to GL and finished with a flush cover. | Scale (approx) | Logged By |
| | 1:50 | MS |
| | Figure No. 9754-07-20.R11-CP04 | |



| | | | | |
|--|--|-----------------------------|---|--------------------------|
| Excavation Method Drive-in Windowless Sampler | Dimensions 88mm to 3.00m 68mm to 3.60m | Ground Level (mOD) 21.45 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 714857.3 E 732431.1 N | Dates 15/03/2021 | Project Contractor Ground Investigations Ireland | Sheet 1/1 |



| | | |
|--|--|-----------------|
| Remarks 0.00m-1.00m BGL 70% recovery 1.00m-2.00m BGL 80% recovery 2.00m-3.00m BGL 80% recovery 3.00m-3.60m BGL 50% recovery Refusal at 3.60m BGL Slotted standpipe with pea gravel surround from 3.60m to 1.00m BGL, plain pipe with bentonite seal from 1.00m BGL to GL, finished with a flush cover | Scale (approx) 1:25 | Logged By PC |
| | Figure No. 9754-07-20.R11-WS01 | |



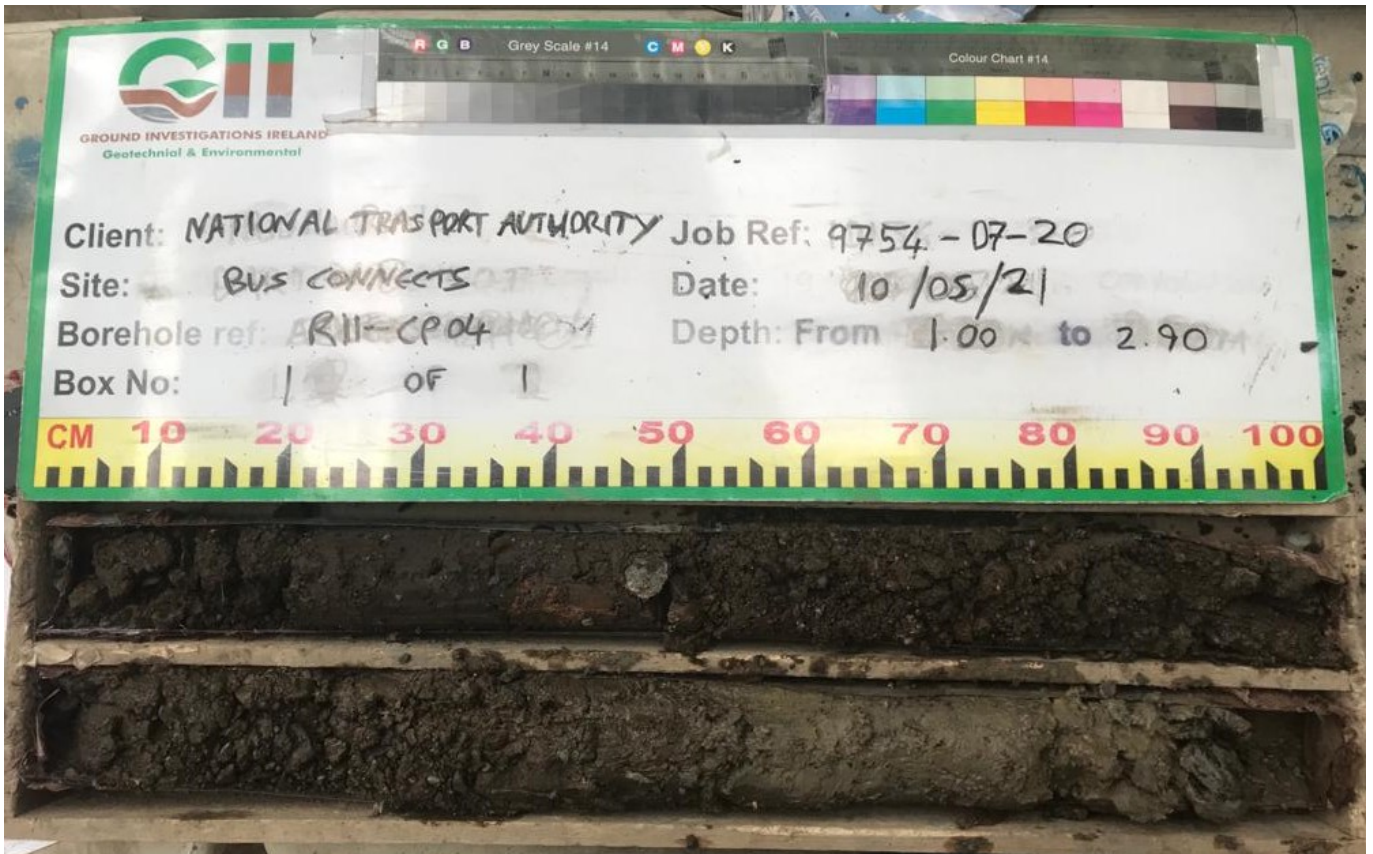
| | | | | |
|--|--|-----------------------------|---|--------------------------|
| Excavation Method Drive-in Windowless Sampler | Dimensions 88mm to 3.00m 68mm to 3.90m | Ground Level (mOD) 21.15 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 714877.6 E 732430.4 N | Dates 15/03/2021 | Project Contractor Ground Investigations Ireland | Sheet 1/1 |

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|-----------|----------------|-----------------|---------------|-------------|-----------------------|---|--------|-------|-------|
| 0.20-1.00 | B | | | 20.95 | (0.20) 0.20 | Greyish brown slightly sandy slightly gravelly TOPSOIL with occasional rootlets MADE GROUND: Greyish brown slightly sandy slightly gravelly Clay with occasional rootlets and occasional fragments of ceramic, plastic and red brick | | | |
| 1.00-2.00 | B | | | | (1.80) | | | | |
| 2.00-2.60 | B | | | 19.15 | 2.00 | Soft greyish brown slightly sandy slightly gravelly CLAY with occasional shell fragments. Gravel is angular to subrounded fine to coarse | | | |
| 2.60-3.00 | B | | | 18.55 | 2.60 | Stiff brown slightly slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse | | | |
| 3.00-3.90 | B | | | 18.15 | 3.00 | Stiff grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse | | | |
| | | | | 17.25 | 3.90 | Refusal at 3.90m BGL Complete at 3.90m | | | |

| | | |
|--|--|-----------------|
| Remarks 0.00m-1.00m BGL 100% recovery 1.00m-2.00m BGL 100% recovery 2.00-3.00m BGL 100% recovery 3.00-3.90m BGL 100% recovery Refusal at 3.90m BGL Slotted standpipe with pea gravel surround from 3.90m to 1.00m BGL, plain pipe with bentonite seal from 1.00m BGL to GL, finished with a flush cover | Scale (approx) 1:25 | Logged By PC |
| | Figure No. 9754-07-20.R11-WS02 | |

Bus Connect Route 11 – Window Sample Photographs

R11 - CP04



Bus Connect Route 11 – Window Sample Photographs

R11 – WS01



Bus Connect Route 11 – Window Sample Photographs

R11 – WS02



APPENDIX 3 – Cable Percussion & Rotary Borehole Records





| | | | | |
|---|---|-----------------------------|---|--------------------------|
| Machine : Dando 2000 Method : Cable Percussion | Casing Diameter 200mm cased to 8.70m | Ground Level (mOD) 21.38 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 714857.4 E 732447 N | Dates 28/09/2020 | Project Contractor Ground Investigations Ireland | Sheet 1/1 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|-----------|----------------|------------------|-----------------|----------------|-------------|-----------------------|---|--------|-------|
| 0.50 | B | | | | 21.28 | 0.10 | TARMACADAM. | | |
| 1.00 | B | | | | | | MADE GROUND: Greyish brown slightly sandy gravelly Clay with occasional sub-angular to sub-rounded cobbles, red brick and mortar fragments. | | |
| 1.20-1.65 | SPT(C) N=2 | | | 1,0/0,1,0,1 | | | | | |
| 1.50 | B | | | | | | | | |
| 2.00-2.45 | SPT(C) N=4 | | | 1,0/1,1,1,1 | | (3.60) | | | |
| 2.00 | B | | | | | | | | |
| 2.50 | B | | | | | | | | |
| 3.00-3.45 | SPT(C) N=13 | | | 6,5/6,3,2,2 | | | | | |
| 3.00 | B | | | | | | | | |
| 3.50 | B | | | | 17.68 | 3.70 | Very stiff brown slightly sandy slightly gravelly CLAY with occasional sand lenses. | | |
| 4.00-4.45 | SPT(C) N=35 | | | 4,4/6,7,10,12 | | (0.70) | | | |
| 4.00 | B | | | | | | | | |
| 4.50 | B | | | | 16.98 | 4.40 | Very stiff dark grey slightly sandy gravelly CLAY with rare sub-rounded cobbles. | | |
| 5.00-5.45 | SPT(C) N=28 | | | 4,5/6,7,7,8 | | | | | |
| 5.00 | B | | | | | | | | |
| 5.50 | B | | | | | | | | |
| 6.00-6.45 | SPT(C) N=31 | | | 3,6/7,7,8,9 | | | | | |
| 6.00 | B | | | | | | | | |
| 6.50 | B | | | | | (4.30) | | | |
| 7.00-7.45 | SPT(C) N=35 | | | 6,7/7,8,9,11 | | | | | |
| 7.00 | B | | | | | | | | |
| 7.50 | B | | | | | | | | |
| 8.00-8.45 | SPT(C) N=50 | | | 7,8/8,12,14,16 | | | | | |
| 8.00 | B | | | | | | | | |
| 8.50 | B | | | | 12.68 | 8.70 | Refusal at 8.70m | | |

| | | |
|--|--|-----------|
| Remarks Slotted standpipe with pea gravel surround from 8.70m to 4.00m BGL, plain pipe with bentonite seal from 4.00m BGL to GL, finished with a cover. Borehole completed at 8.70m BGL. No groundwater encountered. Chiselling from 8.70m to 8.70m for 1 hour. | Scale (approx) | Logged By |
| | 1:50 | JS |
| | Figure No. 9754-07-20.R11-CP01 | |



| | | | | |
|--|---|-----------------------------|---|--------------------------|
| Machine : Beretta T44 Flush : Water Core Dia: 64 mm Method : Rotary Cored | Casing Diameter 96mm cased to 12.50m | Ground Level (mOD) 21.39 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 714858.3 E 732446.8 N | Dates 04/05/2021 | Project Contractor Ground Investigations Ireland | Sheet 1/2 |

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|-----------|---------|---------|---------|----|---------------|-------------|-----------------------|--|--------|-------|
| | | | | | | | | For stratigraphic details see adjacent log for R11-CP01 | | |
| 6.50 | | | | | | 14.89 | 6.50 | OVERBURDEN: Poor recovery - recovery consists of dark grey slightly sandy gravelly CLAY with occasional cobbles (Very Stiff). Driller's notes: Black boulder Clay | | |
| 8.00 | 20 | | | | | | (2.40) | | | |
| 8.90 | 51 | 35 | 27 | 7 | | 12.49 | 8.90 | Medium strong to strong thinly laminated to thinly bedded grey fine grained LIMESTONE interbedded with medium strong thinly laminated dark grey fine grained MUDSTONE. Partially to distinctly weathered | | |
| 9.45 | | | | NI | | | | | | |
| 9.50 | | | | | | | | | | |
| 9.65 | | | | | | | | | | |

| | | |
|---|----------------|-----------|
| Remarks Borehole completed adjacent to cable percussion borehole R11-CP01 Rotary core from 6.50m BGL Borehole complete at 12.50m BGL Borehole backfilled upon completion | Scale (approx) | Logged By |
| | 1:50 | PC |
| Figure No. | | |



| | | | | |
|--|---|-----------------------------|---|--------------------------|
| Machine : Beretta T44 Flush : Water Core Dia: 64 mm Method : Rotary Cored | Casing Diameter 96mm cased to 12.50m | Ground Level (mOD) 21.39 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 714858.3 E 732446.8 N | Dates 04/05/2021 | Project Contractor Ground Investigations Ireland | Sheet 2/2 |

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water |
|-----------|---------|---------|---------|----|---------------|-------------|-----------------------|---|--------|-------|
| 11.00 | 100 | 74 | 23 | 14 | | 10.39 | (2.10) | Strong thinly laminated to thinly bedded grey fine grained LIMESTONE. Partially weathered with occasional calcite veining and rare weak to medium strong Mudstone bands | | |
| | 100 | 95 | 95 | 1 | | | (1.50) | | | |
| 12.50 | | | | | | 8.89 | 12.50 | Borehole complete at 12.50m BGL Refusal at 12.50m | | |

| | | |
|------------|----------------|-----------|
| Remarks | Scale (approx) | Logged By |
| | 1:50 | PC |
| Figure No. | | |



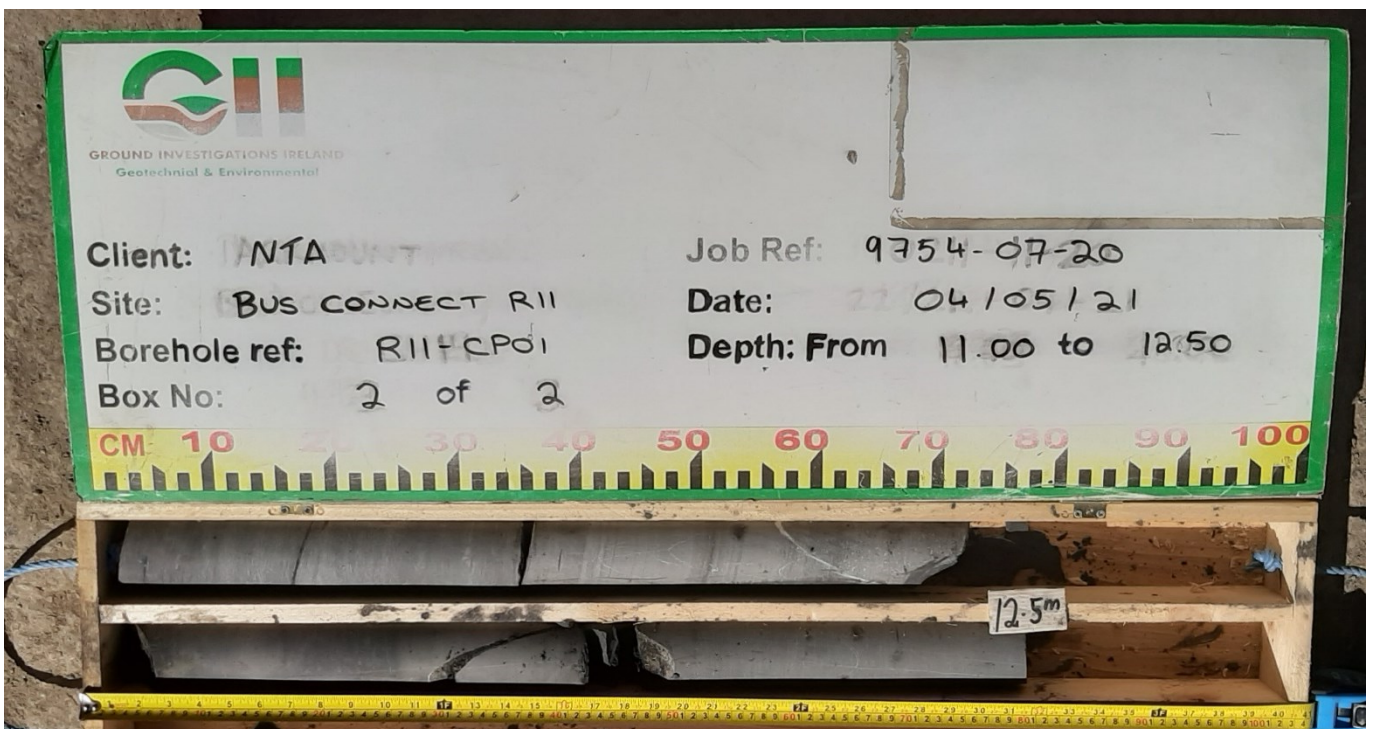
| | | | | |
|--|---|---------------------------------------|--|---------------------------------|
| Machine : Dando 2000 and Beretta T41 Method : Cable Percussion with rotary core follow on | Casing Diameter 200mm cased to 4.10m 78mm cased to 6.30m | Ground Level (mOD) 36.09 | Client National Transport Authority | Job Number 9754-07-20 |
| | Location 713873.9 E 731357.7 N | Dates 23/03/2021-25/03/2021 | Project Contractor Ground Investigations Ireland | Sheet 1/1 |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|-----------|----------------|------------------|-----------------|---------------|-------------|-----------------------|--|--------|-------|-------|
| 0.50 | B | | | | 35.79 | (0.30) | CONCRETE | | | |
| 1.00 | B | | | 1,0/1,0,1,1 | 35.49 | (0.30) | MADE GROUND: Grey sandy subangular to subrounded fine to coarse Gravel with occasional angular to subrounded cobbles | | | |
| 1.00-1.45 | SPT(C) N=3 | | | | 35.09 | (0.40) | MADE GROUND: Dark brown slightly sandy gravelly Clay with occasional angular to subrounded cobbles and occasional fragments of glass, metal, red brick and wood (creosote like odour) | | | |
| 1.50 | UT | | | | | | | | | |
| 2.00 | B | | | 1,2/2,3,2,2 | | (2.50) | MADE GROUND: Grey slightly sandy slightly gravelly Clay with occasional angular to subangular cobbles and occasional fragments of red brick and wood | | | |
| 2.00-2.45 | SPT(C) N=9 | | | | | | | | | |
| 3.00 | B | | | 7,17/50 | | | | | | |
| 3.00-3.20 | SPT(C) 50/50 | | | | | | | | | |
| 4.00-4.06 | | | | 25/50 | 32.59 | 3.50 | Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse | | | |
| 4.00 | TCR | SCR | RQD | FI | | (0.60) | | | | |
| 4.00 | | | | 50/40 | 31.99 | 4.10 | Recovery consists of grey subangular to subrounded fine to coarse Gravel with occasional subangular cobbles. Driller notes: Gravel CLAY. (Clay washed away during drilling) | | | |
| 4.10 | | | | B | 31.69 | 4.40 | | | | |
| 4.40 | 100 | 63 | 50 | 8 | | | Medium strong medium to thickly bedded grey/dark grey fine grained LIMESTONE interbedded with Mudstone. Partially weathered to unweathered. | | | |
| 5.00 | | | | | | (1.90) | (4.40m - 6.30m) Two fracture sets. F1: 0-20 Degrees, very closely to closely spaced, planar to undulating rough with some brown staining and clay infill. F2: 55-70 Degrees, medium to widely spaced, planar to undulating rough with some brown staining and clay smearing. | | | |
| 5.30 | | | | 26 | | | | | | |
| 5.80 | 100 | 85 | 58 | 6 | | | | | | |
| 6.30 | | | | | 29.79 | 6.30 | Complete at 6.30m | | | |

| | | |
|---|--|------------------------|
| Remarks Refusal at 4.10m BGL in Cable percussion borehole. Rotary core follow on from 4.10m BGL No groundwater encountered 50mm Standpipe Installed with slotted section with gravel filter from 6.3m to 1.0m, plain pipe with bentonite seal from 1.0m to GL and finished with a flush cover. Chiselling from 4.00m to 4.10m for 1 hour. | Scale (approx) 1:50 | Logged By PC |
| | Figure No. 9754-07-20.R11-CP03 | |

Bus Connect Route 11 – Rotary Core Photographs

R11-CP01A



Bus Connect Route 11 – Rotary Core Photographs

R11 – CP03



APPENDIX 4 - Laboratory Testing



Ground Investigations Ireland
Catherinstown House
Hazelhatch Road
Newcastle
Co. Dublin
Ireland



Attention : Mike Sutton
Date : 26th April, 2021
Your reference : 9754-07-20
Our reference : Test Report 21/4698 Batch 1
Location : Bus Connect Route 11
Date samples received : 30th March, 2021
Status : Final report
Issue : 1

Five samples were received for analysis on 30th March, 2021 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Phil Sommerton BSc
Senior Project Manager

Please include all sections of this report if it is reproduced

Client Name: Ground Investigations Ireland
Reference: 20/07/9754
Location: Bus Connect Route 11
Contact: Mike Sutton

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|-------------|-------|-----------|-------|----------------|------------------|---|-----------------|
| 21/4698 | 1 | R11-CP03 | 0.50 | 2 | 19/04/2021 | General Description (Bulk Analysis) | Soil/Stone |
| | | | | | 19/04/2021 | Asbestos Fibres | NAD |
| | | | | | 19/04/2021 | Asbestos ACM | NAD |
| | | | | | 19/04/2021 | Asbestos Type | NAD |
| | | | | | 19/04/2021 | Asbestos Level Screen | NAD |
| 21/4698 | 1 | R11-CP03 | 1.00 | 5 | 19/04/2021 | General Description (Bulk Analysis) | Soil/Stone |
| | | | | | 19/04/2021 | Asbestos Fibres | Fibre Bundles |
| | | | | | 19/04/2021 | Asbestos ACM | NAD |
| | | | | | 19/04/2021 | Asbestos Type | Chrysotile |
| | | | | | 19/04/2021 | Asbestos Level Screen | less than 0.1% |
| | | | | | 20/04/2021 | Total ACM Gravimetric Quantification (% Asb) | <0.001 (mass %) |
| | | | | | 20/04/2021 | Total Detailed Gravimetric Quantification (% Asb) | <0.001 (mass %) |
| | | | | | 20/04/2021 | Total Gravimetric Quantification (ACM + Detailed) (% Asb) | <0.001 (mass %) |
| | | | | | 20/04/2021 | Asbestos PCOM Quantification (Fibres) | <0.001 (mass %) |
| | | | | | 20/04/2021 | Asbestos Gravimetric & PCOM Total | <0.001 (mass %) |
| 21/4698 | 1 | R11-CP03 | 2.00 | 8 | 20/04/2021 | General Description (Bulk Analysis) | soil.stones |
| | | | | | 20/04/2021 | Asbestos Fibres | NAD |
| | | | | | 20/04/2021 | Asbestos ACM | NAD |
| | | | | | 20/04/2021 | Asbestos Type | NAD |
| | | | | | 20/04/2021 | Asbestos Level Screen | NAD |
| 21/4698 | 1 | R11-CP03 | 3.00 | 11 | 20/04/2021 | General Description (Bulk Analysis) | soil.stones |
| | | | | | 20/04/2021 | Asbestos Fibres | NAD |
| | | | | | 20/04/2021 | Asbestos ACM | NAD |
| | | | | | 20/04/2021 | Asbestos Type | NAD |
| | | | | | 20/04/2021 | Asbestos Level Screen | NAD |
| 21/4698 | 1 | R11-CP03 | 4.00 | 14 | 20/04/2021 | General Description (Bulk Analysis) | soil/stones |
| | | | | | 20/04/2021 | Asbestos Fibres | NAD |
| | | | | | 20/04/2021 | Asbestos ACM | NAD |
| | | | | | 20/04/2021 | Asbestos Type | NAD |
| | | | | | 20/04/2021 | Asbestos Level Screen | NAD |

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/4698

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

| | |
|---------|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

HWOL ACRONYMS AND OPERATORS USED

| | |
|-------|--|
| HS | Headspace Analysis. |
| EH | Extractable Hydrocarbons - i.e. everything extracted by the solvent. |
| CU | Clean-up - e.g. by florisil, silica gel. |
| 1D | GC - Single coil gas chromatography. |
| Total | Aliphatics & Aromatics. |
| AL | Aliphatics only. |
| AR | Aromatics only. |
| 2D | GC-GC - Double coil gas chromatography. |
| #1 | EH_Total but with humics mathematically subtracted |
| #2 | EU_Total but with fatty acids mathematically subtracted |
| _ | Operator - underscore to separate acronyms (exception for +). |
| + | Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total |
| MS | Mass Spectrometry. |

EMT Job No: 21/4698

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM17 | Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM20 | Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| TM22 | Modified BS1377-3:1990 Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (35C-440C). On request modified ASTM D2974-00 LOI (105C-440C) | PM0 | No preparation is required. | Yes | | AD | Yes |

EMT Job No: 21/4698

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM26 | Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection. | PM0 | No preparation is required. | | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | Yes | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM62 | Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM60 | TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1. | PM0 | No preparation is required. | | | AR | Yes |

EMT Job No: 21/4698

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM61 | Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007 | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| TM131 | Quantification of Asbestos Fibres and ACM based on HSG248 First edition:2006, HSG 264 Second edition:2012, HSE Contract Research Report No.83/1996, MDHS 87:1998, WM3 1st Edition v1.1:2018 | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | Yes |
| TM173 | Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998) | PM0 | No preparation is required. | | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AR | Yes |
| NONE | No Method Code | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | | | AR | |
| NONE | No Method Code | PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | | | AR | |

Ground Investigations Ireland

Catherinstown House

Hazelhatch Road

Newcastle

Co. Dublin

Ireland



Attention : John Duggan

Date : 2nd June, 2021

Your reference : 9754-07-20

Our reference : Test Report 21/7238 Batch 1

Location : Bus Connect Route 11

Date samples received : 14th May, 2021

Status : Final report

Issue : 1

Three samples were received for analysis on 14th May, 2021 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Phil Sommerton BSc

Senior Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connect Route 11
Contact: John Duggan
EMT Job No: 21/7238

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | 4-6 | 7-9 | | | | | | | | | | |
|--|--------------------|------------|------------|--|--|--|--|--|--|---------|-------|------------------------|--|
| Sample ID | R11-CP04 | R11-CP04 | R11-CP04 | | | | | | | | | | |
| Depth | 1.00 | 2.00 | 2.60 | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | | | | | | | | | | |
| Sample Date | 11/05/2021 | 11/05/2021 | 11/05/2021 | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | | | | | | | | | | |
| Batch Number | 1 | 1 | 1 | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | 14/05/2021 | 14/05/2021 | | | | | | | | | | |
| | | | | | | | | | | LOD/LOR | Units | Method No. | |
| Please see attached notes for all abbreviations and acronyms | | | | | | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| Aromatics | | | | | | | | | | | | | |
| >C5-EC7 (HS_1D_AR) # | <0.1 ^{SV} | <0.1 | <0.1 | | | | | | | <0.1 | mg/kg | TM36/PM12 | |
| >EC7-EC8 (HS_1D_AR) # | <0.1 ^{SV} | <0.1 | <0.1 | | | | | | | <0.1 | mg/kg | TM36/PM12 | |
| >EC8-EC10 (HS_1D_AR) # | <0.1 ^{SV} | <0.1 | <0.1 | | | | | | | <0.1 | mg/kg | TM36/PM12 | |
| >EC10-EC12 (EH_CU_1D_AR) # | <0.2 | <0.2 | <0.2 | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 | |
| >EC12-EC16 (EH_CU_1D_AR) # | <4 | <4 | <4 | | | | | | | <4 | mg/kg | TM5/PM8/PM16 | |
| >EC16-EC21 (EH_CU_1D_AR) # | <7 | <7 | <7 | | | | | | | <7 | mg/kg | TM5/PM8/PM16 | |
| >EC21-EC35 (EH_CU_1D_AR) # | 61 | <7 | <7 | | | | | | | <7 | mg/kg | TM5/PM8/PM16 | |
| >EC35-EC40 (EH_1D_AR) | 13 | <7 | <7 | | | | | | | <7 | mg/kg | TM5/PM8/PM16 | |
| Total aromatics C5-40 (EH+HS_1D_AR) | 74 | <26 | <26 | | | | | | | <26 | mg/kg | TM5/PM8/PM16/PM12/PM15 | |
| Total aliphatics and aromatics(C5-40) (EH+HS_CU_1D_Total) | 115 | <52 | <52 | | | | | | | <52 | mg/kg | TM5/PM8/PM16/PM12/PM15 | |
| >EC6-EC10 (HS_1D_AR) # | <0.1 ^{SV} | <0.1 | <0.1 | | | | | | | <0.1 | mg/kg | TM36/PM12 | |
| >EC10-EC25 (EH_1D_AR) | 16 | <10 | <10 | | | | | | | <10 | mg/kg | TM5/PM8/PM16 | |
| >EC25-EC35 (EH_1D_AR) | 53 | <10 | <10 | | | | | | | <10 | mg/kg | TM5/PM8/PM16 | |
| MTBE # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| Benzene # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| Toluene # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| Ethylbenzene # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| m/p-Xylene # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| o-Xylene # | <5 ^{SV} | <5 | <5 | | | | | | | <5 | ug/kg | TM36/PM12 | |
| PCB 28 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 52 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 101 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 118 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 138 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 153 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| PCB 180 # | <5 | <5 | <5 | | | | | | | <5 | ug/kg | TM17/PM8 | |
| Total 7 PCBs # | <35 | <35 | <35 | | | | | | | <35 | ug/kg | TM17/PM8 | |
| Natural Moisture Content | 19.4 | 28.6 | 17.3 | | | | | | | <0.1 | % | PM4/PM0 | |
| Moisture Content (% Wet Weight) | 16.2 | 22.2 | 14.7 | | | | | | | <0.1 | % | PM4/PM0 | |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | | | | | | | <0.3 | mg/kg | TM38/PM20 | |
| Chromium III | - | 62.2 | 27.6 | | | | | | | <0.5 | mg/kg | NONE/NONE | |
| Chromium III | 21.7 | - | - | | | | | | | <0.5 | mg/kg | NONE/NONE | |
| Total Cyanide # | 1.9 | <0.5 | <0.5 | | | | | | | <0.5 | mg/kg | TM89/PM45 | |
| Total Organic Carbon # | NDP | 7.71 | 0.27 | | | | | | | <0.02 | % | TM21/PM24 | |
| Loss on Ignition # | NDP | 6.5 | 1.9 | | | | | | | <1.0 | % | TM22/PM0 | |

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connect Route 11
Contact: John Duggan
EMT Job No: 21/7238

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | 4-6 | 7-9 | | | | | | | | | LOD/LOR | Units | Method No. |
|----------------------------|------------|------------|------------|--|--|--|--|--|--|--|--|---------|----------|------------|
| Sample ID | R11-CP04 | R11-CP04 | R11-CP04 | | | | | | | | | | | |
| Depth | 1.00 | 2.00 | 2.60 | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | | | | | | | | | | | |
| Sample Date | 11/05/2021 | 11/05/2021 | 11/05/2021 | | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | | | | | | | | | | | |
| Batch Number | 1 | 1 | 1 | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | 14/05/2021 | 14/05/2021 | | | | | | | | | | | |
| pH # | 8.16 | 7.95 | 8.16 | | | | | | | | | <0.01 | pH units | TM73/PM11 |
| Mass of raw test portion | 0.1081 | 0.1099 | 0.1044 | | | | | | | | | | kg | NONE/PM17 |
| Mass of dried test portion | 0.09 | 0.09 | 0.09 | | | | | | | | | | kg | NONE/PM17 |
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Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connect Route 11
Contact: John Duggan
EMT Job No: 21/7238

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | 4-6 | 7-9 | | | | | | | | | | | |
|--|------------|------------|------------|--|--|--|--|--|--|--|--|----------|-------|------------|
| Sample ID | R11-CP04 | R11-CP04 | R11-CP04 | | | | | | | | | | | |
| Depth | 1.00 | 2.00 | 2.60 | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | | | | | | | | | | | |
| Sample Date | 11/05/2021 | 11/05/2021 | 11/05/2021 | | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | | | | | | | | | | | |
| Batch Number | 1 | 1 | 1 | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | 14/05/2021 | 14/05/2021 | | | | | | | | | | | |
| Please see attached notes for all abbreviations and acronyms | | | | | | | | | | | | | | |
| | | | | | | | | | | | | LOD/LOR | Units | Method No. |
| Dissolved Antimony # | <0.002 | <0.002 | 0.005 | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Antimony (A10) # | <0.02 | <0.02 | 0.05 | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Arsenic # | 0.0034 | 0.0027 | <0.0025 | | | | | | | | | <0.0025 | mg/l | TM30/PM17 |
| Dissolved Arsenic (A10) # | 0.034 | 0.027 | <0.025 | | | | | | | | | <0.025 | mg/kg | TM30/PM17 |
| Dissolved Barium # | 0.007 | 0.010 | 0.018 | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Barium (A10) # | 0.07 | 0.10 | 0.18 | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Cadmium # | <0.0005 | <0.0005 | <0.0005 | | | | | | | | | <0.0005 | mg/l | TM30/PM17 |
| Dissolved Cadmium (A10) # | <0.005 | <0.005 | <0.005 | | | | | | | | | <0.005 | mg/kg | TM30/PM17 |
| Dissolved Chromium # | <0.0015 | <0.0015 | <0.0015 | | | | | | | | | <0.0015 | mg/l | TM30/PM17 |
| Dissolved Chromium (A10) # | <0.015 | <0.015 | <0.015 | | | | | | | | | <0.015 | mg/kg | TM30/PM17 |
| Dissolved Copper # | <0.007 | <0.007 | <0.007 | | | | | | | | | <0.007 | mg/l | TM30/PM17 |
| Dissolved Copper (A10) # | <0.07 | <0.07 | <0.07 | | | | | | | | | <0.07 | mg/kg | TM30/PM17 |
| Dissolved Lead # | <0.005 | <0.005 | <0.005 | | | | | | | | | <0.005 | mg/l | TM30/PM17 |
| Dissolved Lead (A10) # | <0.05 | <0.05 | <0.05 | | | | | | | | | <0.05 | mg/kg | TM30/PM17 |
| Dissolved Molybdenum # | 0.005 | 0.012 | <0.002 | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Molybdenum (A10) # | 0.05 | 0.12 | <0.02 | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Nickel # | <0.002 | <0.002 | <0.002 | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Nickel (A10) # | <0.02 | <0.02 | <0.02 | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Selenium # | 0.003 | <0.003 | 0.005 | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Selenium (A10) # | 0.03 | <0.03 | 0.05 | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Zinc # | <0.003 | <0.003 | <0.003 | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Zinc (A10) # | <0.03 | <0.03 | <0.03 | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Mercury Dissolved by CVA# | 0.00001 | <0.00001 | <0.00001 | | | | | | | | | <0.00001 | mg/l | TM61/PM0 |
| Mercury Dissolved by CVAF# | 0.0001 | <0.0001 | <0.0001 | | | | | | | | | <0.0001 | mg/kg | TM61/PM0 |
| Total Phenols HPLC | <0.05 | <0.05 | <0.05 | | | | | | | | | <0.05 | mg/l | TM26/PM0 |
| Total Phenols HPLC | <0.5 | <0.5 | <0.5 | | | | | | | | | <0.5 | mg/kg | TM26/PM0 |
| Fluoride | <0.3 | 0.4 | <0.3 | | | | | | | | | <0.3 | mg/l | TM173/PM0 |
| Fluoride | <3 | 4 | <3 | | | | | | | | | <3 | mg/kg | TM173/PM0 |
| Sulphate as SO4 # | 7.6 | 4.9 | 3.8 | | | | | | | | | <0.5 | mg/l | TM38/PM0 |
| Sulphate as SO4 # | 76 | 49 | 38 | | | | | | | | | <5 | mg/kg | TM38/PM0 |
| Chloride # | 0.7 | 0.8 | 0.7 | | | | | | | | | <0.3 | mg/l | TM38/PM0 |
| Chloride # | 7 | 8 | 7 | | | | | | | | | <3 | mg/kg | TM38/PM0 |
| Dissolved Organic Carbon | 5 | <2 | <2 | | | | | | | | | <2 | mg/l | TM60/PM0 |
| Dissolved Organic Carbon | 50 | <20 | <20 | | | | | | | | | <20 | mg/kg | TM60/PM0 |
| Total Dissolved Solids # | 91 | 74 | 42 | | | | | | | | | <35 | mg/l | TM20/PM0 |
| Total Dissolved Solids # | 910 | 740 | 420 | | | | | | | | | <350 | mg/kg | TM20/PM0 |

Client Name: Ground Investigations Ireland
Reference: 20/07/9754
Location: Bus Connect Route 11
Contact: John Duggan

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|-------------|-------|-----------|-------|----------------|------------------|--|-----------------|
| 21/7238 | 1 | R11-CP04 | 1.00 | 2 | 24/05/2021 | General Description (Bulk Analysis) | Soil/Stone |
| | | | | | 24/05/2021 | Asbestos Fibres | Free Fibres |
| | | | | | 24/05/2021 | Asbestos ACM | NAD |
| | | | | | 24/05/2021 | Asbestos Type | Chrysotile |
| | | | | | 24/05/2021 | Asbestos Level Screen | less than 0.1% |
| | | | | | 24/05/2021 | Total ACM Gravimetric Quantification (% Asb) | <0.001 (mass %) |
| | | | | | 24/05/2021 | Total Detailed Gravimetric Quantification (% Asb) | <0.001 (mass %) |
| | | | | | 24/05/2021 | Total Gravimetric Quantification (ACM + Detailed) (% Asb) | <0.001 (mass %) |
| 21/7238 | 1 | R11-CP04 | 2.00 | 5 | 24/05/2021 | General Description (Bulk Analysis) | Soil/Stone |
| | | | | | 24/05/2021 | Asbestos Fibres | NAD |
| | | | | | 24/05/2021 | Asbestos ACM | NAD |
| | | | | | 24/05/2021 | Asbestos Type | NAD |
| | | | | | 24/05/2021 | Asbestos Level Screen | NAD |
| 21/7238 | 1 | R11-CP04 | 2.60 | 8 | 24/05/2021 | General Description (Bulk Analysis) | Soil/Stone |
| | | | | | 24/05/2021 | Asbestos Fibres | NAD |
| | | | | | 24/05/2021 | Asbestos ACM | NAD |
| | | | | | 24/05/2021 | Asbestos Type | NAD |
| | | | | | 24/05/2021 | Asbestos Level Screen | NAD |

Client Name: Ground Investigations Ireland

Reference: 9754-07-20

Location: Bus Connect Route 11

Contact: John Duggan

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|--|-------|-----------|-------|----------------|----------|--------|
| No deviating sample report results for job 21/7238 | | | | | | |
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Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/7238

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

| | |
|---------|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

HWOL ACRONYMS AND OPERATORS USED

| | |
|-------|--|
| HS | Headspace Analysis. |
| EH | Extractable Hydrocarbons - i.e. everything extracted by the solvent. |
| CU | Clean-up - e.g. by florisil, silica gel. |
| 1D | GC - Single coil gas chromatography. |
| Total | Aliphatics & Aromatics. |
| AL | Aliphatics only. |
| AR | Aromatics only. |
| 2D | GC-GC - Double coil gas chromatography. |
| #1 | EH_Total but with humics mathematically subtracted |
| #2 | EU_Total but with fatty acids mathematically subtracted |
| _ | Operator - underscore to separate acronyms (exception for +). |
| + | Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total |
| MS | Mass Spectrometry. |

EMT Job No: 21/7238

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM17 | Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM20 | Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| TM22 | Modified BS1377-3:1990 Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (35C-440C). On request modified ASTM D2974-00 LOI (105C-440C) | PM0 | No preparation is required. | Yes | | AD | Yes |

EMT Job No: 21/7238

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|--|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM26 | Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection. | PM0 | No preparation is required. | | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | Yes | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM62 | Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM60 | TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1. | PM0 | No preparation is required. | | | AR | Yes |

EMT Job No: 21/7238

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM61 | Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007 | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| TM131 | Quantification of Asbestos Fibres and ACM based on HSG248 First edition:2006, HSG 264 Second edition:2012, HSE Contract Research Report No.83/1996, MDHS 87:1998, WM3 1st Edition v1.1:2018 | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | Yes |
| TM173 | Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998) | PM0 | No preparation is required. | | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AR | Yes |
| NONE | No Method Code | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | | | AR | |
| NONE | No Method Code | PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | | | AR | |

Ground Investigations Ireland
Catherinstown House
Hazelhatch Road
Newcastle
Co. Dublin
Ireland



Attention : John Duggan
Date : 2nd June, 2021
Your reference : 9754-07-20
Our reference : Test Report 21/7249 Batch 1
Location : Bus Connects
Date samples received : 14th May, 2021
Status : Final report
Issue : 1

One sample was received for analysis on 14th May, 2021 of which one was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Phil Sommerton BSc

Senior Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connects
Contact: John Duggan
EMT Job No: 21/7249

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | | | | | | | | | | | | | | | | | | | | | |
|--|------------|--|--|--|--|--|--|--|--|--|--|--|--|--|---------|-------|------------|-------|--------------|--|--|--|
| Sample ID | R11-CP04 | | | | | | | | | | | | | | | | | | | | | |
| Depth | 0.50 | | | | | | | | | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | | | | | | | | | | |
| Containers | V J T | | | | | | | | | | | | | | | | | | | | | |
| Sample Date | 11/05/2021 | | | | | | | | | | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | LOD/LOR | Units | Method No. | | | | | |
| Antimony | 2 | | | | | | | | | | | | | | | | <1 | mg/kg | TM30/PM15 | | | |
| Arsenic # | 19.8 | | | | | | | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 | | | |
| Barium # | 135 | | | | | | | | | | | | | | | | <1 | mg/kg | TM30/PM15 | | | |
| Cadmium # | 1.3 | | | | | | | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 | | | |
| Chromium # | 55.8 | | | | | | | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 | | | |
| Copper # | 69 | | | | | | | | | | | | | | | | <1 | mg/kg | TM30/PM15 | | | |
| Lead # | 187 | | | | | | | | | | | | | | | | <5 | mg/kg | TM30/PM15 | | | |
| Mercury # | 0.3 | | | | | | | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 | | | |
| Molybdenum # | 4.8 | | | | | | | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 | | | |
| Nickel # | 36.8 | | | | | | | | | | | | | | | | <0.7 | mg/kg | TM30/PM15 | | | |
| Selenium # | 1 | | | | | | | | | | | | | | | | <1 | mg/kg | TM30/PM15 | | | |
| Zinc # | 225 | | | | | | | | | | | | | | | | <5 | mg/kg | TM30/PM15 | | | |
| Please see attached notes for all abbreviations and acronyms | | | | | | | | | | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Acenaphthylene | 0.10 | | | | | | | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 | | | |
| Acenaphthene # | 0.09 | | | | | | | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 | | | |
| Fluorene # | 0.06 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Phenanthrene # | 1.18 | | | | | | | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 | | | |
| Anthracene # | 0.44 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Fluoranthene # | 5.29 | | | | | | | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 | | | |
| Pyrene # | 4.61 | | | | | | | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 | | | |
| Benzo(a)anthracene # | 3.54 | | | | | | | | | | | | | | | | <0.06 | mg/kg | TM4/PM8 | | | |
| Chrysene # | 3.36 | | | | | | | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 | | | |
| Benzo(bk)fluoranthene # | 8.44 | | | | | | | | | | | | | | | | <0.07 | mg/kg | TM4/PM8 | | | |
| Benzo(a)pyrene # | 4.73 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Indeno(123cd)pyrene # | 3.20 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Dibenzo(ah)anthracene # | 0.65 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Benzo(ghi)perylene # | 3.10 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| Coronene | 0.72 | | | | | | | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 | | | |
| PAH 17 Total | 39.51 | | | | | | | | | | | | | | | | <0.64 | mg/kg | TM4/PM8 | | | |
| Benzo(b)fluoranthene | 6.08 | | | | | | | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 | | | |
| Benzo(k)fluoranthene | 2.36 | | | | | | | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 | | | |
| PAH Surrogate % Recovery | 95 | | | | | | | | | | | | | | | | <0 | % | TM4/PM8 | | | |
| Mineral Oil (C10-C40) (EH_CU_1D_AL) | <30 | | | | | | | | | | | | | | | | <30 | mg/kg | TM5/PM8/PM16 | | | |

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connects
Contact: John Duggan
EMT Job No: 21/7249

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. 1-3 | | | | | | | | | | Please see attached notes for all abbreviations and acronyms | | | |
|---|------------|--|--|--|--|--|--|--|--|--|-------|------------|------------------------|
| Sample ID | R11-CP04 | | | | | | | | | | | | |
| Depth | 0.50 | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | | | | | | | | | | | | |
| Sample Date | 11/05/2021 | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | | | | | | | | | LOD/LOR | Units | Method No. | |
| TPH CWG | | | | | | | | | | | | | |
| Aliphatics | | | | | | | | | | | | | |
| >C5-C6 (HS_1D_AL) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 (HS_1D_AL) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 (HS_1D_AL) | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 (EH_CU_1D_AL) # | <0.2 | | | | | | | | | | <0.2 | mg/kg | TMS/PM8/PM16 |
| >C12-C16 (EH_CU_1D_AL) # | <4 | | | | | | | | | | <4 | mg/kg | TMS/PM8/PM16 |
| >C16-C21 (EH_CU_1D_AL) # | <7 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| >C21-C35 (EH_CU_1D_AL) # | 20 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| >C35-C40 (EH_1D_AL) | <7 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| Total aliphatics C5-40 (EH+HS_1D_AL) | <26 | | | | | | | | | | <26 | mg/kg | TMS/PM8/PM16/PM12/PM10 |
| >C6-C10 (HS_1D_AL) | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C25 (EH_1D_AL) | <10 | | | | | | | | | | <10 | mg/kg | TMS/PM8/PM16 |
| >C25-C35 (EH_1D_AL) | 18 | | | | | | | | | | <10 | mg/kg | TMS/PM8/PM16 |
| Aromatics | | | | | | | | | | | | | |
| >C5-EC7 (HS_1D_AR) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 (HS_1D_AR) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 (HS_1D_AR) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 (EH_CU_1D_AR) # | <0.2 | | | | | | | | | | <0.2 | mg/kg | TMS/PM8/PM16 |
| >EC12-EC16 (EH_CU_1D_AR) # | <4 | | | | | | | | | | <4 | mg/kg | TMS/PM8/PM16 |
| >EC16-EC21 (EH_CU_1D_AR) # | 13 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| >EC21-EC35 (EH_CU_1D_AR) # | 16 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| >EC35-EC40 (EH_1D_AR) | <7 | | | | | | | | | | <7 | mg/kg | TMS/PM8/PM16 |
| Total aromatics C5-40 (EH+HS_1D_AR) | 29 | | | | | | | | | | <26 | mg/kg | TMS/PM8/PM16/PM12/PM10 |
| Total aliphatics and aromatics(C5-40) (EH+HS_CU_1D_Total) | <52 | | | | | | | | | | <52 | mg/kg | TMS/PM8/PM16/PM12/PM10 |
| >EC6-EC10 (HS_1D_AR) # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC25 (EH_1D_AR) | 27 | | | | | | | | | | <10 | mg/kg | TMS/PM8/PM16 |
| >EC25-EC35 (EH_1D_AR) | <10 | | | | | | | | | | <10 | mg/kg | TMS/PM8/PM16 |
| MTBE # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| PCB 28 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 52 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 101 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 118 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 138 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 153 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| PCB 180 # | <5 | | | | | | | | | | <5 | ug/kg | TM17/PM8 |
| Total 7 PCBs # | <35 | | | | | | | | | | <35 | ug/kg | TM17/PM8 |

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connects
Contact: John Duggan
EMT Job No: 21/7249

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | | | | | | | | | | | | | | |
|---------------------------------------|------------|--|--|--|--|--|--|--|--|--|--|--|----------|-------|-----------|
| Sample ID | R11-CP04 | | | | | | | | | | | | | | |
| Depth | 0.50 | | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | | | |
| Containers | V J T | | | | | | | | | | | | | | |
| Sample Date | 11/05/2021 | | | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Dissolved Antimony # | <0.002 | | | | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Antimony (A10) # | <0.02 | | | | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Arsenic # | 0.0061 | | | | | | | | | | | | <0.0025 | mg/l | TM30/PM17 |
| Dissolved Arsenic (A10) # | 0.061 | | | | | | | | | | | | <0.025 | mg/kg | TM30/PM17 |
| Dissolved Barium # | 0.013 | | | | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Barium (A10) # | 0.13 | | | | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Cadmium # | <0.0005 | | | | | | | | | | | | <0.0005 | mg/l | TM30/PM17 |
| Dissolved Cadmium (A10) # | <0.005 | | | | | | | | | | | | <0.005 | mg/kg | TM30/PM17 |
| Dissolved Chromium # | <0.0015 | | | | | | | | | | | | <0.0015 | mg/l | TM30/PM17 |
| Dissolved Chromium (A10) # | <0.015 | | | | | | | | | | | | <0.015 | mg/kg | TM30/PM17 |
| Dissolved Copper # | <0.007 | | | | | | | | | | | | <0.007 | mg/l | TM30/PM17 |
| Dissolved Copper (A10) # | <0.07 | | | | | | | | | | | | <0.07 | mg/kg | TM30/PM17 |
| Dissolved Lead # | <0.005 | | | | | | | | | | | | <0.005 | mg/l | TM30/PM17 |
| Dissolved Lead (A10) # | <0.05 | | | | | | | | | | | | <0.05 | mg/kg | TM30/PM17 |
| Dissolved Molybdenum # | 0.007 | | | | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Molybdenum (A10) # | 0.07 | | | | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Nickel # | <0.002 | | | | | | | | | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Nickel (A10) # | <0.02 | | | | | | | | | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Selenium # | <0.003 | | | | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Selenium (A10) # | <0.03 | | | | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Zinc # | 0.004 | | | | | | | | | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Zinc (A10) # | 0.04 | | | | | | | | | | | | <0.03 | mg/kg | TM30/PM17 |
| Mercury Dissolved by CVA ^F | 0.00001 | | | | | | | | | | | | <0.00001 | mg/l | TM61/PM0 |
| Mercury Dissolved by CVA ^F | 0.0001 | | | | | | | | | | | | <0.0001 | mg/kg | TM61/PM0 |
| Total Phenols HPLC | <0.05 | | | | | | | | | | | | <0.05 | mg/l | TM26/PM0 |
| Total Phenols HPLC | <0.5 | | | | | | | | | | | | <0.5 | mg/kg | TM26/PM0 |
| Fluoride | 0.3 | | | | | | | | | | | | <0.3 | mg/l | TM173/PM0 |
| Fluoride | 3 | | | | | | | | | | | | <3 | mg/kg | TM173/PM0 |
| Sulphate as SO ₄ # | 0.6 | | | | | | | | | | | | <0.5 | mg/l | TM38/PM0 |
| Sulphate as SO ₄ # | 6 | | | | | | | | | | | | <5 | mg/kg | TM38/PM0 |
| Chloride # | 0.7 | | | | | | | | | | | | <0.3 | mg/l | TM38/PM0 |
| Chloride # | 7 | | | | | | | | | | | | <3 | mg/kg | TM38/PM0 |
| Dissolved Organic Carbon | 3 | | | | | | | | | | | | <2 | mg/l | TM60/PM0 |
| Dissolved Organic Carbon | 30 | | | | | | | | | | | | <20 | mg/kg | TM60/PM0 |
| Total Dissolved Solids # | 87 | | | | | | | | | | | | <35 | mg/l | TM20/PM0 |
| Total Dissolved Solids # | 870 | | | | | | | | | | | | <350 | mg/kg | TM20/PM0 |

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connects
Contact: John Duggan
EMT Job No: 21/7249

Report : EN12457_2
Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. 1-3 | | | | | | | | | Inert | Stable Non-reactive | Hazardous | LOD LOR | Units | Method No. | |
|-----------------------------|------------|--|--|--|--|--|--|--|-------|---------------------|-----------|---------|----------|--------------|--|
| Sample ID | R11-CP04 | | | | | | | | | | | | | | |
| Depth | 0.50 | | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | | | |
| Containers | V J T | | | | | | | | | | | | | | |
| Sample Date | 11/05/2021 | | | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | | | |
| Date of Receipt | 14/05/2021 | | | | | | | | | | | | | | |
| Solid Waste Analysis | | | | | | | | | | | | | | | |
| Total Organic Carbon # | 3.83 | | | | | | | | 3 | 5 | 6 | <0.02 | % | TM21/PM24 | |
| Sum of BTEX | <0.025 | | | | | | | | 6 | - | - | <0.025 | mg/kg | TM36/PM12 | |
| Sum of 7 PCBs # | <0.035 | | | | | | | | 1 | - | - | <0.035 | mg/kg | TM17/PM8 | |
| Mineral Oil | <30 | | | | | | | | 500 | - | - | <30 | mg/kg | TM5/PM8/PM16 | |
| PAH Sum of 17 | 39.51 | | | | | | | | 100 | - | - | <0.64 | mg/kg | TM4/PM8 | |
| CEN 10:1 Leachate | | | | | | | | | | | | | | | |
| Arsenic # | 0.061 | | | | | | | | 0.5 | 2 | 25 | <0.025 | mg/kg | TM30/PM17 | |
| Barium # | 0.13 | | | | | | | | 20 | 100 | 300 | <0.03 | mg/kg | TM30/PM17 | |
| Cadmium # | <0.005 | | | | | | | | 0.04 | 1 | 5 | <0.005 | mg/kg | TM30/PM17 | |
| Chromium # | <0.015 | | | | | | | | 0.5 | 10 | 70 | <0.015 | mg/kg | TM30/PM17 | |
| Copper # | <0.07 | | | | | | | | 2 | 50 | 100 | <0.07 | mg/kg | TM30/PM17 | |
| Mercury # | 0.0001 | | | | | | | | 0.01 | 0.2 | 2 | <0.0001 | mg/kg | TM61/PM0 | |
| Molybdenum # | 0.07 | | | | | | | | 0.5 | 10 | 30 | <0.02 | mg/kg | TM30/PM17 | |
| Nickel # | <0.02 | | | | | | | | 0.4 | 10 | 40 | <0.02 | mg/kg | TM30/PM17 | |
| Lead # | <0.05 | | | | | | | | 0.5 | 10 | 50 | <0.05 | mg/kg | TM30/PM17 | |
| Antimony # | <0.02 | | | | | | | | 0.06 | 0.7 | 5 | <0.02 | mg/kg | TM30/PM17 | |
| Selenium # | <0.03 | | | | | | | | 0.1 | 0.5 | 7 | <0.03 | mg/kg | TM30/PM17 | |
| Zinc # | 0.04 | | | | | | | | 4 | 50 | 200 | <0.03 | mg/kg | TM30/PM17 | |
| Total Dissolved Solids # | 870 | | | | | | | | 4000 | 60000 | 100000 | <350 | mg/kg | TM20/PM0 | |
| Dissolved Organic Carbon | 30 | | | | | | | | 500 | 800 | 1000 | <20 | mg/kg | TM60/PM0 | |
| Dry Matter Content Ratio | 82.3 | | | | | | | | - | - | - | <0.1 | % | NONE/PM4 | |
| pH # | 7.94 | | | | | | | | - | - | - | <0.01 | pH units | TM73/PM11 | |
| Fluoride | 3 | | | | | | | | - | - | - | <3 | mg/kg | TM173/PM0 | |
| Sulphate as SO4 # | 6 | | | | | | | | 1000 | 20000 | 50000 | <5 | mg/kg | TM38/PM0 | |
| Chloride # | 7 | | | | | | | | 800 | 15000 | 25000 | <3 | mg/kg | TM38/PM0 | |

Client Name: Ground Investigations Ireland
Reference: 9754-07-20
Location: Bus Connects
Contact: John Duggan

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|--|-------|-----------|-------|----------------|----------|--------|
| No deviating sample report results for job 21/7249 | | | | | | |
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Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/7249

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

| | |
|---------|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

HWOL ACRONYMS AND OPERATORS USED

| | |
|-------|--|
| HS | Headspace Analysis. |
| EH | Extractable Hydrocarbons - i.e. everything extracted by the solvent. |
| CU | Clean-up - e.g. by florisil, silica gel. |
| 1D | GC - Single coil gas chromatography. |
| Total | Aliphatics & Aromatics. |
| AL | Aliphatics only. |
| AR | Aromatics only. |
| 2D | GC-GC - Double coil gas chromatography. |
| #1 | EH_Total but with humics mathematically subtracted |
| #2 | EU_Total but with fatty acids mathematically subtracted |
| _ | Operator - underscore to separate acronyms (exception for +). |
| + | Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total |
| MS | Mass Spectrometry. |

EMT Job No: 21/7249

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|---|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM17 | Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM20 | Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| TM22 | Modified BS1377-3:1990 Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (35C-440C). On request modified ASTM D2974-00 LOI (105C-440C) | PM0 | No preparation is required. | Yes | | AD | Yes |

EMT Job No: 21/7249

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|--|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM26 | Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection. | PM0 | No preparation is required. | | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | Yes | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013I | PM0 | No preparation is required. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013I | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM60 | TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1. | PM0 | No preparation is required. | | | AR | Yes |
| TM61 | Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007 | PM0 | No preparation is required. | Yes | | AR | Yes |

EMT Job No: 21/7249

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/S ANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|-----------------|--|----------------------------------|---|-------------------------|------------------------|---|------------------------------|
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| TM173 | Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998) | PM0 | No preparation is required. | | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| NONE | No Method Code | PM17 | Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio. | | | AR | |
| NONE | No Method Code | PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | | | AR | |
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National Materials Testing Laboratory Ltd.

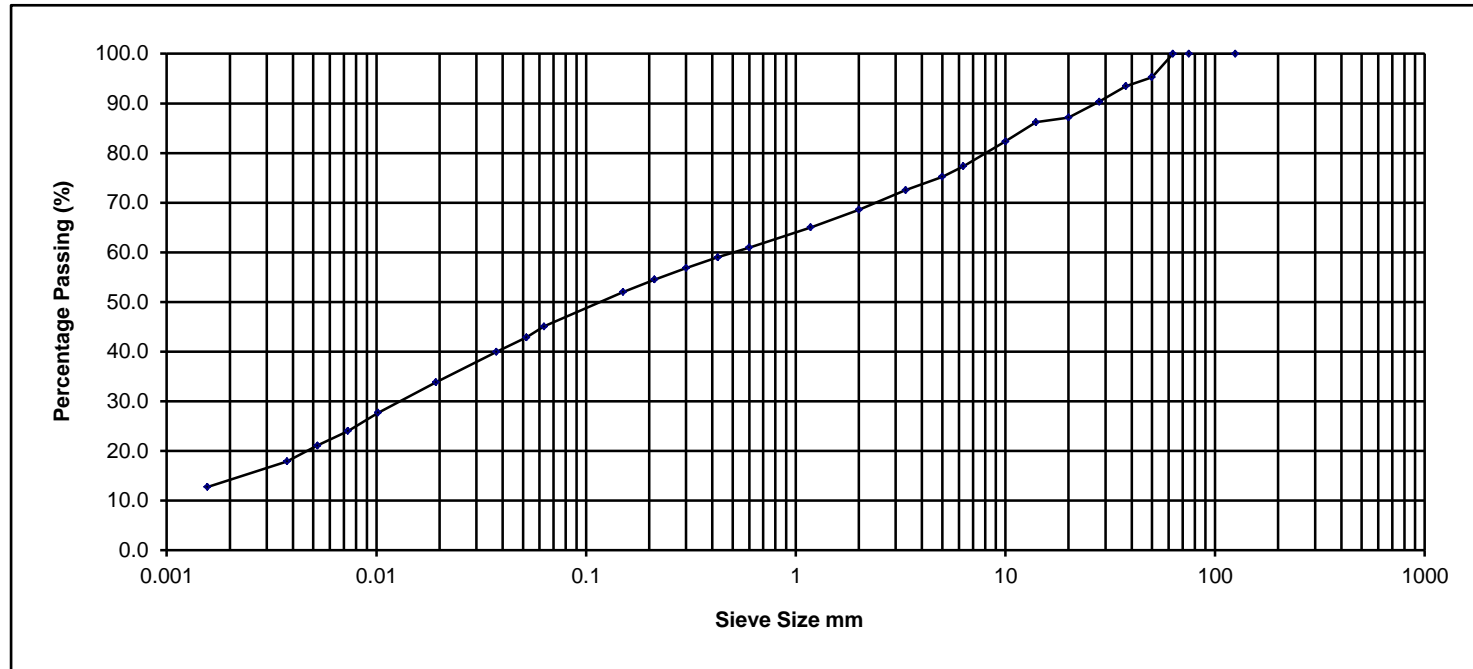
SUMMARY OF TEST RESULTS

| BH/TP No | Depth m | sample No. | Moisture % | Particle | | Index Properties | | | Bulk | Cell | Undrained Triaxial Tests | | Lab | Remarks |
|-------------|------------|--|---------------|------------------|-------------|------------------|---------|---------|------------------|------------------|---------------------------|------------------------|----------------------------|---------|
| | | | | Density Mg/m3 | <425um % | LL % | PL % | PI % | Density Mg/m3 | Presssure kPa | Compressive Stress kPa | Strain at Failure % | Vane kPa | |
| R11-CP01 | 2.0 | B | 15.6 | | 59.0 | 42 | 24 | 18 | | | | | | |
| R11-CP01 | 2.5 | B | 14.2 | | | | | | | | | | | |
| R11-CP01 | 4.0 | B | 15.9 | | 59.0 | 37 | 21 | 16 | | | | | | |
| R11-CP01 | 5.5 | B | 13.5 | | | | | | | | | | | |
| R11-CP01 | 6.0 | B | 13.6 | | 54.5 | 30 | 18 | 12 | | | | | | |
| R11-CP01 | 7.5 | B | 13.3 | | 58.2 | 34 | 18 | 16 | | | | | | |
| R11-CP01 | 8.0 | B | 14.3 | | | | | | | | | | | |
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| NMTL | | Notes : | | | | | | | | | Job ref No. | NMTL 3326 | GII Project ID: 9754-07-20 | |
| | | 1. All BS tests carried out using preferred (definitive) method unless otherwise stated. | | | | | | | | | Location | Bus Connect Routes | | |

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 95.3 |
| 37.500 | 93.5 |
| 28.000 | 90.4 |
| 20.000 | 87.2 |
| 14.000 | 86.2 |
| 10.000 | 82.3 |
| 6.300 | 77.4 |
| 5.000 | 75.2 |
| 3.350 | 72.5 |
| 2.000 | 68.6 |
| 1.180 | 65.0 |
| 0.600 | 61.0 |
| 0.425 | 59.0 |
| 0.300 | 56.9 |
| 0.212 | 54.5 |
| 0.150 | 52.0 |
| 0.063 | 45.1 |
| 0.052 | 42.9 |
| 0.037 | 39.9 |
| 0.019 | 33.8 |
| 0.010 | 27.7 |
| 0.007 | 24.0 |
| 0.005 | 21.1 |
| 0.004 | 17.9 |
| 0.002 | 12.7 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| 12.7 | Silt | | | Sand | | | Gravel | | | 0.0 | 0.0 |

Sample Description Grey brown slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

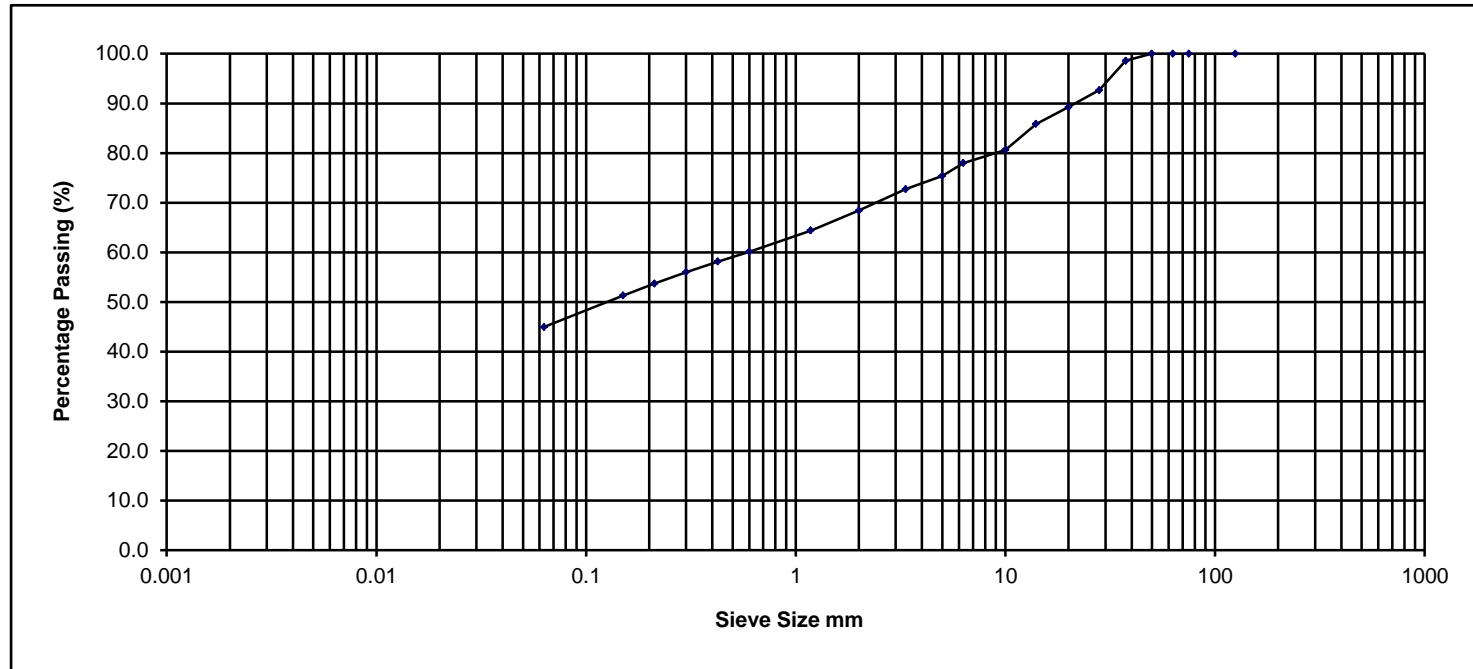
NM
TL
Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 16/12/2020 | Depth | 2.0m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 98.6 |
| 28.000 | 92.7 |
| 20.000 | 89.2 |
| 14.000 | 85.9 |
| 10.000 | 80.6 |
| 6.300 | 78.0 |
| 5.000 | 75.4 |
| 3.350 | 72.7 |
| 2.000 | 68.4 |
| 1.180 | 64.4 |
| 0.600 | 60.1 |
| 0.425 | 58.1 |
| 0.300 | 56.0 |
| 0.212 | 53.7 |
| 0.150 | 51.3 |
| 0.063 | 44.9 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| | Silt | | | Sand | | | Gravel | | | | |
| | 44.9 | | | 23.5 | | | 31.6 | | | 0.0 | 0.0 |

Sample Description Grey brown slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

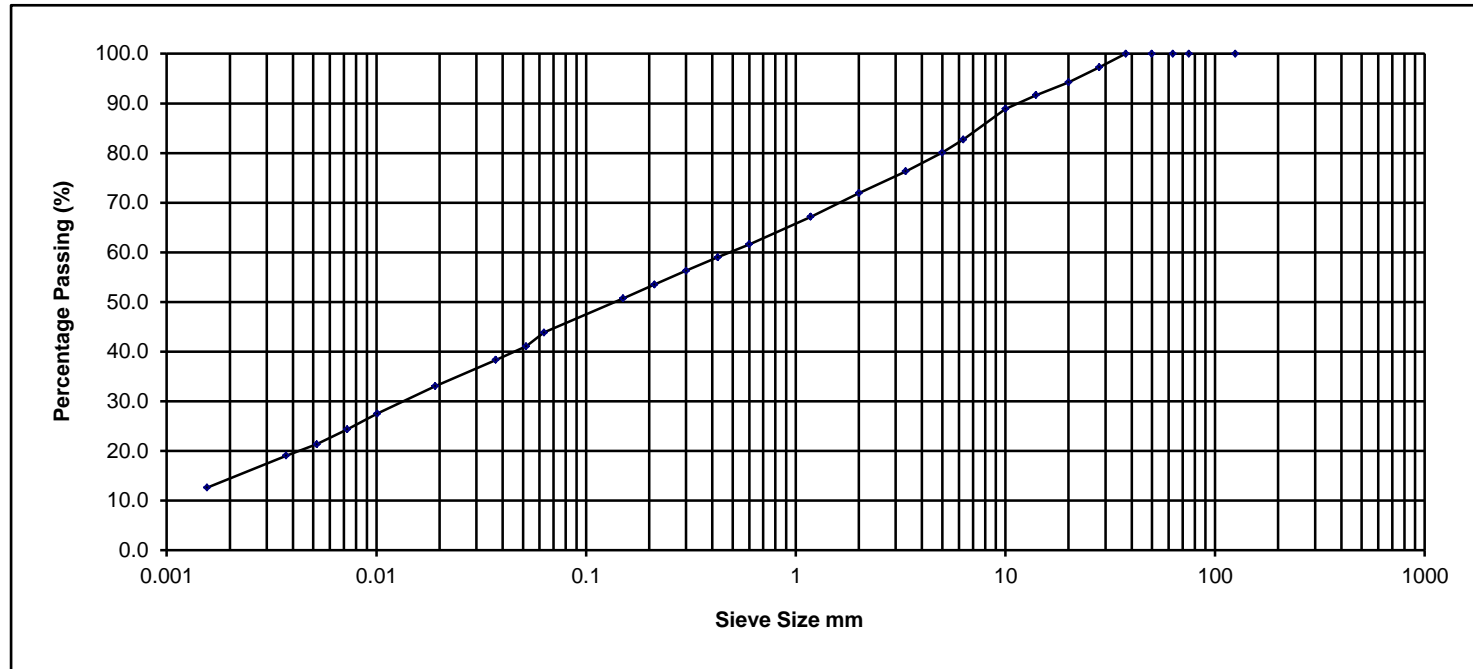
NMTL Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 18/12/2020 | Depth | 2.50m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 100.0 |
| 28.000 | 97.3 |
| 20.000 | 94.3 |
| 14.000 | 91.7 |
| 10.000 | 88.9 |
| 6.300 | 82.7 |
| 5.000 | 80.1 |
| 3.350 | 76.3 |
| 2.000 | 71.9 |
| 1.180 | 67.2 |
| 0.600 | 61.6 |
| 0.425 | 59.0 |
| 0.300 | 56.3 |
| 0.212 | 53.5 |
| 0.150 | 50.7 |
| 0.063 | 43.8 |
| 0.052 | 41.1 |
| 0.037 | 38.3 |
| 0.019 | 33.1 |
| 0.010 | 27.5 |
| 0.007 | 24.3 |
| 0.005 | 21.3 |
| 0.004 | 19.1 |
| 0.002 | 12.6 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| | Silt | | | Sand | | | Gravel | | | 0.0 | 0.0 |
| | 31.2 | | | 28.1 | | | 28.1 | | | | |

Sample Description Grey brown slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

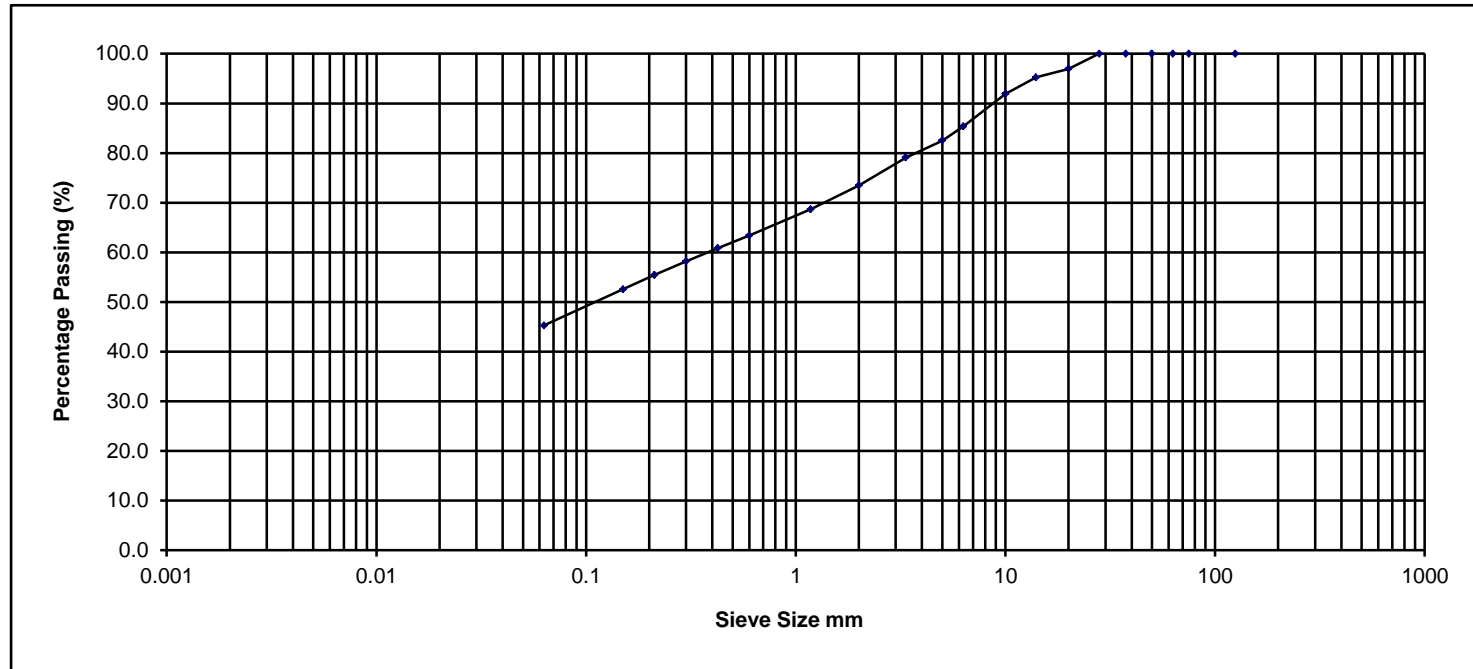
NMTL Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 16/12/2020 | Depth | 4.0m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 100.0 |
| 28.000 | 100.0 |
| 20.000 | 97.0 |
| 14.000 | 95.2 |
| 10.000 | 91.9 |
| 6.300 | 85.4 |
| 5.000 | 82.5 |
| 3.350 | 79.1 |
| 2.000 | 73.5 |
| 1.180 | 68.7 |
| 0.600 | 63.4 |
| 0.425 | 60.8 |
| 0.300 | 58.2 |
| 0.212 | 55.4 |
| 0.150 | 52.5 |
| 0.063 | 45.3 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| | Silt | | | Sand | | | Gravel | | | | |
| | 45.3 | | | 28.2 | | | 26.5 | | | 0.0 | 0.0 |

Sample Description Dark grey slightly gravelly slightly sandy silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

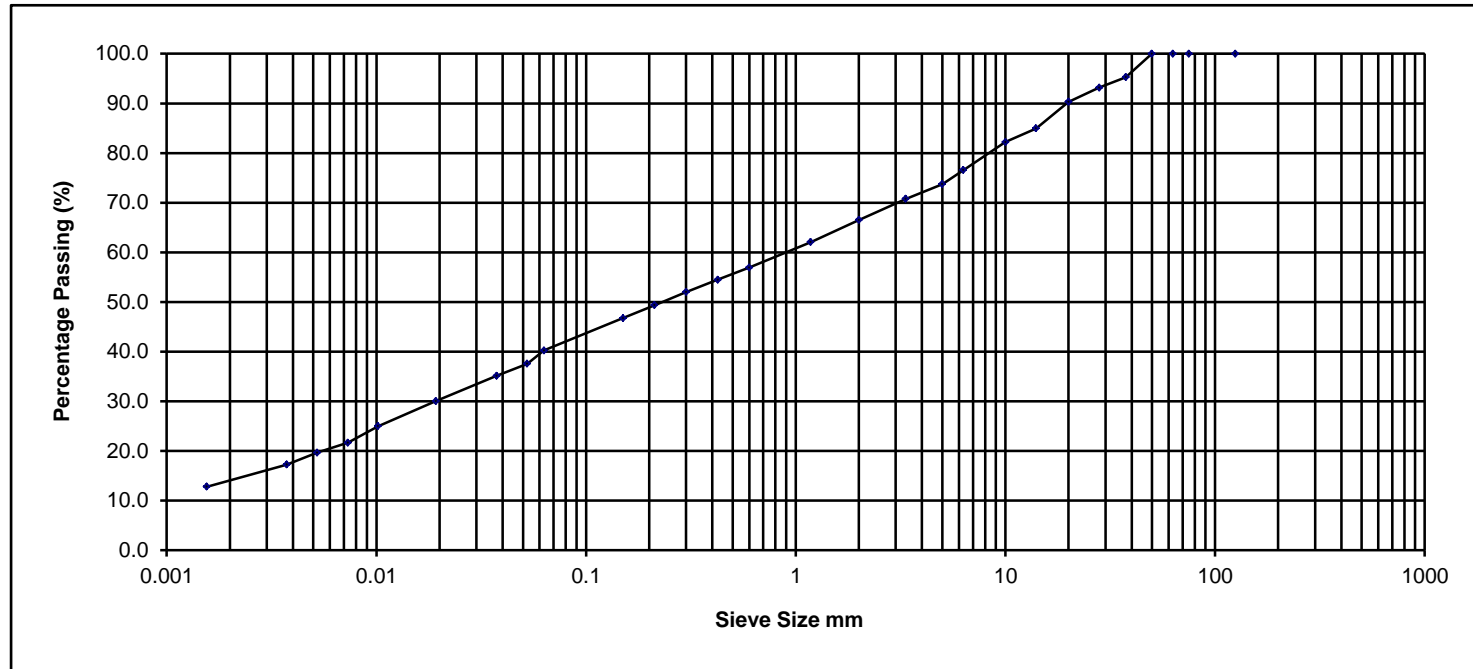
NMTL Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 18/12/2020 | Depth | 5.50m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 95.3 |
| 28.000 | 93.2 |
| 20.000 | 90.3 |
| 14.000 | 85.0 |
| 10.000 | 82.2 |
| 6.300 | 76.6 |
| 5.000 | 73.7 |
| 3.350 | 70.8 |
| 2.000 | 66.5 |
| 1.180 | 62.1 |
| 0.600 | 56.9 |
| 0.425 | 54.5 |
| 0.300 | 52.0 |
| 0.212 | 49.4 |
| 0.150 | 46.8 |
| 0.063 | 40.2 |
| 0.052 | 37.6 |
| 0.037 | 35.1 |
| 0.019 | 30.1 |
| 0.010 | 25.0 |
| 0.007 | 21.7 |
| 0.005 | 19.7 |
| 0.004 | 17.2 |
| 0.002 | 12.8 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| | Silt | | | Sand | | | Gravel | | | | |
| 12.8 | 27.4 | | | 26.3 | | | 33.5 | | | 0.0 | 0.0 |

Sample Description Dark grey slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

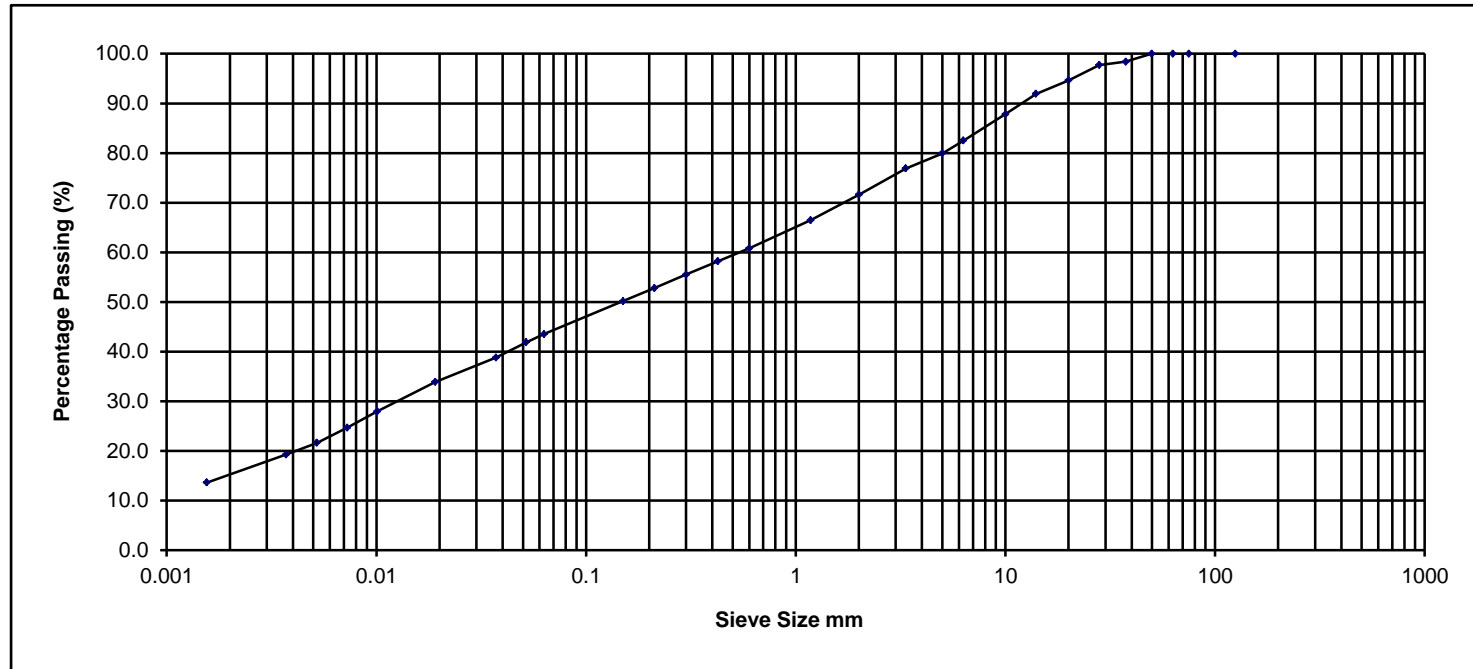
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Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 16/12/2020 | Depth | 6.0m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 98.4 |
| 28.000 | 97.7 |
| 20.000 | 94.6 |
| 14.000 | 91.9 |
| 10.000 | 87.8 |
| 6.300 | 82.5 |
| 5.000 | 79.9 |
| 3.350 | 76.9 |
| 2.000 | 71.6 |
| 1.180 | 66.5 |
| 0.600 | 60.8 |
| 0.425 | 58.2 |
| 0.300 | 55.5 |
| 0.212 | 52.8 |
| 0.150 | 50.2 |
| 0.063 | 43.5 |
| 0.052 | 41.9 |
| 0.037 | 38.8 |
| 0.019 | 33.9 |
| 0.010 | 28.0 |
| 0.007 | 24.7 |
| 0.005 | 21.7 |
| 0.004 | 19.3 |
| 0.002 | 13.6 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| 13.6 | Silt | | | Sand | | | Gravel | | | 0.0 | 0.0 |

Sample Description Dark grey slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 11

GII Project ID-9754-07-20

Sample No. B

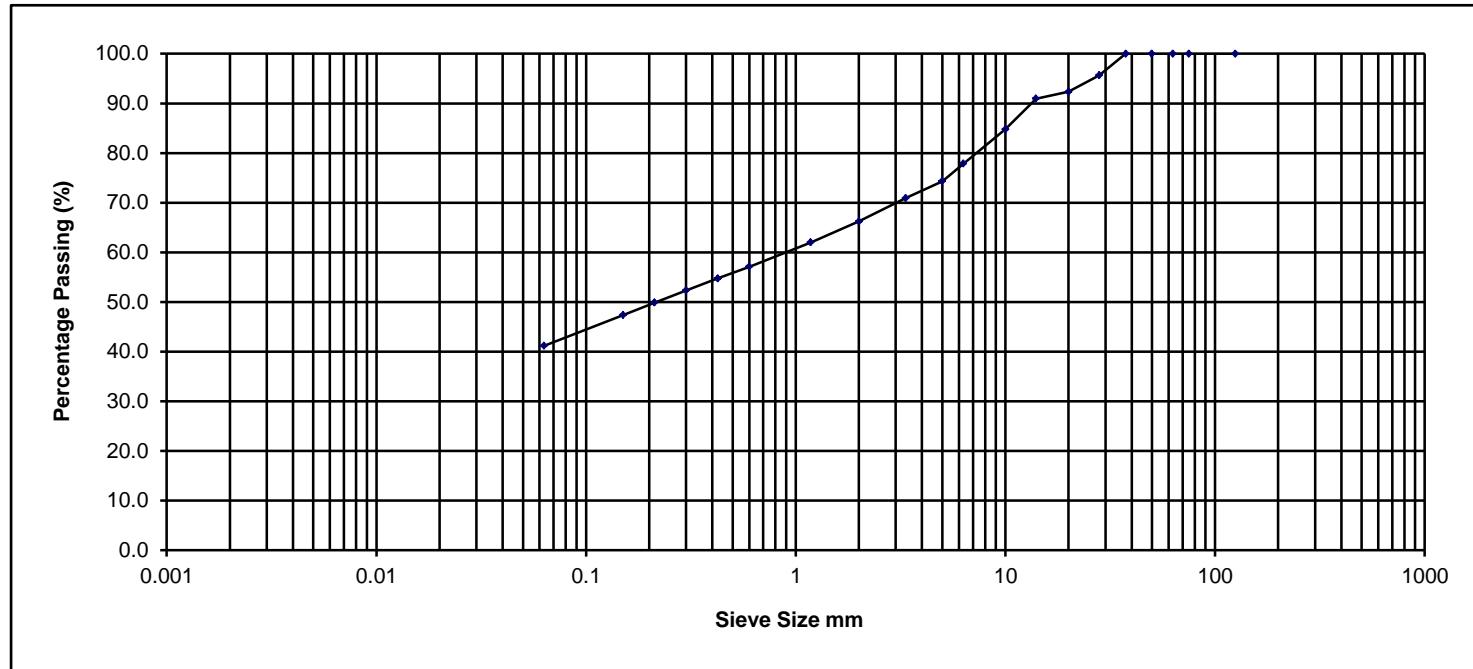
NM
TL
Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 16/12/2020 | Depth | 7.50m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|-------|

NMTL Ltd

| Sieve Size mm | % Passing |
|---------------|-----------|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 100.0 |
| 28.000 | 95.7 |
| 20.000 | 92.3 |
| 14.000 | 90.9 |
| 10.000 | 84.8 |
| 6.300 | 77.8 |
| 5.000 | 74.3 |
| 3.350 | 70.9 |
| 2.000 | 66.2 |
| 1.180 | 62.0 |
| 0.600 | 57.1 |
| 0.425 | 54.7 |
| 0.300 | 52.3 |
| 0.212 | 49.9 |
| 0.150 | 47.4 |
| 0.063 | 41.2 |

Determination of Particle Size Distribution BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

| Clay | Fine | | | Medium | | | Coarse | | | Cobbles | Boulder |
|------|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | | |
| | Silt | | | Sand | | | Gravel | | | | |
| | 41.2 | | | 25.1 | | | 33.8 | | | 0.0 | 0.0 |

Sample Description Dark grey slightly sandy slightly gravelly silty CLAY

Project No. NMTL 3326

BH/TP No. R11-CP01

Project Bus connect Route 5

GII Project ID-9754-07-20

Sample No. B

NMTL Ltd

| | | | | | | | | | |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 18/12/2020 | Depth | 8.0m |
|----------|-----|---------|----|----------|----|--------------------|------------|-------|------|

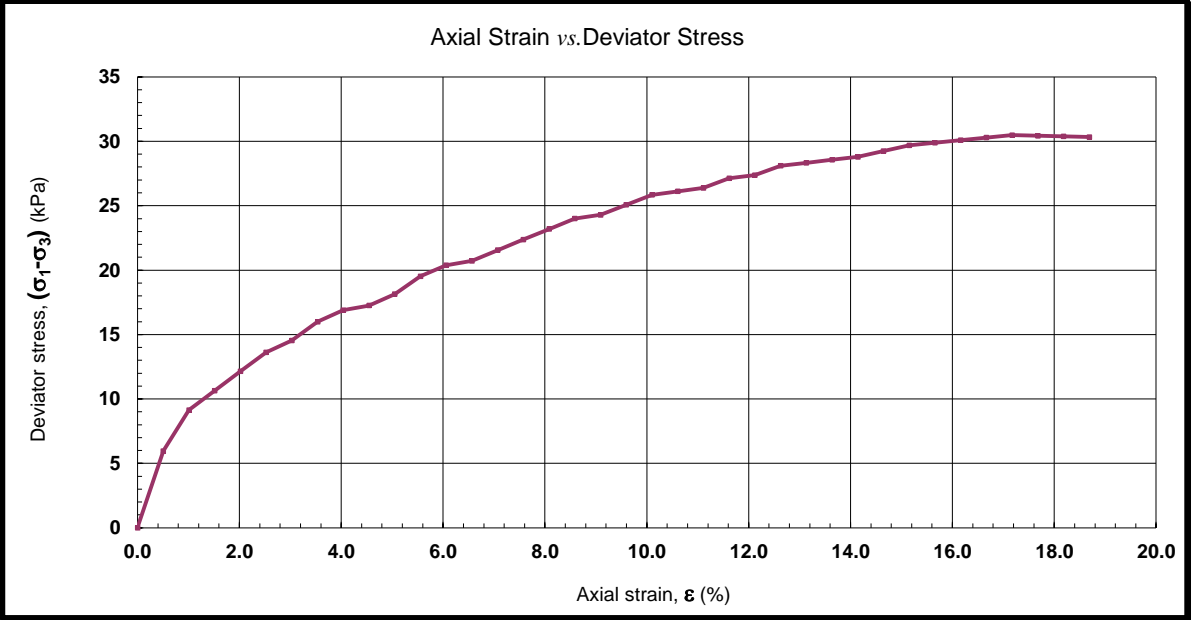
Certificate of Test

Determination of the Undrained Shear Strength in Triaxial Compression BS 1377 : Part 7 : 1990 Clause 8

| | | | |
|--------------|---|---------------|------------------------------|
| Client Name: | Ground Investigations Ireland Ltd | Contract: | Bus Connects Route 11 |
| Address: | Catherinstown House Hazelhatch Newcastle, Co. Dublin | Site Address: | N/A |

| | | | | | |
|---------------------|---|-----------------------|--|-----------------|------------------|
| Sample No.: | RC11-CP01 | Depth: | 2.50m | File Reference: | NMTL 3326 |
| Sample Description: | Grey/brown slightly gravelly slightly sandy silty CLAY | | | | |
| Location: | Bus Connects Route 11 | Date Sampled: | N/A | | |
| Sample Type: | B | Sampled by: | Ground Investigations Ireland Ltd | | |
| Client Sample Ref.: | RC11-CP01-B-2.50m | Sampling Cert. Recd.: | No | | |
| Source / Supplier: | GII | Date Received: | 09 December 2020 | | |
| Specification: | BS 1377: Part 7: 1990 Clause 8 | Date Tested: | 18 December 2020 | | |

| Specimen | | Test | |
|---------------------|--|----------------------|--------------------------------|
| Length: | 198.0 mm | Diameter: | 100.0 mm |
| Area: | 7854.0 mm ² | Volume: | 1555.1 cm ³ |
| Mass: | 3299.8 g | Membrane type: | Latex |
| Moisture content: | 14.2 % | Membrane thickness: | 0.3 mm |
| Bulk density: | 2.12 Mg m ⁻³ | Membrane correction: | 2.40 |
| Dry density: | 1.86 Mg m ⁻³ | Sample state: | Disturbed |
| Preparation Method: | BS 1377: Part 1: 1990 Clause 8 .3.1 | Number of stages: | Single |
| | | Rate of strain: | 1.0 % min ⁻¹ |
| | | Cell pressure: | σ_3 50 kPa |



| | | |
|--|---------------------------|-----------------|
| Maximum Corrected Deviator Stress at Failure: | $(\sigma_1 - \sigma_3)_f$ | 30.5 kPa |
| Strain at Failure: | ϵ | 17.17 % |
| Maximum Cohesion / Shear Strength: | C_u | 15.2 kPa |
| Type of Failure: | | Plastic |

| | |
|--|--|
| Signed | Remarks: Remoulded with 2.5kg hammer at natural moisture content |
| For NMTL Ltd Authorised Signatories <input type="checkbox"/> N Chana <input type="checkbox"/> B Chana 19 December 2020 | Original to: Client Rep. Copy 1 to: File copy |

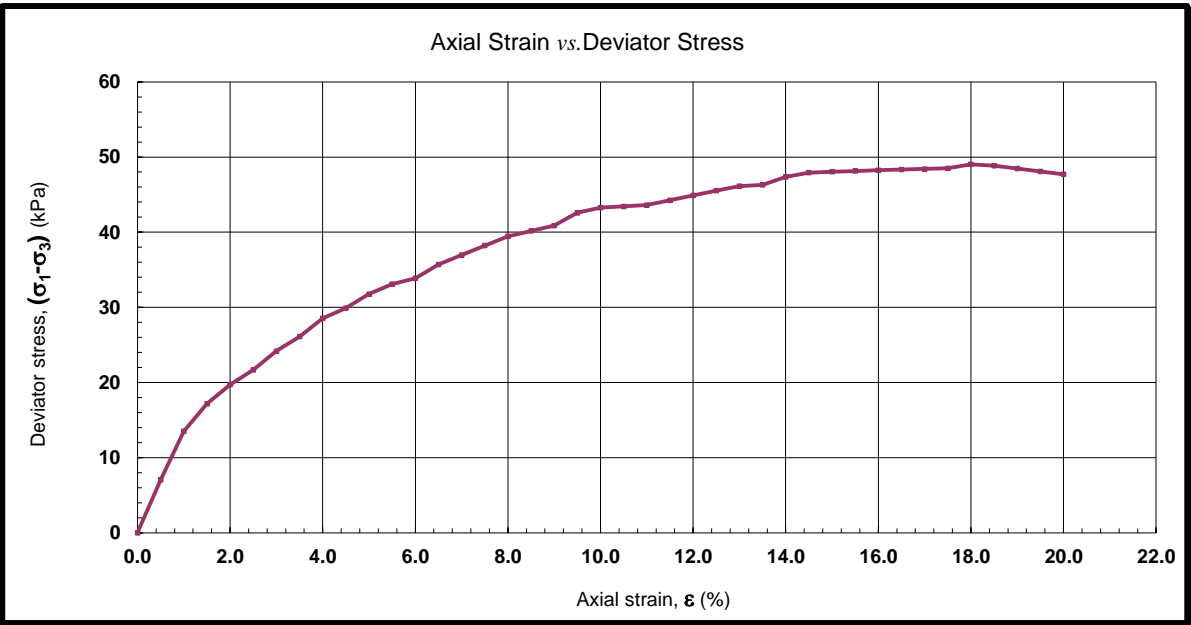
Certificate of Test

Determination of the Undrained Shear Strength in Triaxial Compression BS 1377 : Part 7 : 1990 Clause 8

| | | | |
|--------------|---|---------------|------------------------------|
| Client Name: | Ground Investigations Ireland Ltd | Contract: | Bus Connects Route 11 |
| Address: | Catherinstown House Hazelhatch Newcastle, Co. Dublin | Site Address: | N/A |

| | | | | | |
|---------------------|---|-----------------------|--|-----------------|------------------|
| Sample No.: | RC11-CP01 | Depth: | 5.50m | File Reference: | NMTL 3326 |
| Sample Description: | Dark grey slightly gravelly slightly sandy silty CLAY. | | | | |
| Location: | Bus Connects Route 11 | Date Sampled: | N/A | | |
| Sample Type: | B | Sampled by: | Ground Investigations Ireland Ltd | | |
| Client Sample Ref.: | RC11-CP01-B-5.50m | Sampling Cert. Recd.: | No | | |
| Source / Supplier: | GII | Date Received: | 09 December 2020 | | |
| Specification: | BS 1377: Part 7: 1990 Clause 8 | Date Tested: | 18 December 2020 | | |

| Specimen | | Test | |
|---------------------|--|----------------------|--------------------------------|
| Length: | 200.0 mm | Diameter: | 100.0 mm |
| Area: | 7854.0 mm ² | Volume: | 1570.8 cm ³ |
| Mass: | 3588.4 g | Membrane type: | Latex |
| Moisture content: | 13.5 % | Membrane thickness: | 0.3 mm |
| Bulk density: | 2.28 Mg m ⁻³ | Membrane correction: | 2.38 |
| Dry density: | 2.01 Mg m ⁻³ | Sample state: | Disturbed |
| Preparation Method: | BS 1377: Part 1: 1990 Clause 8 .3.1 | Number of stages: | Single |
| | | Rate of strain: | 1.0 % min ⁻¹ |
| | | Cell pressure: | σ_3 100 kPa |



| | | |
|--|---------------------------|-----------------|
| Maximum Corrected Deviator Stress at Failure: | $(\sigma_1 - \sigma_3)_f$ | 49.0 kPa |
| Strain at Failure: | ϵ | 17.00 % |
| Maximum Cohesion / Shear Strength: | C_u | 24.5 kPa |
| Type of Failure: | | Plastic |

| | |
|--|--|
| Signed | Remarks: Remoulded with 2.5kg hammer at natural moisture content |
| For NMTL Ltd Authorised Signatories <input type="checkbox"/> N Chana <input type="checkbox"/> B Chana 19 December 2020 | Original to: Client Rep. Copy 1 to: File copy |

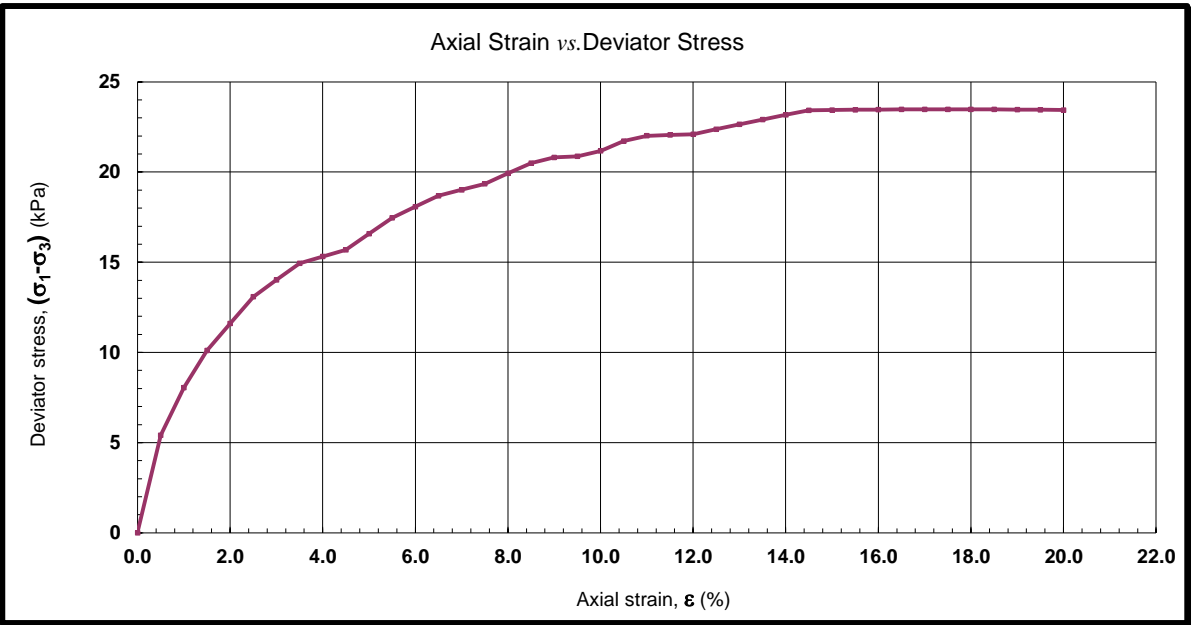
Certificate of Test

Determination of the Undrained Shear Strength in Triaxial Compression BS 1377 : Part 7 : 1990 Clause 8

| | | | |
|--------------|---|---------------|------------------------------|
| Client Name: | Ground Investigations Ireland Ltd | Contract: | Bus Connects Route 11 |
| Address: | Catherinstown House Hazelhatch Newcastle, Co. Dublin | Site Address: | N/A |

| | | | | | |
|---------------------|---|-----------------------|--|-----------------|------------------|
| Sample No.: | RC11-CP01 | Depth: | 8.0m | File Reference: | NMTL 3326 |
| Sample Description: | Dark grey slightly gravelly slightly sandy silty CLAY. | | | | |
| Location: | Bus Connects Route 11 | Date Sampled: | N/A | | |
| Sample Type: | B | Sampled by: | Ground Investigations Ireland Ltd | | |
| Client Sample Ref.: | RC11-CP01-B-5.50m | Sampling Cert. Recd.: | No | | |
| Source / Supplier: | GII | Date Received: | 09 December 2020 | | |
| Specification: | BS 1377: Part 7: 1990 Clause 8 | Date Tested: | 18 December 2020 | | |

| Specimen | | Test | |
|---------------------|--|----------------------|--------------------------------|
| Length: | 200.0 mm | Diameter: | 100.0 mm |
| Area: | 7854.0 mm ² | Volume: | 1570.8 cm ³ |
| Mass: | 3551.0 g | Membrane type: | Latex |
| Moisture content: | 15.0 % | Membrane thickness: | 0.3 mm |
| Bulk density: | 2.26 Mg m ⁻³ | Membrane correction: | 2.31 |
| Dry density: | 1.97 Mg m ⁻³ | Sample state: | Disturbed |
| Preparation Method: | BS 1377: Part 1: 1990 Clause 8 .3.1 | Number of stages: | Single |
| | | Rate of strain: | 1.0 % min ⁻¹ |
| | | Cell pressure: | σ_3 160 kPa |



| | | |
|--|---------------------------|-----------------|
| Maximum Corrected Deviator Stress at Failure: | $(\sigma_1 - \sigma_3)_f$ | 23.5 kPa |
| Strain at Failure: | ϵ | 16.50 % |
| Maximum Cohesion / Shear Strength: | C_u | 11.7 kPa |
| Type of Failure: | | Plastic |

| | |
|--|--|
| Signed | Remarks: Remoulded with 2.5kg hammer at natural moisture content |
| For NMTL Ltd Authorised Signatories <input type="checkbox"/> N Chana <input type="checkbox"/> B Chana 19 December 2020 | Original to: Client Rep. Copy 1 to: File copy |



LABORATORY REPORT



4043

Contract Number: PSL21/3245

Report Date: 27 May 2021
Client's Reference: 2868817
Client Name: Ground Investigations Ireland Ltd
Catherinestown House
Hazelhatch Road
Newcastle
Co Dublin
D22 YD52

For the attention of: Patrick Cochran

Contract Title: Bus Connect Route 11
Date Received: 21/4/2021
Date Commenced: 21/4/2021
Date Completed: 27/5/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)


S Eyre
(Senior Technician)


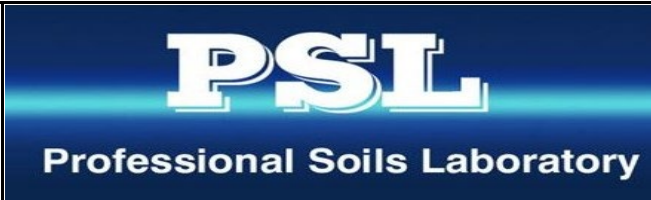
T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample |
|-------------|---------------|-------------|-------------|--------------|--|
| R11-CP03 | | B | 2.00 | | MADE GROUND brownish grey very gravelly very sandy CLAY. |
| R11-CP03 | | B | 3.00 | | Grey very sandy clayey GRAVEL. |
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|---|---|-----------------------------|---------------------|
|  4043 |  | Bus Connect Route 11 | Contract No: |
| | | | PSL21/3245 |
| | | | Client Ref: |
| | | | 9754-07-20 |

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

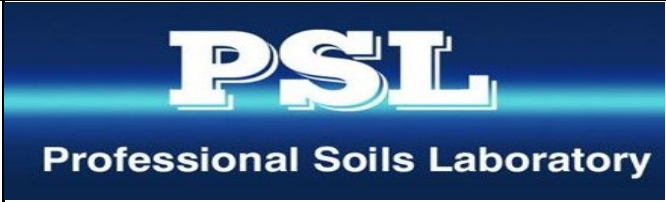
| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % Clause 3.2 | Linear Shrinkage % Clause 6.5 | Particle Density Mg/m ³ Clause 8.2 | Liquid Limit % Clause 4.3/4 | Plastic Limit % Clause 5.3 | Plasticity Index % Clause 5.4 | Passing .425mm % | Remarks |
|-------------|---------------|-------------|----------------|-----------------|----------------------------------|----------------------------------|--|--------------------------------|-------------------------------|----------------------------------|------------------|----------------------------|
| R11-CP03 | | B | 2.00 | | 23 | | | 36 | 20 | 16 | 49 | Intermediate Plasticity CI |
| R11-CP03 | | B | 3.00 | | 15 | | 2.67 | | | | | |
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SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.



4043



Bus Connect Route 11

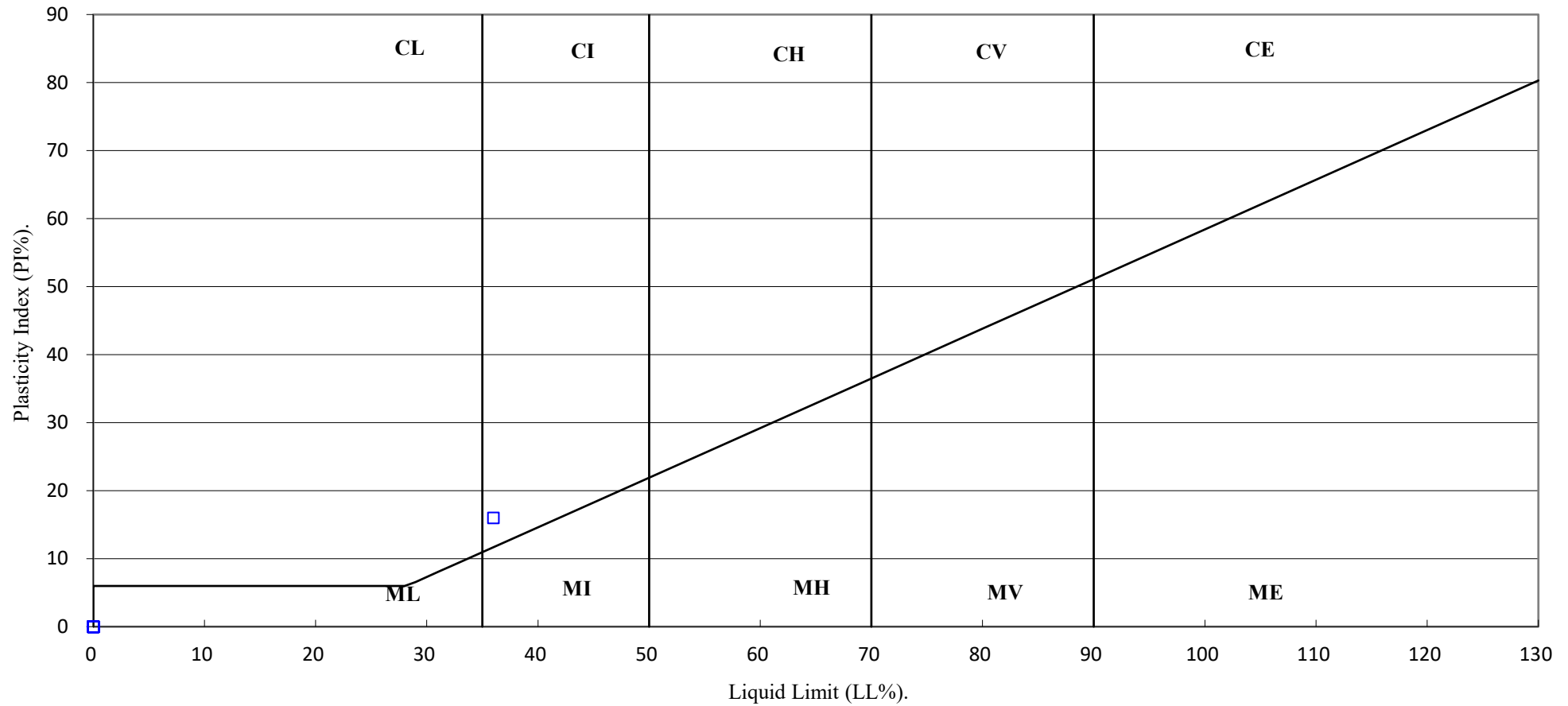
Contract No:

PSL21/3245

Client Ref:

9754-07-20

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL

Professional Soils Laboratory

Bus Connect Route 11

Contract No:

PSL21/3245

Client Ref:

9754-07-20

PARTICLE SIZE DISTRIBUTION TEST

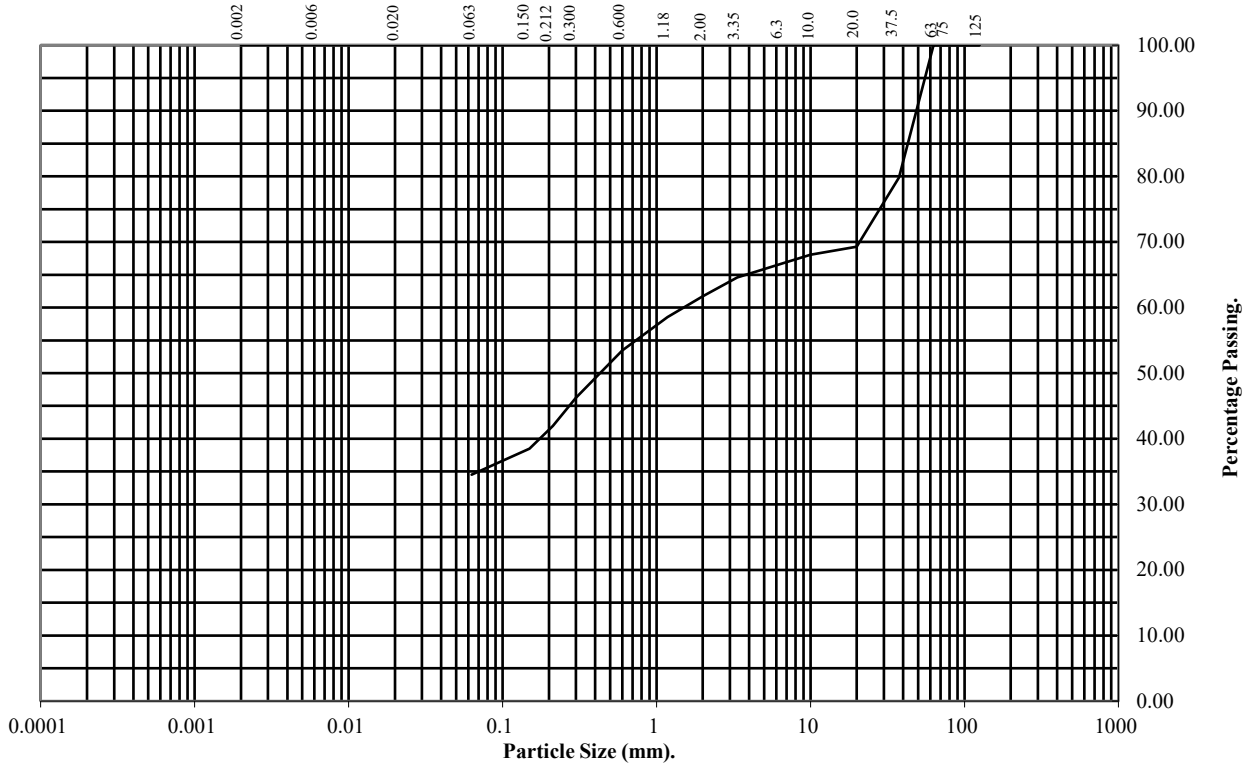
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: R11-CP03 **Top Depth (m):** 2.00

Sample Number: **Base Depth(m):**

Sample Type: B



| BS Test Sieve (mm) | Percentage Passing |
|--------------------|--------------------|
| 125 | 100 |
| 75 | 100 |
| 63 | 100 |
| 37.5 | 80 |
| 20 | 69 |
| 10 | 68 |
| 6.3 | 67 |
| 3.35 | 65 |
| 2 | 62 |
| 1.18 | 59 |
| 0.6 | 53 |
| 0.3 | 46 |
| 0.212 | 42 |
| 0.15 | 38 |
| 0.063 | 35 |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles | 0 |
| Gravel | 38 |
| Sand | 27 |
| Silt/Clay | 35 |

Remarks:
See Summary of Soil Descriptions



Bus Connect Route 11

| |
|---------------------|
| Contract No: |
| PSL21/3245 |
| Client Ref: |
| 9754-07-20 |

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

| Hole Number | Sample Number | Sample Type | Top Depth (m) | Base Depth (m) | Sample Diameter (mm) | Sample Length (mm) | Height Ratio | Initial Mass (g) | Bulk Density (Mg/m) | Moisture Content (%) | Dry Density (Mg/m) | Load Failure (kN) | UCS (MPa) | Failure Mode | Date Tested | Remarks |
|-------------|---------------|-------------|---------------|----------------|----------------------|--------------------|--------------|------------------|---------------------|----------------------|--------------------|-------------------|-----------|--------------|-------------|---------|
| R11-CP03 | | C | 4.48 | 4.66 | 63 | 126 | 2.0 | 1066 | 2.71 | 0.3 | 2.71 | 154.4 | 49.5 | Brittle | 21/05/21 | |
| | | | | | | | | | | | | | | | | |
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Bus Connect Route 11

Contract No:

PSL21/3245

Client Ref:

9754-07-20



ANALYTICAL TEST REPORT

Contract no: 95960
Contract name: Bus Connects Route 11
Client reference: PSL21/3245
Clients name: Professional Soils Laboratory
Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 06 May 2021

Analysis started: 06 May 2021

Analysis completed: 13 May 2021

Report issued: 13 May 2021

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by: 
Rachael Burton
Customer Support Squad Leader

Chemtech Environmental Limited

SOILS

| | | | |
|---------------------------------------|--------------------|--------------|------|
| Lab number | 95960-1 | | |
| Sample id | R11-CP03 | | |
| Depth (m) | 1.00 | | |
| Date sampled | - | | |
| Test | Method | Units | |
| pH | CE004 ^U | units | 8.9 |
| Total Organic Carbon (TOC) | CE197 | % w/w C | 10.7 |
| Estimate of OMC (calculated from TOC) | CE197 | % w/w | 18.4 |

Chemtech Environmental Limited

METHOD DETAILS

| METHOD | SOILS | METHOD SUMMARY | SAMPLE | STATUS | LOD | UNITS |
|--------|---------------------------------------|---------------------------------------|-------------|--------|-----|---------|
| CE004 | pH | Based on BS 1377, pH Meter | As received | U | - | units |
| CE197 | Total Organic Carbon (TOC) | Carbon Analyser | Dry | | 0.1 | % w/w C |
| CE197 | Estimate of OMC (calculated from TOC) | Calculation from Total Organic Carbon | Dry | | 0.1 | % w/w |

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

| | |
|-----|---|
| N | No (not deviating sample) |
| Y | Yes (deviating sample) |
| NSD | Sampling date not provided |
| NST | Sampling time not provided (waters only) |
| EHT | Sample exceeded holding time(s) |
| IC | Sample not received in appropriate containers |
| HP | Headspace present in sample container |
| NCF | Sample not chemically fixed (where appropriate) |
| OR | Other (specify) |

| Lab ref | Sample id | Depth (m) | Deviating | Tests (Reason for deviation) |
|---------|-----------|-----------|-----------|------------------------------|
| 95960-1 | R11-CP03 | 1.00 | Y | All (NSD) |



LABORATORY REPORT



4043

Contract Number: PSL21/4159

Report Date: 06 July 2021
Client's Reference: 9754-07-20
Client Name: Ground Investigations Ireland Ltd
Catherinestown House
Hazelhatch Road
Newcastle
Co Dublin
D22 YD52

For the attention of: Michael Sutton

Contract Title: Bus Connect Route 11
Date Received: 20/5/2021
Date Commenced: 20/5/2021
Date Completed: 6/7/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
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fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample |
|-------------|---------------|-------------|----------------|-----------------|--|
| R11-WS02 | | | 2.60 | 3.00 | Brown slightly sandy slightly gravelly CLAY. |
| R11-WS02 | | | 3.00 | 3.90 | Grey gravelly very sandy CLAY. |
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Bus Connects Route 11

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|---------------------|
| Contract No: |
| PSL21/4159 |
| Client Ref: |
| 9754-07-20 |

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % Clause 3.2 | Particle Density Mg/m ³ Clause 8.2 | Liquid Limit % Clause 4.3/4 | Plastic Limit % Clause 5.3 | Plasticity Index % Clause 5.4 | Passing .425mm % | Remarks |
|-------------|---------------|-------------|----------------|-----------------|-------------------------------------|---|-----------------------------------|----------------------------------|-------------------------------------|---------------------|-------------------|
| R11-WS02 | | | 2.60 | 3.00 | 12 | | 31 | 15 | 16 | 57 | Low Plasticity CL |
| R11-WS02 | | | 3.00 | 3.90 | 10 | 2.66 | | | | | |
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SYMBOLS : NP : Non Plastic

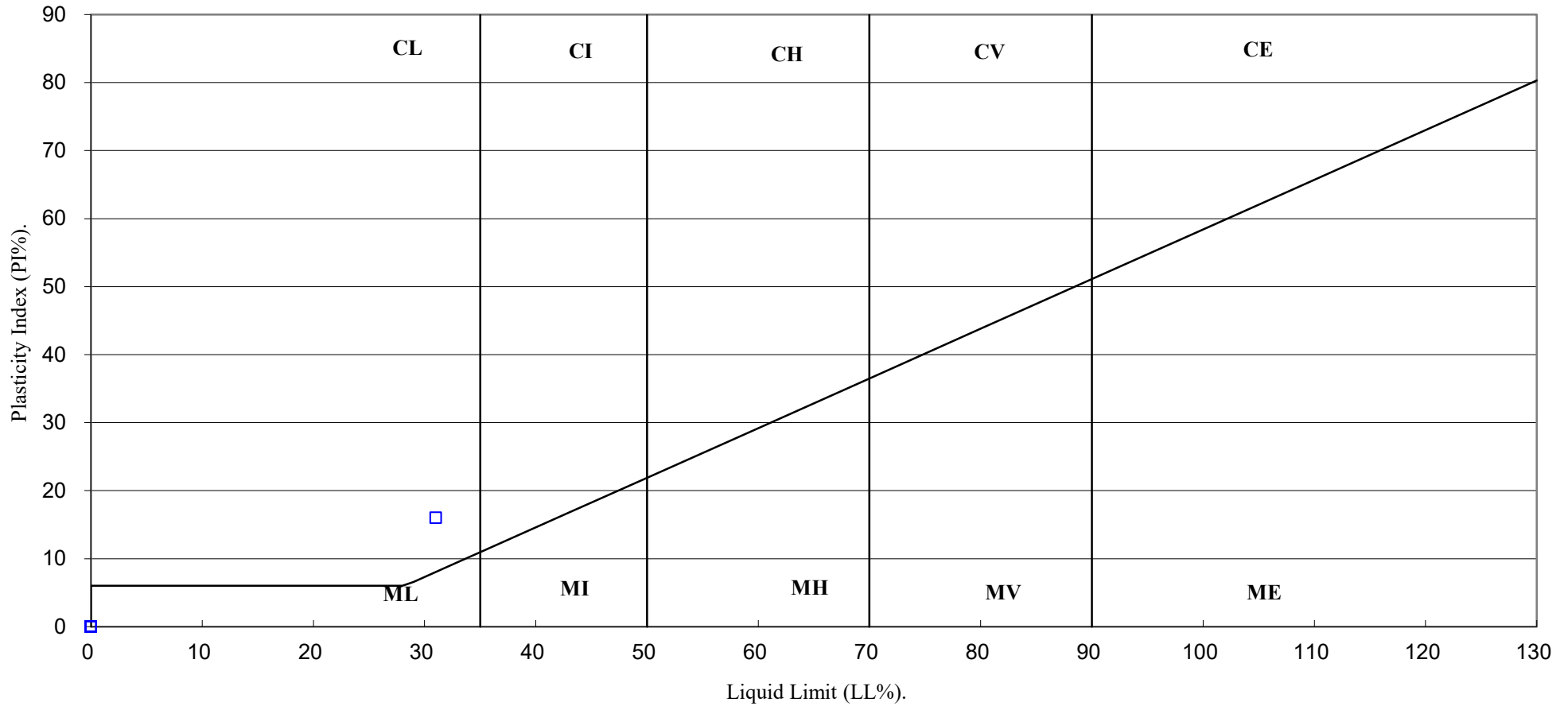
* : Liquid Limit and Plastic Limit Wet Sieved.



Bus Connects Route 11

| |
|---------------------|
| Contract No: |
| PSL21/4159 |
| Client Ref: |
| 9754-07-20 |

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL
Professional Soils Laboratory

Bus Connects Route 11

Contract No:

PSL21/4159

Client Ref:

9754-07-20

PARTICLE SIZE DISTRIBUTION TEST

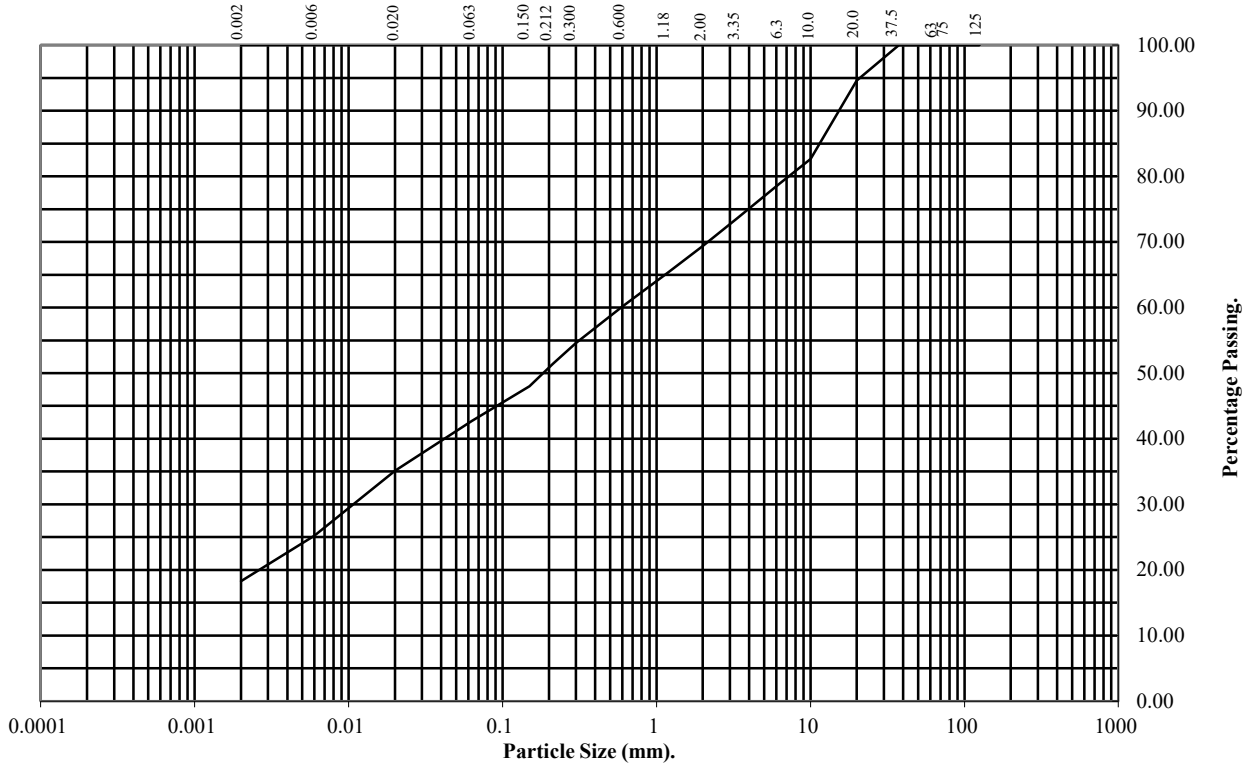
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **R11-WS02** Top Depth (m): **2.60**

Sample Number: Base Depth(m): **3.00**

Sample Type:

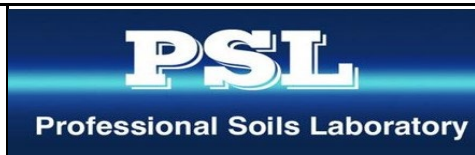


| BS Test Sieve (mm) | Percentage Passing |
|--------------------|--------------------|
| 125 | 100 |
| 75 | 100 |
| 63 | 100 |
| 37.5 | 100 |
| 20 | 95 |
| 10 | 83 |
| 6.3 | 79 |
| 3.35 | 74 |
| 2 | 69 |
| 1.18 | 65 |
| 0.6 | 60 |
| 0.3 | 55 |
| 0.212 | 51 |
| 0.15 | 48 |
| 0.063 | 43 |

| Particle Diameter | Percentage Passing |
|-------------------|--------------------|
| 0.02 | 35 |
| 0.006 | 25 |
| 0.002 | 18 |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles | 0 |
| Gravel | 31 |
| Sand | 26 |
| Silt | 25 |
| Clay | 18 |

Remarks:
See Summary of Soil Descriptions



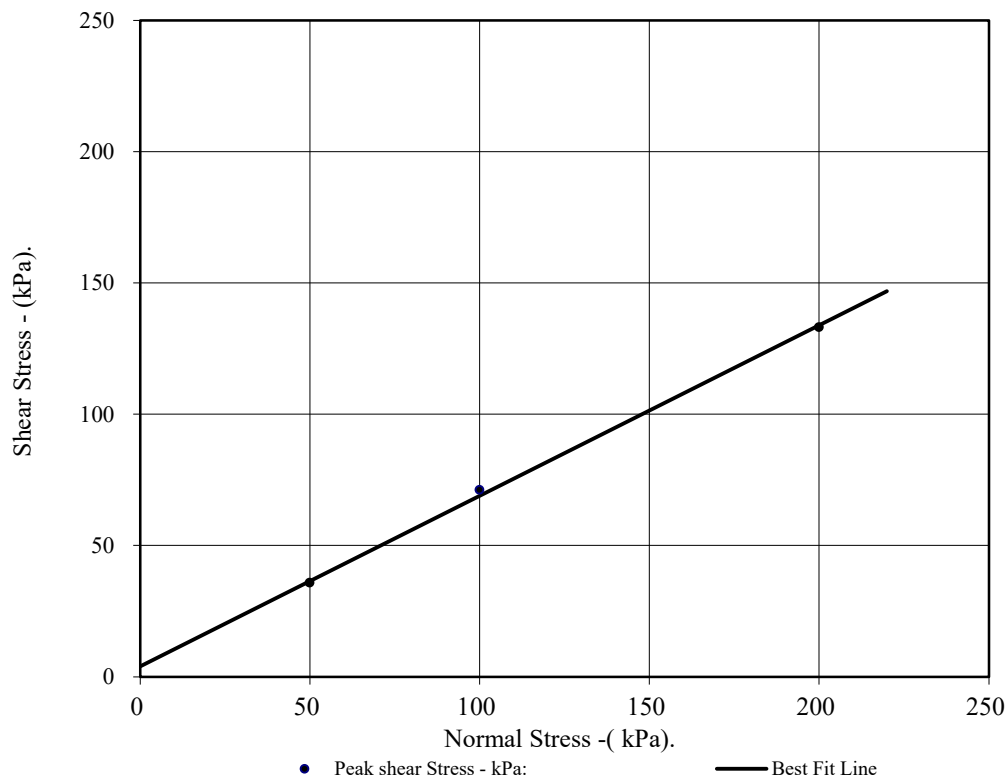
Bus Connects Route 11

| |
|---------------------|
| Contract No: |
| PSL21/4159 |
| Client Ref: |
| 9754-07-20 |

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

| | | | | | |
|---|--|----------|-----------------|----------|----------|
| Hole Number: | R11-WS02 | | Top Depth: | 3.00 | |
| Sample Number: | | | Base Depth: | 3.90 | |
| Sample Conditions: | Submerged | | Sample Type | | |
| Particle Density - Mg/m ³ : | 2.65 | Measured | Remarks: | | |
| Sample Preparation: | Material tested passing 2mm sieve Remoulded using 2.5kg effort. | | | | |
| Sample Description: | See summary of soil descriptions. | | | | |
| STAGE | | | 1 | 2 | 3 |
| Initial Conditions | | | | | |
| Height - mm: | | | 20.05 | 20.05 | 20.05 |
| Length - mm: | | | 59.97 | 59.97 | 59.97 |
| Moisture Content - %: | | | 12 | 12 | 12 |
| Bulk Density - Mg/m ³ : | | | 1.96 | 1.97 | 1.96 |
| Dry Density - Mg/m ³ : | | | 1.76 | 1.76 | 1.76 |
| Voids Ratio: | | | 0.509 | 0.507 | 0.509 |
| Normal Pressure- kPa | | | 50 | 100 | 200 |
| Consolidation Stage | | | | | |
| Consolidated Height - mm: | | | 18.75 | 18.35 | 17.49 |
| Shearing Stage | | | | | |
| Rate of Strain - mm/min | | | 0.046 | 0.046 | 0.046 |
| Displacement at peak shear stress - mm | | | 7.51 | 9.91 | 9.91 |
| Peak shear Stress - kPa: | | | 36 | 71 | 133 |
| Final Consolidated Conditions | | | | | |
| Moisture Content - %: | | | 15 | 14 | 14 |
| Bulk Density - Mg/m ³ : | | | 2.10 | 2.15 | 2.25 |
| Dry Density - Mg/m ³ : | | | 1.83 | 1.88 | 1.98 |
| Peak | | | | | |
| Angle of Shearing Resistance:(θ) | | | 33 | | |
| Effective Cohesion - kPa: | | | 4 | | |



PSL
Professional Soils Laboratory

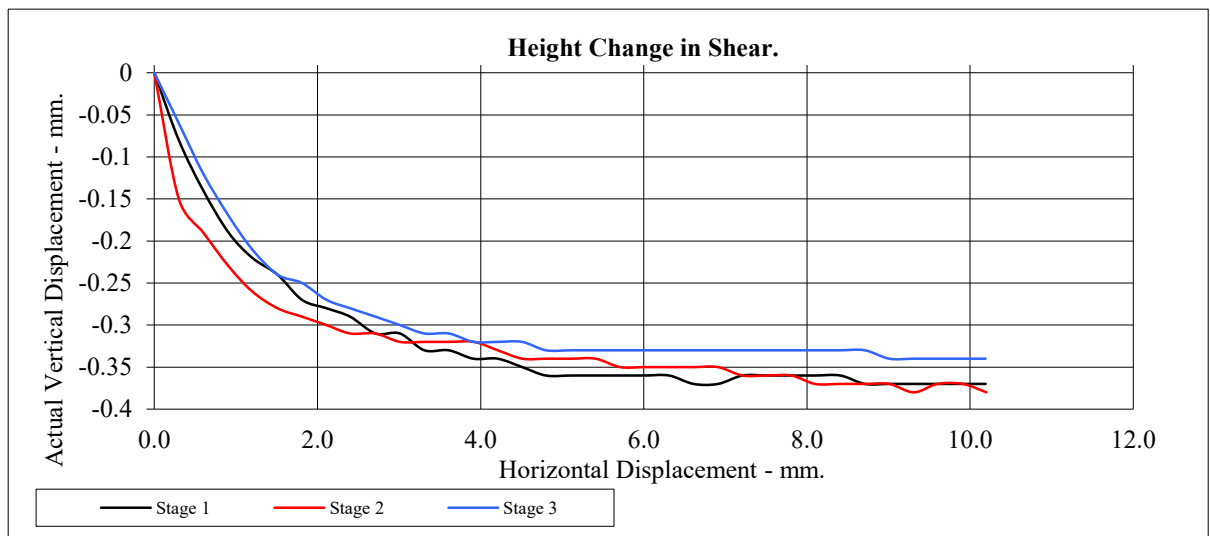
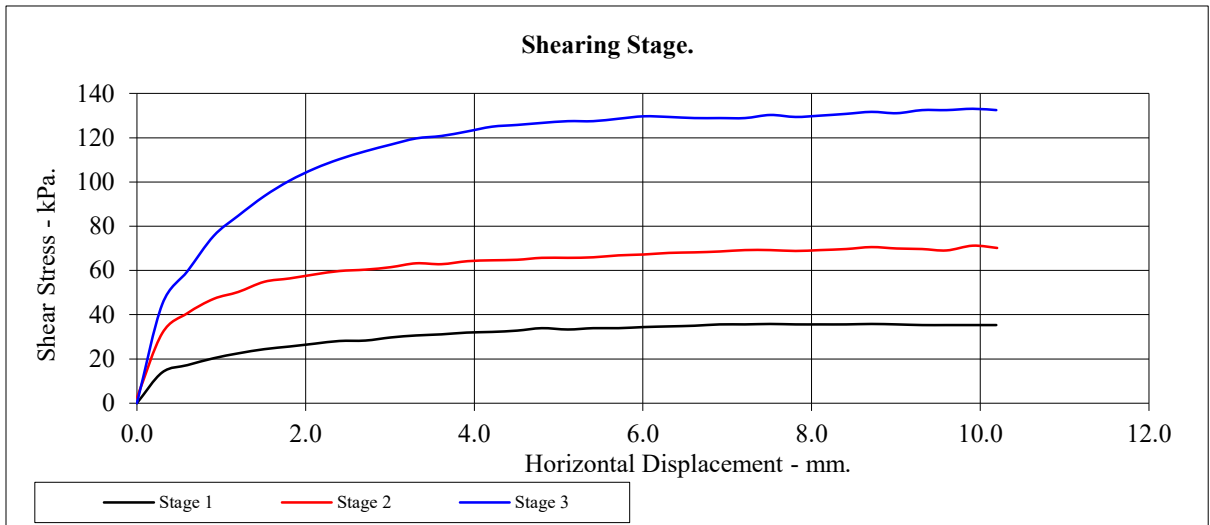
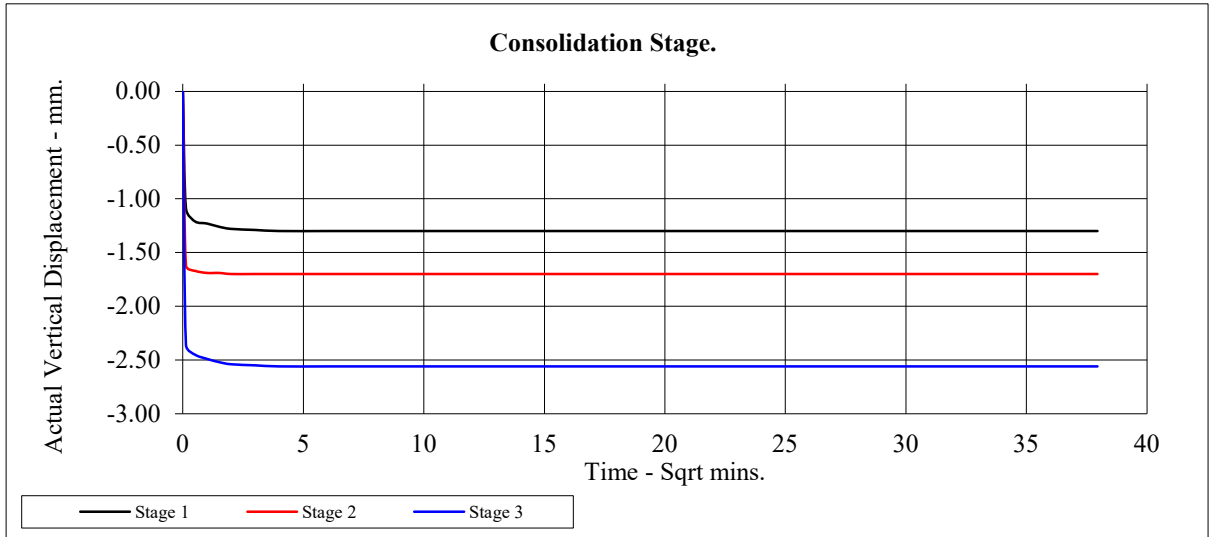
Bus Connects Route 11

Contract No:
PSL21/4159
Client Ref:
9754-07-20

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

| | | | |
|----------------|----------|-------------|------|
| Hole Number: | R11-WS02 | Top Depth: | 3.00 |
| Sample Number: | | Base Depth: | 3.90 |



PSL
Professional Soils Laboratory

Bus Connects Route 11

Contract No:
PSL21/4159
Client Ref:
9754-07-20



ANALYTICAL TEST REPORT


Contract no: 96946
Contract name: Bus Connects Route 11
Client reference: PSL21/4159
Clients name: Professional Soils Laboratory
Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 04 June 2021
Analysis started: 04 June 2021
Analysis completed: 10 June 2021
Report issued: 11 June 2021

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope. Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling. All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing. Methods, procedures and performance data are available on request. Results reported herein relate only to the material supplied to the laboratory. This report shall not be reproduced except in full, without prior written approval. Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by:



Rachael Burton
Customer Support Squad Leader

Chemtech Environmental Limited

SOILS

| | | | |
|---------------------------------------|--------------------|--------------|-----|
| Lab number | 96946-1 | | |
| Sample id | R11-WS01 | | |
| Depth (m) | 1.00 | | |
| Date sampled | - | | |
| Test | Method | Units | |
| pH | CE004 ^u | units | 7.4 |
| Total Organic Carbon (TOC) | CE197 | % w/w C | 1.8 |
| Estimate of OMC (calculated from TOC) | CE197 | % w/w | 3.1 |

Chemtech Environmental Limited

METHOD DETAILS

| METHOD | SOILS | METHOD SUMMARY | SAMPLE | STATUS | LOD | UNITS |
|--------|---------------------------------------|---------------------------------------|-------------|--------|-----|---------|
| CE004 | pH | Based on BS 1377, pH Meter | As received | U | - | units |
| CE197 | Total Organic Carbon (TOC) | Carbon Analyser | Dry | | 0.1 | % w/w C |
| CE197 | Estimate of OMC (calculated from TOC) | Calculation from Total Organic Carbon | Dry | | 0.1 | % w/w |

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

| | |
|-----|---|
| N | No (not deviating sample) |
| Y | Yes (deviating sample) |
| NSD | Sampling date not provided |
| NST | Sampling time not provided (waters only) |
| EHT | Sample exceeded holding time(s) |
| IC | Sample not received in appropriate containers |
| HP | Headspace present in sample container |
| NCF | Sample not chemically fixed (where appropriate) |
| OR | Other (specify) |

| Lab ref | Sample id | Depth (m) | Deviating | Tests (Reason for deviation) |
|---------|-----------|-----------|-----------|------------------------------|
| 96946-1 | R11-WS01 | 1.00 | Y | All (NSD) |



LABORATORY REPORT



4043

Contract Number: PSL21/4164

Report Date: 06 July 2021
Client's Reference: 9754-07-20
Client Name: Ground Investigations Ireland Ltd
Catherinstown House
Hazelhatch Road
Newcastle
Co Dublin
D22 YD52

For the attention of: Michael Sutton

Contract Title: Bus Connect Route 11
Date Received: 20/5/2021
Date Commenced: 20/5/2021
Date Completed: 6/7/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

S Eyre
(Senior Technician)

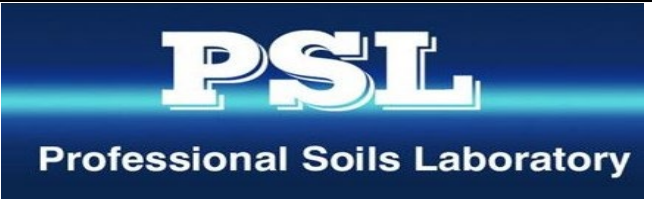
T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample |
|-------------|---------------|-------------|----------------|-----------------|-------------------------------------|
| R11-CP04 | | B | 1.50 | 1.80 | Brown very silty very sandy GRAVEL. |
| R11-CP04 | | B | 2.20 | 2.40 | Brown silty very gravelly SAND. |
| R11-CP04 | | B | 2.40 | 2.70 | Brown clayey very gravelly SAND. |
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Bus Connects Route 11

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| Contract No: |
| PSL21/4164 |
| Client Ref: |
| 9754-07-20 |

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % Clause 3.2 | Particle Density Mg/m ³ Clause 8.2 | Liquid Limit % Clause 4.3/4 | Plastic Limit % Clause 5.3 | Plasticity Index % Clause 5.4 | Passing .425mm % | Remarks |
|-------------|---------------|-------------|----------------|-----------------|-------------------------------------|---|-----------------------------------|----------------------------------|-------------------------------------|---------------------|---------|
| R11-CP04 | | B | 2.40 | 2.70 | 7.9 | | | NP | | | |
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SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.

UKAS TESTING
4043
PSL
Professional Soils Laboratory

Bus Connects Route 11

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| Contract No: |
| PSL21/4164 |
| Client Ref: |
| 9754-07-20 |

PARTICLE SIZE DISTRIBUTION TEST

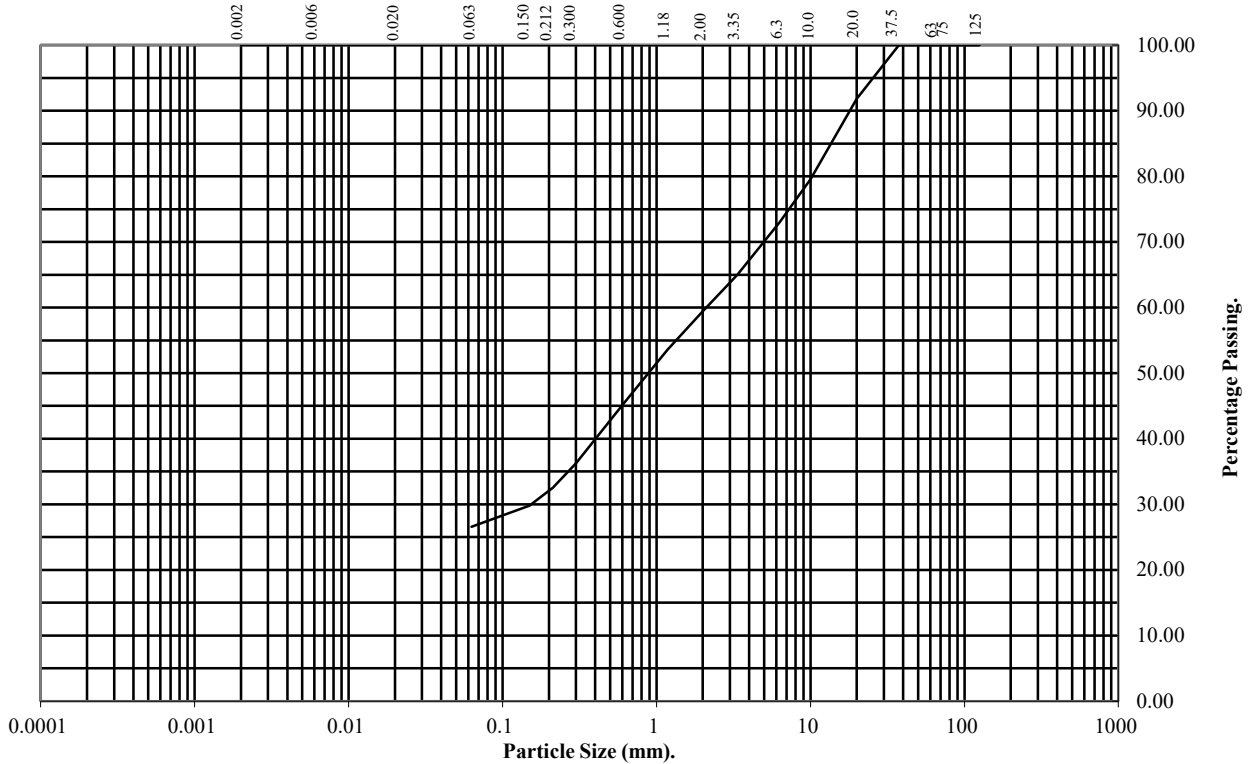
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: R11-CP04 **Top Depth (m):** 1.50

Sample Number: **Base Depth(m):** 1.80

Sample Type: B



| BS Test Sieve (mm) | Percentage Passing |
|--------------------|--------------------|
| 125 | 100 |
| 75 | 100 |
| 63 | 100 |
| 37.5 | 100 |
| 20 | 92 |
| 10 | 80 |
| 6.3 | 73 |
| 3.35 | 65 |
| 2 | 59 |
| 1.18 | 54 |
| 0.6 | 45 |
| 0.3 | 36 |
| 0.212 | 33 |
| 0.15 | 30 |
| 0.063 | 27 |

| Soil Fraction | Total Percentage |
|---------------|------------------|
| Cobbles | 0 |
| Gravel | 41 |
| Sand | 32 |
| Silt/Clay | 27 |

Remarks:
See Summary of Soil Descriptions



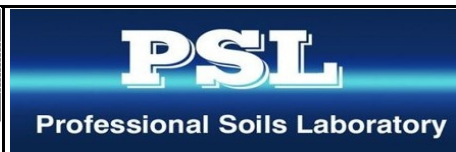
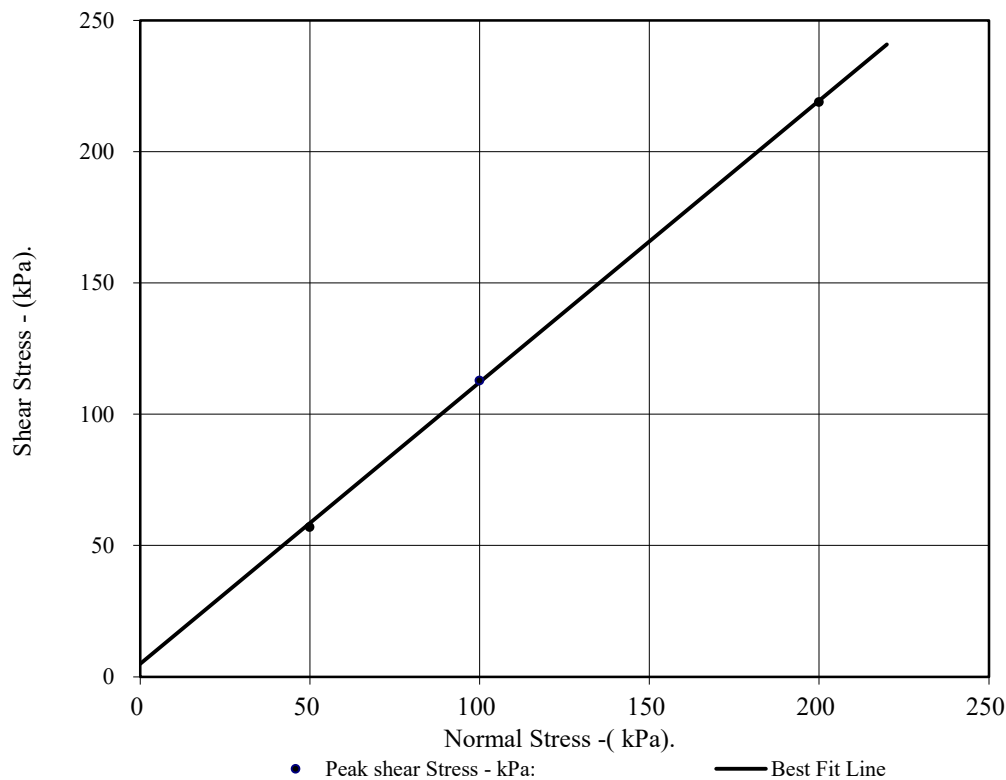
Bus Connects Route 11

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| Contract No: |
| PSL21/4164 |
| Client Ref: |
| 9754-07-20 |

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

| | | | | | |
|---|---|---------|-------------|----------|----------|
| Hole Number: | R11-CP04 | | Top Depth: | 2.20 | |
| Sample Number: | | | Base Depth: | 2.40 | |
| Sample Conditions: | Dry | | Sample Type | B | |
| Particle Density - Mg/m ³ : | 2.65 | Assumed | Remarks: | | |
| Sample Preparation: | Material tested passing 2mm sieve Remoulded using hand tamped effort | | | | |
| Sample Description: | See summary of soil descriptions | | | | |
| STAGE | | | 1 | 2 | 3 |
| Initial Conditions | | | | | |
| Height - mm: | | | 20.05 | 20.05 | 20.05 |
| Length - mm: | | | 59.97 | 59.97 | 59.97 |
| Moisture Content - %: | | | 12 | 12 | 12 |
| Bulk Density - Mg/m ³ : | | | 1.97 | 1.97 | 1.97 |
| Dry Density - Mg/m ³ : | | | 1.76 | 1.77 | 1.76 |
| Voids Ratio: | | | 0.507 | 0.500 | 0.504 |
| Normal Pressure- kPa | | | 50 | 100 | 200 |
| Consolidation Stage | | | | | |
| Consolidated Height - mm: | | | 19.66 | 19.56 | 19.49 |
| Shearing Stage | | | | | |
| Rate of Strain (mm/min) | | | 0.100 | 0.100 | 0.100 |
| Displacement at peak shear stress (mm) | | | 3.00 | 3.00 | 5.00 |
| Peak shear Stress - kPa: | | | 57 | 113 | 219 |
| Final Consolidated Conditions | | | | | |
| Moisture Content - %: | | | 10 | 10 | 10 |
| Bulk Density - Mg/m ³ : | | | 2.01 | 2.02 | 2.03 |
| Dry Density - Mg/m ³ : | | | 1.82 | 1.83 | 1.84 |
| Peak | | | | | |
| Angle of Shearing Resistance:(θ) | | | 47 | | |
| Effective Cohesion - kPa: | | | 5 | | |



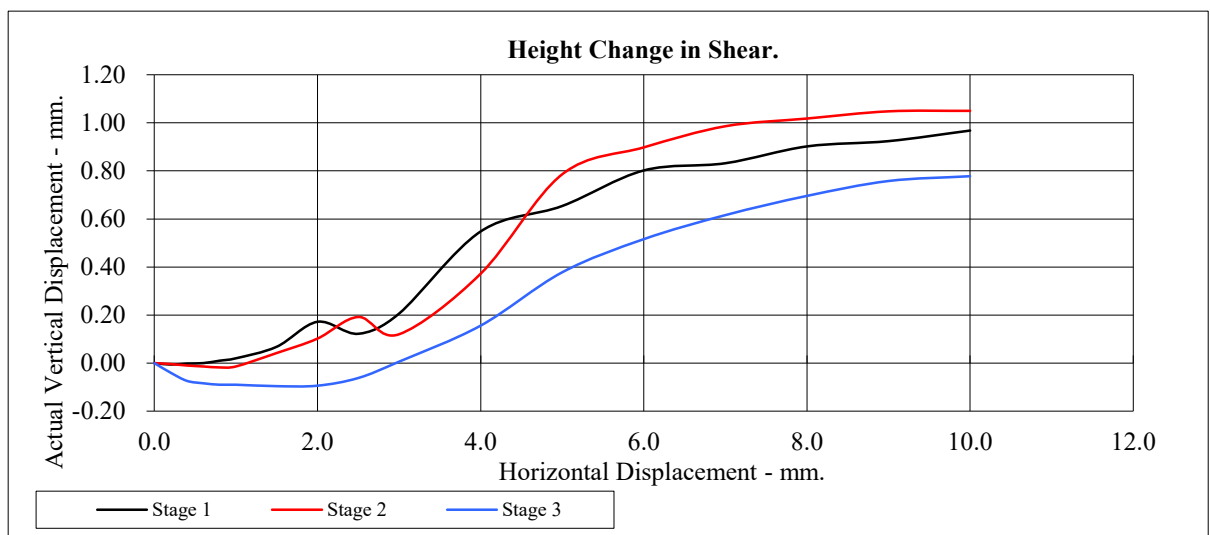
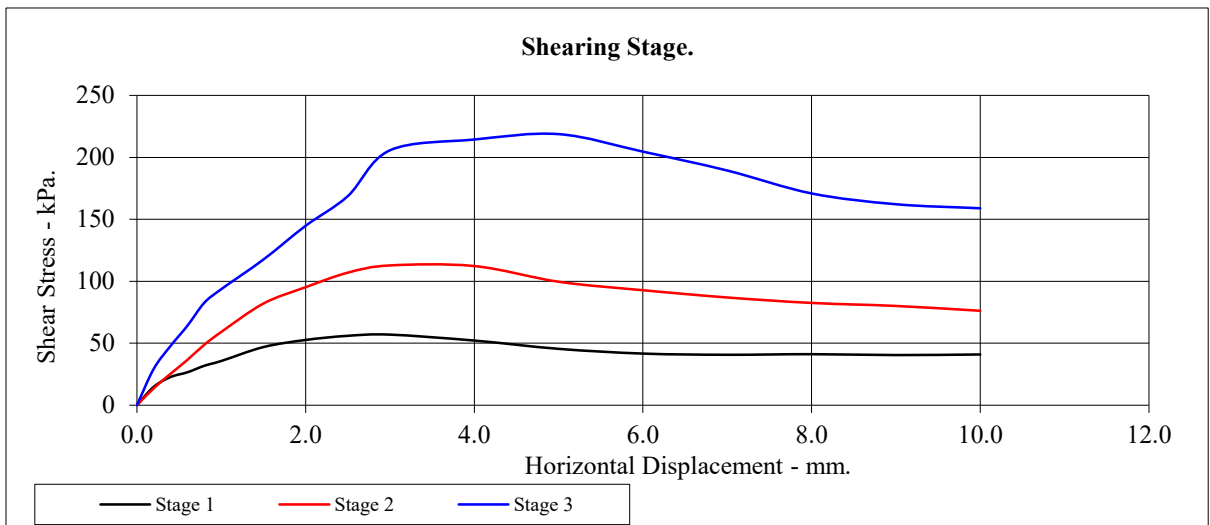
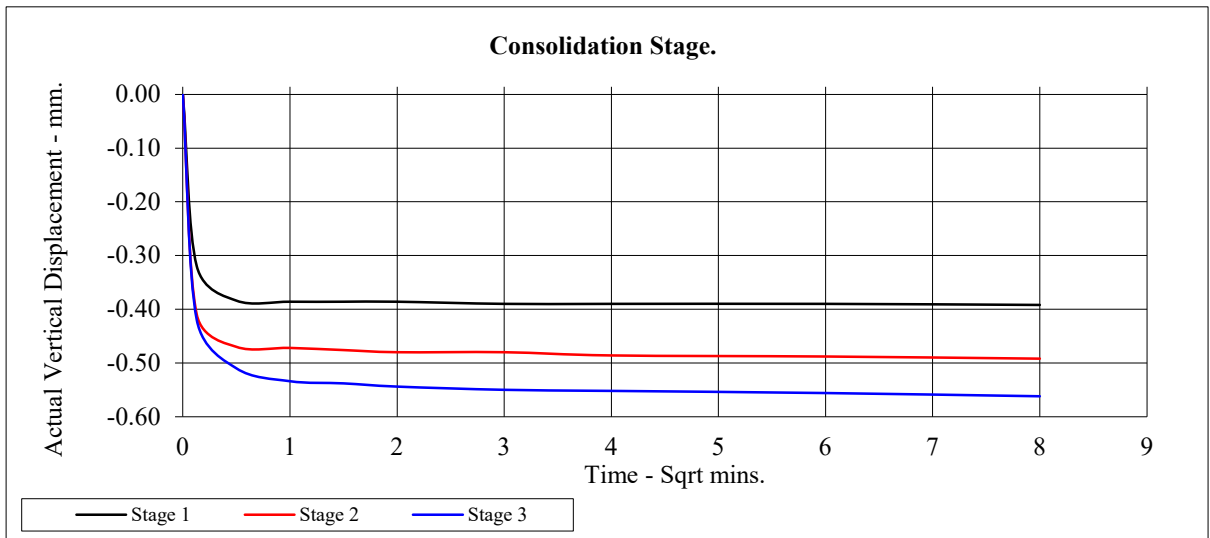
Bus Connects Route 11

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| Contract No: |
| PSL21/4164 |
| Client Ref: |
| 9754-07-20 |

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

| | | | |
|----------------|----------|-------------|------|
| Hole Number: | R11-CP04 | Top Depth: | 2.20 |
| Sample Number: | | Base Depth: | 2.40 |



PSL
Professional Soils Laboratory

Bus Connects Route 11

Contract No:
PSL21/4164
Client Ref:
9754-07-20



LABORATORY REPORT



4043

Contract Number: PSL21/3993

Report Date: 24 May 2021
Client's Reference: 2868817
Client Name: Ground Investigations Ireland Ltd
Catherinestown House
Hazelhatch Road
Newcastle
Co Dublin
D22 YD52

For the attention of: Michael Sutton

Contract Title: Bus Connect Route 11
Date Received: 17/5/2021
Date Commenced: 17/5/2021
Date Completed: 24/5/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)


S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

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awatkins@prosoils.co.uk

Page 1 of

DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

ISRM Suggested Methods, pp 111 –116, 1981.

| Hole Number | Sample Number | Sample Type | Top Depth (m) | Base Depth (m) | Sample Diameter (mm) | Sample Length (mm) | Height Ratio | Initial Mass (g) | Bulk Density (Mg/m) | Moisture Content (%) | Dry Density (Mg/m) | Load Failure (kN) | UCS (MPa) | Failure Mode | Date Tested | Remarks |
|-------------|---------------|-------------|---------------|----------------|----------------------|--------------------|--------------|------------------|---------------------|----------------------|--------------------|-------------------|-----------|--------------|-------------|---------|
| R11-CP01A | | C | 11.00 | | 64 | 127 | 2.0 | 1082 | 2.65 | 3.2 | 2.57 | 100.6 | 31.3 | Brittle | 21/05/21 | |
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Bus Connect Route 11

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| Contract No: |
| PSL21/3993 |
| Client Ref: |
| 9754-07-20 |

APPENDIX 5 – Groundwater Monitoring





GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

GROUNDWATER MONITORING

Bus Connects Stage 1 Lot 1 - Route 11

| BOREHOLE | DATE | TIME | GROUNDWATER (m BGL) | Comments |
|----------|------------|-------|----------------------|----------|
| | | | | |
| R11-WS01 | 04/05/2021 | 8:35 | 0.68 | |
| R11-WS02 | 04/05/2021 | 8:40 | 0.47 | |
| R11-CP01 | 04/05/2021 | 10:00 | 1.44 | |
| R11-CP03 | 04/05/2021 | 11:25 | 2.74 | |
| R11-WS01 | 21/05/2021 | 7:30 | 0.61 | |
| R11-WS02 | 21/05/2021 | 7:40 | 0.40 | |
| R11-CP01 | 21/05/2021 | 7:50 | 1.94 | |
| R11-CP03 | 21/05/2021 | 8:20 | 2.67 | |
| R11-CP04 | 21/05/2021 | 8:05 | 1.35 | |
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