# **Appendix A14.2**
# Ground Investigation Report

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# Ground Investigations Ireland

# Bus Connect Detailed Stage 1 Lot 1

# Route 12

# National Transport Authority

# Ground Investigation Report

# April 2021

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## *DOCUMENT CONTROL SHEET*

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*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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## CONTENTS



### APPENDICES

## 1.0 Preamble

On the instructions of Arup, a site investigation was carried out by Ground Investigations Ireland Ltd., between October and November 2020 at the site of the proposed bus corridor along Route 12: Rathfarnham 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 12 is proposed to run between Rathfarnham and the 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 changed throughout the project with extra locations added and removed based on design changes at the request of the client. R12-CP01 was not undertaken due to access issues. The final scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 3 No. Cable Percussion boreholes to a maximum depth of 4.50m BGL with rotary follow on to a maximum depth of 15.50m BGL.
- Installation of 2 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. 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 60º 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 2 of this Report.

### 3.3. 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 2 of this Report.

### 3.4. 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.

### 3.5. Groundwater Monitoring Installations

Groundwater Monitoring 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. Where required the standpipe is sealed with a gas tap and 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.

### 3.6. 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 the Arup specified suite based on Engineers Ireland Suite E was carried out by Element Materials Technology Laboratory in the UK on 7 samples.
Geotechnical testing consisting of 4 moisture content, 4 Atterberg limits, 4 Particle Size Distribution (PSD) and 4 hydrometer tests were carried out in NMTL's Geotechnical Laboratory in Carlow.
The results of the laboratory testing are included in Appendix 3 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 across the site generally comprised;

- Topsoil
- Made Ground
- Cohesive Deposits
- Granular Deposits

- Bedrock

**TOPSOIL:** Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.8m BGL.

**MADE GROUND:** Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to a depth of between 1.5m and 1.6m BGL. These deposits were described generally as *brown sandy slightly gravelly Clay and contained occasional fragments of red brick and plastic.*

**COHESIVE DEPOSITS:** Cohesive deposits were generally encountered beneath the Made Ground and were described typically as *brown sandy gravelly CLAY with occasional cobbles*. 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 was typically stiff in the exploratory holes.

**GRANULAR DEPOSITS:** The granular deposits were generally encountered at the base of the cohesive deposits and were typically described as G*rey brown sandy sub angular to sub rounded to fine to coarse GRAVEL with occasional cobbles.* The secondary sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble content also present where noted on the exploratory hole logs.
Based on the SPT N values the deposits are typically medium dense or dense. 2 groundwater strikes were noted in borehole R12-CP02 within the granular deposits.

**BEDROCK**: The rotary core boreholes recovered weak to strong greyish brown or dark grey fine to medium grained laminated argillaceous / fossiliferous LIMESTONE. This is typical of the Calp Formation, which is noted on the geological mapping to the east of the proposed site. Rare visible calcite veins were noted during logging which are typically present within the Calp Limestone.
The depth to rock varies from 5.5m BGL in R12-CP03 to 5.6m BGL in R12-CP02. The total core recovery is good, typically 100% with some of the uppermost runs dropping between 70 and 90%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

### 4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. 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 time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in R12-CP02 and R12-CP03 to allow the equilibrium groundwater level to be determined. The groundwater monitoring is included in Appendix 4 of this Report.

## 4.3. Laboratory Testing

### 4.3.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on 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 test on the cohesive on a sample from CP02 at 2.0m confirm the cohesive deposits are well-graded with percentages of sands and gravels ranging between 23% and 49% generally with fines contents of 28%

The Particle Size Distribution tests confirm that generally the granular deposits are gap graded with percentages of sands between 1.4 and 26.8%, silt/clay typically between 1.3% and 15.6% with a gravel content of typically 45% to 84%. Cobble content also was encountered on some holes and recorded between 0 and 51.8%

### 4.3.1. Environmental Laboratory Testing

Seven samples were analysed for a Suite of testing specified by ARUP based on suite E according to engineers Ireland.

The possibility for 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.

The results from the completed laboratory testing is included in Appendix 3 of this report.

# **APPENDIX 1** - Site Location Plan


Cable Percussion

Cable Percussion with Rotary follow on

**Client:**

ARUP

**Project Code:**

9754-07-20 R12

**Project Title:**

Bus Connect Route 12

**Drawing Title:**

Figure 1 Site Location

GROUND INVESTIGATIONS IRELAND
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0 5 10 15 20 25 m

| Drawn By: | Date: |
|---|---|
| PC | 15/03/2021 |

# **APPENDIX 2** – Borehole Records

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| | | | |
|---|---|---|---|
| **Site** Bus Connect Detailed Stage 1 Lot 1 | | | **Borehole Number** R12-CP02 |
| **Machine :** Dando 2000 & Beretta T44<br>**Method :** Cable Percussion | **Casing Diameter** 200mm cased to + 68mm cased to 15.50m | **Ground Level (mOD)** 35.44 | **Client** National Transport Authority | **Job Number** 9754-07-20 |
| | **Location** 714398.9 E 729676.1 N | **Dates** 27/10/2020-13/11/2020 | **Project Contractor** Ground Investigations Ireland | **Sheet** 1/2 |

| Depth (m) | Sample / Tests | TCR | SCR | Casing Depth (m) | RQD | Water Depth (m) | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (0.80) | Brown slightly sandy slightly gravelly TOPSOIL. | | | |
| 0.50 | EN | | | | | | | | 34.64 | 0.80 | | | | |
| 1.00-1.45 | SPT(C) N=23 | | | | | | | 3,3/4,6,6,7 | | (0.70) | MADE GROUND: Brownish grey sandy gravelly Clay with occasional fragments of brick. | | | |
| 1.00 | B | | | | | | | | | | | | | |
| 1.00 | T | | | | | | | | 33.94 | 1.50 | | | | |
| 1.50 | EN | | | | | | | | | (0.90) | Medium dense brownish grey sandy clayey sub-angular to sub-rounded fine to coarse GRAVEL. | | | |
| 2.00-2.45 | SPT(C) N=31 | | | | | | | 8,10/9,9,8,5 | | | | | | |
| 2.00 | B | | | | | | | | 33.04 | 2.40 | | | | |
| 2.00 | T | | | | | | | | | | Dense grey sandy sub-angular to sub-rounded fine to coarse GRAVEL. | | ▼1 | |
| 2.50 | EN | | | | | | | Water strike(1) at 2.60m, no rise after 20 mins, sealed at 2.80m. | | (0.90) | | | | |
| 3.00 | B | | | | | | | | 32.14 | 3.30 | | | | |
| 3.00-3.43 | SPT(C) 50/280 | | | | | | | 15,17/15,13,13,9 | | | Very stiff brown slightly sandy gravelly CLAY with occasional sub-angular to sub-rounded cobbles. Gravel is sub angular to sub rounded fine to coarse. | | ▼2 | |
| 3.00 | B | | | | | | | | | (0.70) | | | | |
| 3.50 | EN | | | | | | | 9,19/16,23,11 SPT(C) 50/195 | 31.44 | 4.00 | | | ▽2 | |
| 4.00-4.35 | | | | | | | | Water strike(2) at 4.00m, rose to 3.60m in 20 mins. | | | Dense grey/brownish grey angular to subrounded fine to coarse GRAVEL with frequent angular to subrounded cobbles | | | |
| 4.00 | | | | | | | | T | | | | | | |
| 4.00 | | | | | | | | T | | | | | | |
| 4.00 | | 55 | | | | | | | | | | | | |
| 5.00-5.12 | | | | | | | | 15,10/50 SPT(C) 25*/115 50/5 | | (1.60) | | | | |
| 5.00 | | | | | | | | | | | | | | |
| 5.60 | | 97 | 55 | | 48 | | 4 | | 29.84 | 5.60 | Strong thinly laminated grey fine grained fossiliferous LIMESTONE. Partially weathered with occasional calcite veining | | | |
| 6.50 | | | | | | | | | | | | | | |
| 6.90 | | | | | | | NI | | | | 6.90m-7.20m BGL - Mostly Non Intact | | | |
| 7.20 | | 100 | 61 | | 68 | | 3 | | | (3.90) | 7.20m-7.85m BGL - F1: Closely to medium spaced, 60° to 80°, undulating smooth to rough | | | |
| 7.85 | | | | | | | | | | | | | | |
| 8.00 | | | | | | | NI | | | | 7.85m-8.25m BGL - Mostly Non Intact | | | |
| 8.25 | | | | | | | 6 | | | | 8.25m-8.75m BGL - Two fracture sets. F1: Very closely to closely spaced, 0° to 10°, undulating smooth to rough with occasional clay staining. F2: Very closely to closely spaced, 80° to 90°, undulating rough | | | |
| 8.75 | | 100 | 75 | | 67 | | | | | | | | | |
| 9.50 | | | | | | | | | 25.94 | 9.50 | Poor Recovery: Brown slightly sandy slightly gravelly CILAY: Driller notes Clay Band (Possible clay infilled cavity) | | | |
| | | | | | | | | | | (0.60) | | | | |

**Remarks**
Cable percussion refusal at 4.50m BGL
Rotary core follow on from 4.00m BGL due to slight collapse at the base of the cable percussion hole
Groundwater encountered at 2.60m and 4.00mBGL.
Borehole complete at 15.50m BGL
50mm slotted standpipe installed from 4.50m to 1.50m BGL with pea gravel surrounds, plain standpipe installed from 1.50m BGL to ground level with bentonite surrounds and flush cover
Chiselling from 4.00m to 4.00m for 1 hour.

| Scale (approx) | Logged By |
|---|---|
| 1:50 | TMcl & PC |

**Figure No.** 9754-07-20.R12-CP03

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| | | | |
|---|---|---|---|
| **Site** Bus Connect Detailed Stage 1 Lot 1 | | | **Borehole Number** R12-CP02 |
| **Machine :** Dando 2000 & Beretta T44<br>**Flush :** Water<br>**Core Dia :** 68 mm<br>**Method :** Cable Percussion | **Casing Diameter** 200mm cased to + 68mm cased to 15.50m | **Ground Level (mOD)** 35.44 | **Client** National Transport Authority | **Job Number** 9754-07-20 |
| | **Location** 714398.9 E 729676.1 N | **Dates** 27/10/2020-13/11/2020 | **Project Contractor** Ground Investigations Ireland | **Sheet** 2/2 |

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 73 | 57 | 57 | | | 25.34 | 10.10 | Strong thinly laminated grey fine grained fossiliferous LIMESTONE. Partially weathered with occasional calcite veining | | | |
| 11.00 | 93 | 93 | 93 | 3 | | | | 8.75m-15.50mBGL - Two fracture sets. F1: Closely to medium spaced, 0° to 10°, undulating smooth with occasional clay staining. F2: Closely to medium spaced, 80° to 90°, undulating smooth | | | |
| 12.50 | 100 | 93 | 83 | | | | (5.40) | | | | |
| 14.00 | 100 | 100 | 98 | | | | | | | | |
| 15.50 | | | | | | 19.94 | 15.50 | Complete at 15.50m | | | |

**Remarks**

| Scale (approx) | Logged By |
|---|---|
| 1:50 | TMcl & PC |

**Figure No.** 9754-07-20.R12-CP03

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| | | | |
|---|---|---|---|
| **Site** Bus Connect Detailed Stage 1 Lot 1 | | | **Borehole Number** R12-CP03 |
| **Machine :** Dando 2000 & Beretta T44<br>**Method :** 68Cable Percussion | **Casing Diameter** 200mm cased to 4.30m<br>68mm cased to 14.00m | **Ground Level (mOD)** 36.96 | **Client** National Transport Authority | **Job Number** 9754-07-20 |
| | **Location** 714299.5 E 729634.3 N | **Dates** 28/10/2020-12/11/2020 | **Project Contractor** Ground Investigations Ireland | **Sheet** 1/2 |

| Depth (m) | Sample / Tests | TCR | SCR | RQD | FI | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 36.96 | (0.40) | Brown slightly sandy slightly gravelly TOPSOIL. | | | |
| | | | | | | | | | 36.56 | 0.40 | MADE GROUND: Brown slightly sandy gravelly Clay with occasional fragments of plastic. | | | |
| 0.50 | EN | | | | | | | | | | | | | |
| 1.00-1.45<br>1.00<br>1.00 | SPT(C) N=17<br>B<br>T | | | | | | | 4,5/3,3,6,5 | | (1.20) | | | | |
| 1.50 | EN<br>11 | | | | | | | | 35.36 | 1.60 | Stiff brown slightly sandy gravelly CLAY with occasional sub-angular cobbles. Gravel is sub angular to sub rounded fine to coarse. | | | |
| 2.00-2.34<br>2.00<br>2.00 | SPT(C) 50/190<br>B<br>T | | | | | | | 3,3/3,5,42 | | (1.30) | | | | |
| 2.50 | EN | | | | | | | | 34.06 | 2.90 | Grey sub-angular COBBLES. | | | |
| 3.50-3.66 | | | | | | | | 12,12/50<br>SPT(C) 50/10 | 33.96 | 3.00 | Dense grey/brownish grey angular to subrounded fine to coarse GRAVEL with frequent angular to subrounded cobbles | | | |
| 3.50 | | 63 | | | | | | | | (2.50) | | | | |
| 5.00-5.15<br>5.00 | | | | | | | | 25/50<br>SPT(C) 25*/50<br>50/100 | | | | | | |
| 5.50 | | 87 | 11 | 0 | | | | | 31.46 | 5.50 | Weak to medium strong thinly laminated greyish brown fine to medium grained DOLOMITISED LIMESTONE with occasional vugs. Distinctly weathered with occasional clay infilling | Dol | | |
| 6.50 | | 73 | 0 | 0 | MNI | | | | | (2.50) | 5.50m-8.00m BGL - Mostly Non Intact | | | |
| 8.00 | | 83 | 51 | 47 | 1 | | | | 28.96 | 8.00 | Strong thinly laminated greyish brown fine to medium grained DOLOMITISED LIMESTONE. Partially weathered with occasional calcite veining<br>8.00m-9.10m BGL - F1: Closely to medium spaced, 0° to 10°, undulating smooth with clay staining | | | |
| 9.10 | | | | | MNI | | | | | | 9.10m-9.50m BGL - Mostly Non Intact | | | |
| 9.50 | | | | | 3 | | | | | | 9.50m-9.90m BGL - F1: Medium spaced, 0° to 10°, undulating smooth with clay staining | | | |
| 9.90 | | | | | | | | | | | | | | |

**Remarks**
Cable persussion refusal at 3.00m BGL
Borehole backfilled upon completion of cable percussion drilling
Rotary follow on from 3.00m BGL
No groundwater encountered.
Borehole complete at 14.00m BGL
50mm slotted standpipe installed from 8.00m to 4.00m BGL with pea gravel surrounds, plain standpipe installed from 4.00m BGL to ground level with bentonite surrounds and flush cover
Chiselling from 3.00m to 3.00m for 1.0 hour.

| Scale (approx) | Logged By |
|---|---|
| 1:50 | TMcI & PC |

**Figure No.** 9754-07-20.R12-CP03

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| | | | |
|---|---|---|---|
| **Site** Bus Connect Detailed Stage 1 Lot 1 | | | **Borehole Number** R12-CP03 |
| **Machine :** Dando 2000 & Beretta T44<br>**Flush :** Water<br>**Core Dia :** 68 mm<br>**Method :** 68Cable Percussion | **Casing Diameter** 200mm cased to 4.30m 68mm cased to 14.00m | **Ground Level (mOD)** 36.96 | **Client** National Transport Authority | **Job Number** 9754-07-20 |
| | **Location** 714299.5 E 729634.3 N | **Dates** 28/10/2020-12/11/2020 | **Project Contractor** Ground Investigations Ireland | **Sheet** 2/2 |

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Description | Legend | Water | Instr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.30 | 100 | 64 | 58 | MNI | | | | 9.90m-10.30m BGL - Mostly Non Intact | | | |
| 10.85 | | | | 11 | | | | 10.30m-10.85m BGL - Very closely to closely spaced, 10° to 20°, undulating smooth with clay staining | | | |
| 11.00 | 100 | 93 | 85 | | | | (6.00) | | | | |
| 12.50 | 100 | 75 | 75 | 3 | | | | 10.85m-14.00m BGL - Two fracture sets. F1: Closely to medium spaced, 0° to 10°, undulating smooth to rough with occasional clay infilling/staining. F2: Closely to medium spaced, 80° to 90°, undulating smooth to rough | | | |
| 14.00 | | | | | | 22.96 | 14.00 | Complete at 14.00m | | | |

**Remarks**

| Scale (approx) | Logged By |
|---|---|
| 1:50 | TMcl & PC |

**Figure No.** 9754-07-20.R12-CP03

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| | | | |
|---|---|---|---|
| **Site** Bus Connect Detailed Stage 1 Lot 1 | | | **Borehole Number** R12-CP03A |
| **Machine :** Dando 2000<br>**Method :** Cable Percussion | **Casing Diameter** 200mm cased to 3.30m | **Ground Level (mOD)** | **Client** National Transport Authority | **Job Number** 9754-07-20 |
| | **Location** | **Dates** 28/10/2020-29/10/2020 | **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 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (0.40) 0.40 | Brown slightly sandy slightly gravelly TOPSOIL. | | |
| | | | | | | (1.20) 1.60 | MADE GROUND: Brown slightly sandy gravelly Clay with occasional fragments of plastic. | | |
| | | | | | | (1.30) 2.90 | Stiff brown slightly sandy gravelly CLAY with occasional sub-angular cobbles. Gravel is sub angular to sub rounded finw to coarse. | | |
| 3.00-3.05<br>3.00 | SPT(C) 50*/50<br>B | | | 50/ | | 3.00 | Grey sub-angular COBBLES.<br>Refusal at 3.30m | | |

**Remarks**
Borehole complete at 3.30m BGL.
No groundwater encountered.
Chiselling from 3.00m to 3.10m for 1 hour. Chiselling from 3.30m to 3.30m for 1 hour.

| Scale (approx) | Logged By |
|---|---|
| 1:50 | Tmcl |

**Figure No.** 9754-07-20.R12-CP03A

**Bus Connects Route 12 – Rotary Core Photographs**

R12 – CP02


**Bus Connects Route 12 – Rotary Core Photographs**

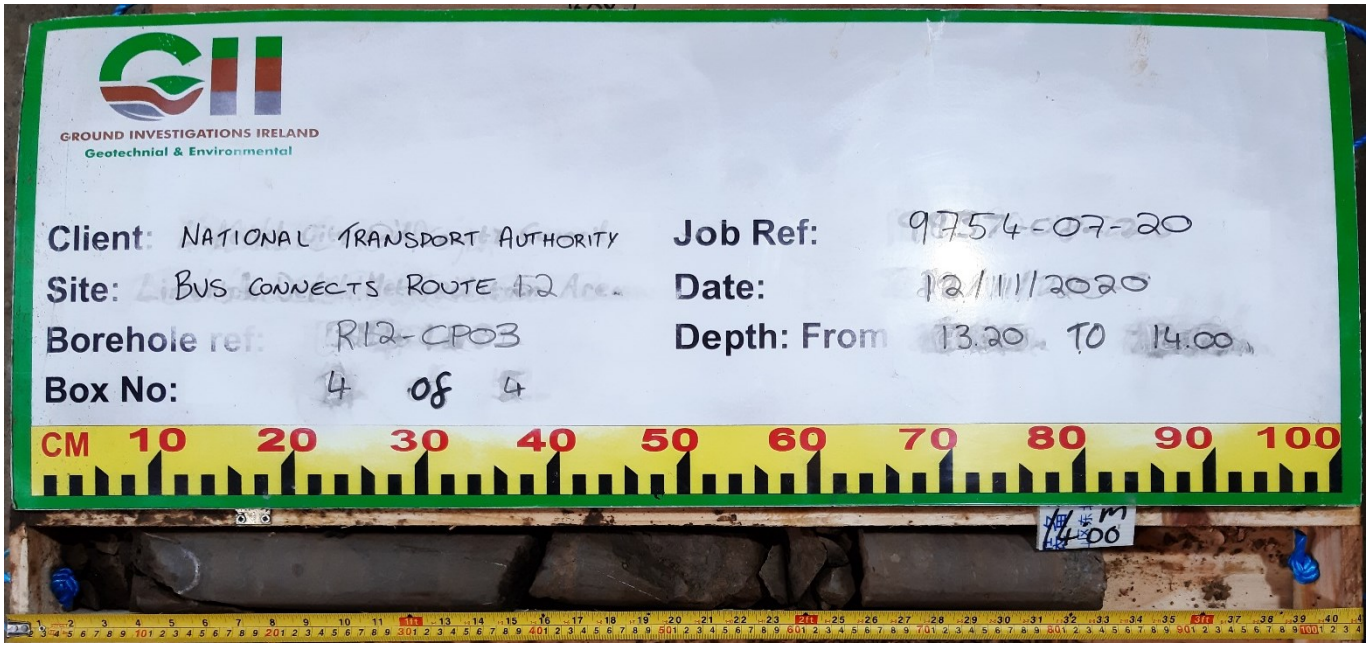
R12 – CP02


**Bus Connects Route 12 – Rotary Core Photographs**

R12 – CP03


**Bus Connects Route 12 – Rotary Core Photographs**

R12 – CP03

# **APPENDIX 3** – Laboratory Testing

***National Materials Testing Laboratory Ltd.***

## SUMMARY OF TEST RESULTS

| | | | | Particle | | | Index Properties | | Bulk | Cell | Undrained Triaxial Tests | | Lab | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH/TP | Depth | sample | Moisture | Density | <425um | LL | PL | PI | Density | Presssure | Compressive | Strain at | Vane | Remarks |
| No | m | No. | % | Mg/m3 | % | % | % | % | Mg/m3 | kPa | Stress kPa | Failure % | kPa | |
| | | | | | | | | | | | | | | |
| R12-CP02 | 2.0 | B | 9.0 | | 28.9 | 37 | 26 | 11 | | | | | | |
| R12-CP02 | 3.0 | B | 2.2 | | 1.6 | Non Plastic | | | | | | | | |
| R12-CP03 | 2.0 | B | 13.9 | | 40.5 | 32 | 19 | 13 | | | | | | |
| R12-CP03 | 3.0 | B | 8.1 | | 1.9 | Non Plastic | | | | | | | | |
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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**

# Determination of Particle Size Distribution

**BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5**

| Sieve Size mm | % Passing |
|---|---|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 100.0 |
| 37.500 | 81.3 |
| 28.000 | 74.9 |
| 20.000 | 66.9 |
| 14.000 | 65.5 |
| 10.000 | 59.5 |
| 6.300 | 53.7 |
| 5.000 | 50.8 |
| 3.350 | 48.2 |
| 2.000 | 42.4 |
| 1.180 | 37.3 |
| 0.600 | 31.4 |
| 0.425 | 28.9 |
| 0.300 | 26.4 |
| 0.212 | 23.9 |
| 0.150 | 21.3 |
| 0.063 | 15.6 |
| 0.056 | 14.3 |
| 0.040 | 12.8 |
| 0.020 | 9.8 |
| 0.011 | 7.2 |
| 0.008 | 6.1 |
| 0.005 | 4.8 |
| 0.004 | 4.1 |
| 0.002 | 3.0 |


Percentage Particle Size

| Clay | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | Cobbles | Boulder |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Silt | | | Sand | | | Gravel | | | |
| 3.0 | | 12.6 | | | 26.8 | | | 57.6 | | 0.0 | 0.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Description | Brown silty very sandy GRAVEL | | | | | Project No. | NMTL 3326 |
| | | | | | | BH/TP No. | R12-CP02 |
| Project | Bus connect Route 12 | | | GII Project ID-9754-07-20 | | Sample No. | B |
| Operator | Tzr | Checked | Nc | Approved | Bc | Depth | 2.0m |
| | | | | Date sample tested | 15/12/2020 | | |

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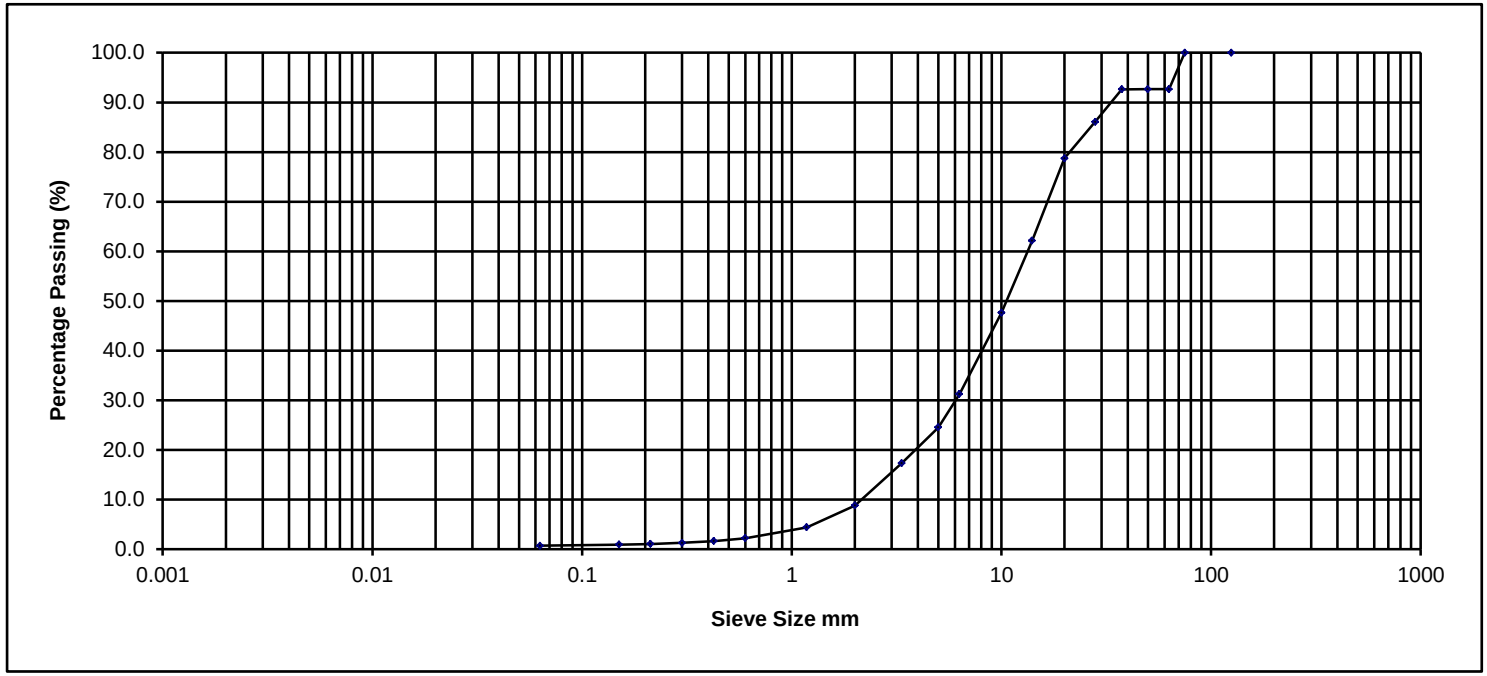
# Determination of Particle Size Distribution

**BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5**

| Sieve Size mm | % Passing |
|---|---|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 92.7 |
| 50.000 | 92.7 |
| 37.500 | 92.6 |
| 28.000 | 86.1 |
| 20.000 | 78.7 |
| 14.000 | 62.1 |
| 10.000 | 47.6 |
| 6.300 | 31.2 |
| 5.000 | 24.5 |
| 3.350 | 17.4 |
| 2.000 | 8.8 |
| 1.180 | 4.4 |
| 0.600 | 2.2 |
| 0.425 | 1.6 |
| 0.300 | 1.3 |
| 0.212 | 1.1 |
| 0.150 | 0.9 |
| 0.063 | 0.7 |




Percentage Particle Size

| Clay | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | Cobbles | Boulder |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Silt | | | Sand | | | Gravel | | | |
| 0.0 | | 0.7 | | | 8.1 | | | 83.9 | | 7.3 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| Sample Description | Grey sandy fine to coarse gravel with some cobbles. | | | Project No. | NMTL 3326 |
| | | | | BH/TP No. | R12-CP02 |
| Project | Bus connect Route 12 | | GII Project ID-9754-07-20 | Sample No. | B |
| Operator Tzr | Checked Nc | Approved Bc | Date sample tested 15/12/2020 | Depth | 3.0m |

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# Determination of Particle Size Distribution

**BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5**

| Sieve Size mm | % Passing |
|---|---|
| 125.000 | 100.0 |
| 75.000 | 100.0 |
| 63.000 | 100.0 |
| 50.000 | 90.8 |
| 37.500 | 81.6 |
| 28.000 | 78.6 |
| 20.000 | 73.8 |
| 14.000 | 69.9 |
| 10.000 | 66.4 |
| 6.300 | 60.9 |
| 5.000 | 57.7 |
| 3.350 | 55.4 |
| 2.000 | 51.2 |
| 1.180 | 47.2 |
| 0.600 | 42.7 |
| 0.425 | 40.5 |
| 0.300 | 38.3 |
| 0.212 | 36.3 |
| 0.150 | 32.4 |
| 0.063 | 27.5 |
| 0.052 | 25.6 |
| 0.037 | 22.9 |
| 0.019 | 19.6 |
| 0.010 | 15.7 |
| 0.007 | 13.7 |
| 0.005 | 11.9 |
| 0.004 | 10.6 |
| 0.002 | 6.4 |


Percentage Particle Size

| Clay | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | Cobbles | Boulder |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Silt | | | Sand | | | Gravel | | | |
| 6.4 | | 21.0 | | | 23.8 | | | 48.8 | | 0.0 | 0.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Description | Brown slightly sandy gravelly silty CLAY | | | | | Project No. | NMTL 3326 |
| | | | | | | BH/TP No. | R12-CP03 |
| Project | Bus connect Route 12 | | | GII Project ID-9754-07-20 | | Sample No. | B |
| Operator | Tzr | Checked | Nc | Approved | Bc | Depth | 2.0m |
| | | | | Date sample tested | 15/12/2020 | | |

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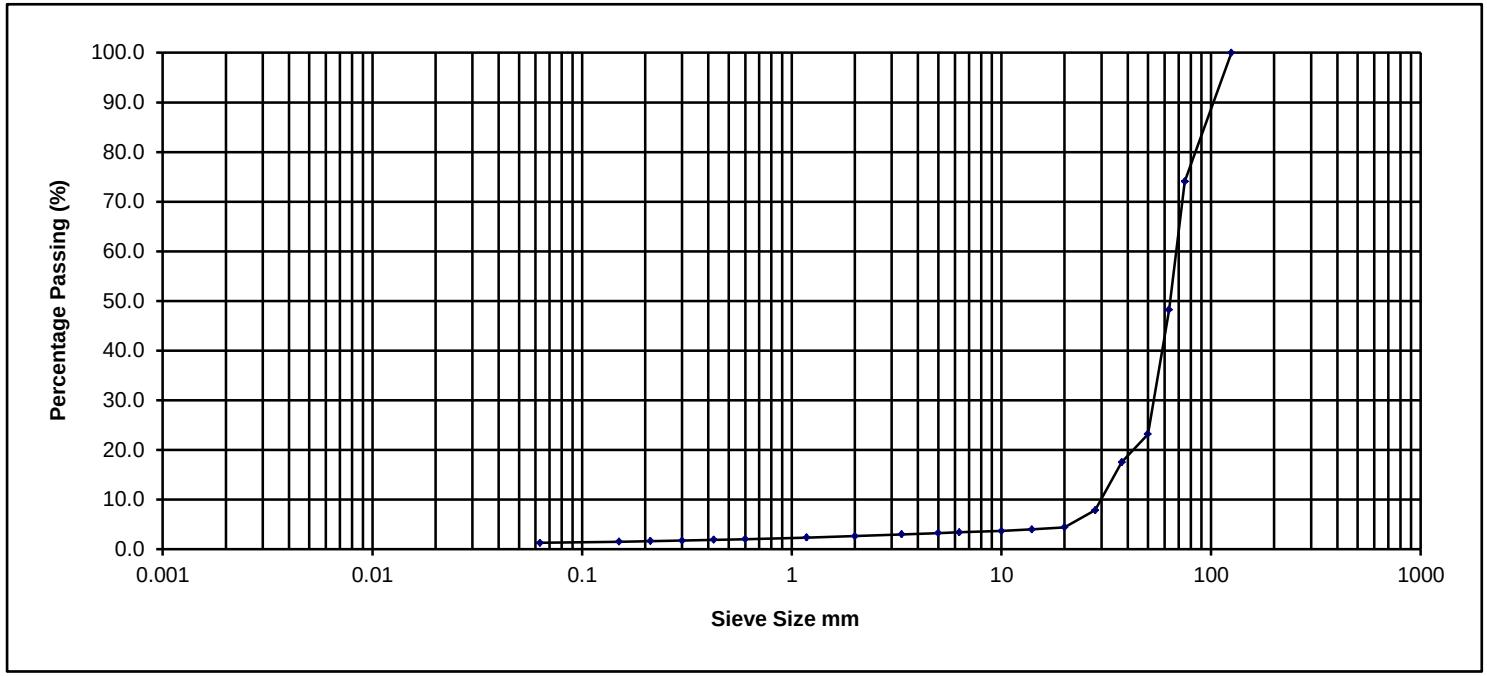
# Determination of Particle Size Distribution

**BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5**

| Sieve Size mm | % Passing |
|---|---|
| 125.000 | 100.0 |
| 75.000 | 74.1 |
| 63.000 | 48.2 |
| 50.000 | 23.2 |
| 37.500 | 17.5 |
| 28.000 | 7.9 |
| 20.000 | 4.4 |
| 14.000 | 4.0 |
| 10.000 | 3.7 |
| 6.300 | 3.4 |
| 5.000 | 3.3 |
| 3.350 | 3.0 |
| 2.000 | 2.7 |
| 1.180 | 2.4 |
| 0.600 | 2.0 |
| 0.425 | 1.9 |
| 0.300 | 1.8 |
| 0.212 | 1.6 |
| 0.150 | 1.5 |
| 0.063 | 1.3 |




Percentage Particle Size

| Clay | Fine Medium Coarse | Fine Medium Coarse | Fine Medium Coarse | Cobbles | Boulder |
|---|---|---|---|---|---|
| | Silt | Sand | Gravel | | |
| | 1.3 | 1.4 | 45.5 | 51.8 | 0.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Description | Brown slightly sandy gravelly silty CLAY | | | | | Project No. | NMTL 3326 |
| | | | | | | BH/TP No. | R12-CP03 |
| Project | Bus connect Route 12 | | | GII Project ID-9754-07-20 | | Sample No. | B |
| Operator | Tzr | Checked | Nc | Approved | Bc | Date sample tested | 15/12/2020 | Depth | 3.0m |

**NM TL Ltd**

Element Materials Technology
Unit 3 Deeside Point
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Deeside Industrial Park
Deeside
CH5 2UA

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W: www.element.com

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

| | |
|---|---|
| **Attention :** | John Duggan |
| **Date :** | 16th November, 2020 |
| **Your reference :** | 9754-07-20 |
| **Our reference :** | Test Report 20/15139 Batch 1 |
| **Location :** | BusConnects Route 12 |
| **Date samples received :** | 2nd November, 2020 |
| **Status :** | Final report |
| **Issue :** | 1 |

Seven samples were received for analysis on 2nd November, 2020 of which seven 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**

## Element Materials Technology

**Client Name:** Ground Investigations Ireland
**Reference:** 9754-07-20
**Location:** BusConnects Route 12
**Contact:** John Duggan
**EMT Job No:** 20/15139

**Report : Solid**

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

| EMT Sample No. | 1-3 | 4-6 | 7-9 | 10-12 | 13-15 | 16-18 | 19-21 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP03 | R12-CP03 | R12-CP03 | | | | | | |
| Depth | 0.50 | 1.50 | 2.50 | 3.50 | 0.50 | 1.50 | 2.50 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | |
| Sample Date | 27/10/2020 | 27/10/2020 | 27/10/2020 | 27/10/2020 | 28/10/2020 | 28/10/2020 | 28/10/2020 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | | | | | | |
| Antimony | 1 | 1 | 1 | 1 | 1 | 2 | 1 | | | | <1 | mg/kg | TM30/PM15 |
| Arsenic # | 15.0 | 11.4 | 10.1 | 41.9 | 11.3 | 11.6 | 9.2 | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 68 | 40 | 54 | 79 | 34 | 44 | 168 | | | | <1 | mg/kg | TM30/PM15 |
| Cadmium # | 1.0 | 0.7 | 0.6 | 1.2 | 1.3 | 1.4 | 1.4 | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 43.5 | 76.0 | 52.5 | 45.8 | 44.0 | 44.3 | 45.7 | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 28 | 19 | 18 | 22 | 23 | 30 | 24 | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 50 | 15 | 15 | 21 | 26 | 29 | 23 | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM30/PM15 |
| Molybdenum # | 3.1 | 4.4 | 2.7 | 3.9 | 3.3 | 3.8 | 4.2 | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 22.8 | 23.8 | 30.0 | 30.7 | 31.2 | 40.9 | 36.0 | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | <1 | <1 | <1 | <1 | <1 | 1 | 1 | | | | <1 | mg/kg | TM30/PM15 |
| Zinc # | 92 | 68 | 61 | 85 | 93 | 108 | 81 | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | 0.21 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | 0.07 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | 0.69 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | 0.38 | 0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | 4.89 | 0.61 | <0.03 | <0.03 | 0.04 | 0.07 | 0.13 | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | 0.73 | 0.11 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 9.55 | 1.69 | <0.03 | <0.03 | 0.06 | 0.09 | 0.13 | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 9.15 | 1.71 | <0.03 | <0.03 | 0.06 | 0.09 | 0.12 | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | 4.67 | 0.90 | <0.06 | <0.06 | <0.06 | 0.10 | 0.08 | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 6.01 | 1.21 | <0.02 | <0.02 | 0.03 | 0.06 | 0.07 | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | 10.19 | 2.20 | <0.07 | <0.07 | <0.07 | 0.11 | 0.11 | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | 5.49 | 1.20 | <0.04 | <0.04 | 0.04 | 0.07 | 0.07 | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene | 3.57 | 0.85 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | 0.89 | 0.19 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | 4.21 | 0.96 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Coronene | 0.63 | 0.18 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 17 Total | 61.33 | 11.94 | <0.64 | <0.64 | <0.64 | <0.64 | 0.71 | | | | <0.64 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | 7.34 | 1.58 | <0.05 | <0.05 | <0.05 | 0.08 | 0.08 | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | 2.85 | 0.62 | <0.02 | <0.02 | <0.02 | 0.03 | 0.03 | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 88 | 90 | 74 | 82 | 87 | 86 | 85 | | | | <0 | % | TM4/PM8 |
| | | | | | | | | | | | | | |
| Mineral Oil (C10-C40) (EH_CU_1D_Total) | <30 | <30 | <30 | <30 | <30 | <30 | <30 | | | | <30 | mg/kg | TM5/PM8/PM16 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** Ground Investigations Ireland
**Reference:** 9754-07-20
**Location:** BusConnects Route 12
**Contact:** John Duggan
**EMT Job No:** 20/15139

**Report : Solid**

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

| EMT Sample No. | 1-3 | 4-6 | 7-9 | 10-12 | 13-15 | 16-18 | 19-21 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP03 | R12-CP03 | R12-CP03 | | | | | | |
| Depth | 0.50 | 1.50 | 2.50 | 3.50 | 0.50 | 1.50 | 2.50 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | |
| Sample Date | 27/10/2020 | 27/10/2020 | 27/10/2020 | 27/10/2020 | 28/10/2020 | 28/10/2020 | 28/10/2020 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 (HS_1D_AL) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 (HS_1D_AL) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 (HS_1D_AL) | <0.1 SV | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 (EH_1D_AL) # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 (EH_1D_AL) # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 (EH_1D_AL) # | <7 | <7 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 (EH_1D_AL) # | 23 | <7 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C35-C40 (EH_1D_AL) | <7 | <7 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-40 (EH+HS_1D_AL) | <26 | <26 | <26 | <26 | <26 | <26 | <26 | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| >C6-C10 (HS_1D_AL) | <0.1 SV | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C25 (EH_1D_AL) | <10 | <10 | <10 | <10 | <10 | <10 | <10 | | | | <10 | mg/kg | TM5/PM8/PM16 |
| >C25-C35 (EH_1D_AL) | 19 | <10 | <10 | <10 | <10 | <10 | <10 | | | | <10 | mg/kg | TM5/PM8/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 (HS_1D_AR) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 (HS_1D_AR) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 (HS_1D_AR) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 (EH_1D_AR) # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 (EH_1D_AR) # | 6 | <4 | <4 | <4 | <4 | <4 | <4 | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 (EH_1D_AR) # | 57 | <7 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 (EH_1D_AR) # | 287 | 61 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC35-EC40 (EH_1D_AR) | 45 | 12 | <7 | <7 | <7 | <7 | <7 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-40 (EH+HS_1D_AR) | 395 | 73 | <26 | <26 | <26 | <26 | <26 | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-40) (EH+HS_CU_1D_Total) | 395 | 73 | <52 | <52 | <52 | <52 | <52 | | | | <52 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| >EC6-EC10 (HS_1D_AR) # | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC25 (EH_1D_AR) | 140 | 16 | <10 | <10 | <10 | <10 | <10 | | | | <10 | mg/kg | TM5/PM8/PM16 |
| >EC25-EC35 (EH_1D_AR) | 212 | 50 | <10 | <10 | <10 | <10 | <10 | | | | <10 | mg/kg | TM5/PM8/PM16 |
| MTBE # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 SV | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM36/PM12 |
| PCB 28 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 52 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 101 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 118 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 138 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 153 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| PCB 180 # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | | | | <5 | ug/kg | TM17/PM8 |
| Total 7 PCBs # | <35 | <35 | <35 | <35 | <35 | <35 | <35 | | | | <35 | ug/kg | TM17/PM8 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** Ground Investigations Ireland
**Reference:** 9754-07-20
**Location:** BusConnects Route 12
**Contact:** John Duggan
**EMT Job No:** 20/15139

**Report : Solid**

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

| EMT Sample No. | 1-3 | 4-6 | 7-9 | 10-12 | 13-15 | 16-18 | 19-21 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample ID** | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP03 | R12-CP03 | R12-CP03 | | | | | | |
| **Depth** | 0.50 | 1.50 | 2.50 | 3.50 | 0.50 | 1.50 | 2.50 | | | | | | |
| **COC No / misc** | | | | | | | | | | | | | |
| **Containers** | V J T | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | |
| **Sample Date** | 27/10/2020 | 27/10/2020 | 27/10/2020 | 27/10/2020 | 28/10/2020 | 28/10/2020 | 28/10/2020 | | | | | | |
| **Sample Type** | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| **Batch Number** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| **Date of Receipt** | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | | | | | | |
| Natural Moisture Content | 21.7 | 11.7 | 9.5 | 13.0 | 12.2 | 10.8 | 11.9 | | | | <0.1 | % | PM4/PM0 |
| Moisture Content (% Wet Weight) | 17.9 | 10.4 | 8.7 | 11.5 | 10.9 | 9.8 | 10.6 | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | | | | <0.3 | mg/kg | TM38/PM20 |
| Chromium III | 43.5 | 76.0 | 52.5 | 45.8 | 44.0 | 44.3 | 45.7 | | | | <0.5 | mg/kg | NONE/NONE |
| Total Cyanide # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | 1.39 | 0.63 | 0.21 | 0.20 | 0.33 | 0.44 | 0.34 | | | | <0.02 | % | TM21/PM24 |
| Loss on Ignition # | 3.6 | 1.7 | 1.8 | 1.6 | 1.7 | 2.3 | 1.7 | | | | <1.0 | % | TM22/PM0 |
| pH # | 8.35 | 8.73 | 8.79 | 8.75 | 8.76 | 8.75 | 8.81 | | | | <0.01 | pH units | TM73/PM11 |
| Mass of raw test portion | 0.1091 | 0.1037 | 0.0981 | 0.1041 | 0.1051 | 0.1005 | 0.0995 | | | | | kg | NONE/PM17 |
| Mass of dried test portion | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | kg | NONE/PM17 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** Ground Investigations Ireland
**Reference:** 9754-07-20
**Location:** BusConnects Route 12
**Contact:** John Duggan
**EMT Job No:** 20/15139

**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 | 10-12 | 13-15 | 16-18 | 19-21 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP02 | R12-CP03 | R12-CP03 | R12-CP03 | | | | | | |
| Depth | 0.50 | 1.50 | 2.50 | 3.50 | 0.50 | 1.50 | 2.50 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | |
| Sample Date | 27/10/2020 | 27/10/2020 | 27/10/2020 | 27/10/2020 | 28/10/2020 | 28/10/2020 | 28/10/2020 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | 02/11/2020 | | | | | | |
| Dissolved Antimony # | 0.004 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Antimony (A10) # | 0.04 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Arsenic # | <0.0025 | 0.0085 | 0.0046 | <0.0025 | 0.0055 | <0.0025 | <0.0025 | | | | <0.0025 | mg/l | TM30/PM17 |
| Dissolved Arsenic (A10) # | <0.025 | 0.085 | 0.046 | <0.025 | 0.055 | <0.025 | <0.025 | | | | <0.025 | mg/kg | TM30/PM17 |
| Dissolved Barium # | 0.011 | 0.005 | 0.007 | 0.005 | <0.003 | <0.003 | <0.003 | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Barium (A10) # | 0.11 | 0.05 | 0.07 | 0.05 | <0.03 | <0.03 | <0.03 | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Cadmium # | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | | | | <0.0005 | mg/l | TM30/PM17 |
| Dissolved Cadmium (A10) # | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | | | <0.005 | mg/kg | TM30/PM17 |
| Dissolved Chromium # | <0.0015 | <0.0015 | <0.0015 | <0.0015 | <0.0015 | <0.0015 | <0.0015 | | | | <0.0015 | mg/l | TM30/PM17 |
| Dissolved Chromium (A10) # | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | | | | <0.015 | mg/kg | TM30/PM17 |
| Dissolved Copper # | <0.007 | <0.007 | <0.007 | <0.007 | <0.007 | <0.007 | <0.007 | | | | <0.007 | mg/l | TM30/PM17 |
| Dissolved Copper (A10) # | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | | | | <0.07 | mg/kg | TM30/PM17 |
| Dissolved Lead # | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | | | | <0.005 | mg/l | TM30/PM17 |
| Dissolved Lead (A10) # | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | <0.05 | mg/kg | TM30/PM17 |
| Dissolved Molybdenum # | 0.005 | 0.008 | 0.005 | 0.008 | 0.006 | 0.005 | 0.009 | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Molybdenum (A10) # | 0.05 | 0.08 | 0.05 | 0.08 | 0.06 | 0.05 | 0.09 | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Nickel # | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | | | | <0.002 | mg/l | TM30/PM17 |
| Dissolved Nickel (A10) # | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | | <0.02 | mg/kg | TM30/PM17 |
| Dissolved Selenium # | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Selenium (A10) # | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | | | | <0.03 | mg/kg | TM30/PM17 |
| Dissolved Zinc # | 0.007 | 0.006 | 0.008 | 0.004 | 0.005 | 0.003 | 0.003 | | | | <0.003 | mg/l | TM30/PM17 |
| Dissolved Zinc (A10) # | 0.07 | 0.06 | 0.08 | 0.04 | 0.05 | <0.03 | <0.03 | | | | <0.03 | mg/kg | TM30/PM17 |
| Mercury Dissolved by CVAF # | 0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | | | | <0.00001 | mg/l | TM61/PM0 |
| Mercury Dissolved by CVAF # | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | | | | <0.0001 | mg/kg | TM61/PM0 |
| Total Phenols HPLC | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | <0.05 | mg/l | TM26/PM0 |
| Total Phenols HPLC | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | <0.5 | mg/kg | TM26/PM0 |
| Fluoride | <0.3 | <0.3 | <0.3 | 0.3 | <0.3 | <0.3 | <0.3 | | | | <0.3 | mg/l | TM173/PM0 |
| Fluoride | <3 | <3 | <3 | 3 | <3 | <3 | <3 | | | | <3 | mg/kg | TM173/PM0 |
| Sulphate as SO4 # | 0.7 | 2.3 | 1.7 | 1.4 | <0.5 | <0.5 | 1.3 | | | | <0.5 | mg/l | TM38/PM0 |
| Sulphate as SO4 # | 7 | 23 | 17 | 14 | <5 | <5 | 13 | | | | <5 | mg/kg | TM38/PM0 |
| Chloride # | <0.3 | 0.4 | <0.3 | <0.3 | <0.3 | <0.3 | 0.6 | | | | <0.3 | mg/l | TM38/PM0 |
| Chloride # | <3 | 4 | <3 | <3 | <3 | <3 | 6 | | | | <3 | mg/kg | TM38/PM0 |
| Dissolved Organic Carbon | 5 | 5 | 7 | 3 | 3 | 4 | 2 | | | | <2 | mg/l | TM60/PM0 |
| Dissolved Organic Carbon | 50 | 50 | 70 | 30 | 30 | 40 | <20 | | | | <20 | mg/kg | TM60/PM0 |
| Total Dissolved Solids # | 75 | 54 | 46 | 56 | 69 | 52 | 45 | | | | <35 | mg/l | TM20/PM0 |
| Total Dissolved Solids # | 750 | 540 | 460 | 560 | 690 | 520 | 450 | | | | <350 | mg/kg | TM20/PM0 |

Please see attached notes for all abbreviations and acronyms

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.1091 | Dry Matter Content Ratio (%) = | 82.1 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.88 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **3** | | | |
| **Client Sample No** | **R12-CP02** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **0.50** | | | |
| **Sample Date** | **27/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 1.39 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | 61.33 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | <0.025 | 0.5 | 2 | 25 |
| Barium | 0.11 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.05 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | 0.04 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | 0.07 | 4 | 50 | 200 |
| Chloride | <3 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | 7 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 750 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 50 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.1037 | Dry Matter Content Ratio (%) = | 87.0 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.887 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **6** | | | |
| **Client Sample No** | **R12-CP02** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **1.50** | | | |
| **Sample Date** | **27/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.63 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | 11.94 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | 0.085 | 0.5 | 2 | 25 |
| Barium | 0.05 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.08 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | 0.06 | 4 | 50 | 200 |
| Chloride | 4 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | 23 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 540 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 50 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.0981 | Dry Matter Content Ratio (%) = | 91.8 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.892 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **9** | | | |
| **Client Sample No** | **R12-CP02** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **2.50** | | | |
| **Sample Date** | **27/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.21 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | <0.64 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | 0.046 | 0.5 | 2 | 25 |
| Barium | 0.07 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.05 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | 0.08 | 4 | 50 | 200 |
| Chloride | <3 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | 17 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 460 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 70 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.1041 | Dry Matter Content Ratio (%) = | 86.2 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.886 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **12** | | | |
| **Client Sample No** | **R12-CP02** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **3.50** | | | |
| **Sample Date** | **27/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.20 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | <0.64 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | <0.025 | 0.5 | 2 | 25 |
| Barium | 0.05 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.08 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | 0.04 | 4 | 50 | 200 |
| Chloride | <3 | 800 | 15000 | 25000 |
| Fluoride | 3 | 10 | 150 | 500 |
| Sulphate as SO4 | 14 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 560 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 30 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.1051 | Dry Matter Content Ratio (%) = | 85.5 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.885 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **15** | | | |
| **Client Sample No** | **R12-CP03** | | | |
| **Depth/Other** | **0.50** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Sample Date** | **28/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.33 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | <0.64 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | 0.055 | 0.5 | 2 | 25 |
| Barium | <0.03 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.06 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | 0.05 | 4 | 50 | 200 |
| Chloride | <3 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | <5 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 690 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 30 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.1005 | Dry Matter Content Ratio (%) = | 89.6 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.889 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **18** | | | |
| **Client Sample No** | **R12-CP03** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **1.50** | | | |
| **Sample Date** | **28/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.44 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | <0.64 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | <0.025 | 0.5 | 2 | 25 |
| Barium | <0.03 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.05 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | <0.03 | 4 | 50 | 200 |
| Chloride | <3 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | <5 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 520 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | 40 | 500 | 800 | 1000 |

| | | | |
|---|---|---|---|
| Mass of sample taken (kg) | 0.0995 | Dry Matter Content Ratio (%) = | 90.0 |
| Mass of dry sample (kg) = | 0.09 | Leachant Volume (l) | 0.89 |
| Particle Size <4mm = | >95% | | |

| **EMT Job No** | **20/15139** | **Landfill Waste Acceptance Criteria Limits** | | |
|---|---|---|---|---|
| **Sample No** | **21** | | | |
| **Client Sample No** | **R12-CP03** | **Inert** | **Stable Non-reactive** | **Hazardous** |
| **Depth/Other** | **2.50** | | | |
| **Sample Date** | **28/10/2020** | | | |
| **Batch No** | **1** | | | |
| **Solid Waste Analysis** | | | | |
| Total Organic Carbon (%) | 0.34 | 3 | 5 | 6 |
| Sum of BTEX (mg/kg) | <0.025 | 6 | - | - |
| Sum of 7 PCBs (mg/kg) | <0.035 | 1 | - | - |
| Mineral Oil (mg/kg) | <30 | 500 | - | - |
| PAH Sum of 6 (mg/kg) | - | - | - | - |
| PAH Sum of 17 (mg/kg) | 0.71 | 100 | - | - |
| | | | | |
| | | | | |
| | | | | |

| **Eluate Analysis** | **10:1 concn leached** | **Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg** | | |
|---|---|---|---|---|
| | **A10** | | | |
| | **mg/kg** | **mg/kg** | | |
| Arsenic | <0.025 | 0.5 | 2 | 25 |
| Barium | <0.03 | 20 | 100 | 300 |
| Cadmium | <0.005 | 0.04 | 1 | 5 |
| Chromium | <0.015 | 0.5 | 10 | 70 |
| Copper | <0.07 | 2 | 50 | 100 |
| Mercury | <0.0001 | 0.01 | 0.2 | 2 |
| Molybdenum | 0.09 | 0.5 | 10 | 30 |
| Nickel | <0.02 | 0.4 | 10 | 40 |
| Lead | <0.05 | 0.5 | 10 | 50 |
| Antimony | <0.02 | 0.06 | 0.7 | 5 |
| Selenium | <0.03 | 0.1 | 0.5 | 7 |
| Zinc | <0.03 | 4 | 50 | 200 |
| Chloride | 6 | 800 | 15000 | 25000 |
| Fluoride | <3 | 10 | 150 | 500 |
| Sulphate as SO4 | 13 | 1000 | 20000 | 50000 |
| Total Dissolved Solids | 450 | 4000 | 60000 | 100000 |
| Phenol | - | 1 | - | - |
| Dissolved Organic Carbon | <20 | 500 | 800 | 1000 |

**Client Name:** Ground Investigations Ireland
**Reference:** 20/07/9754
**Location:** BusConnects Route 12
**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 |
|---|---|---|---|---|---|---|---|
| 20/15139 | 1 | R12-CP02 | 0.50 | 2 | 12/11/2020 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP02 | 1.50 | 5 | 12/11/2020 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP02 | 2.50 | 8 | 12/11/2020 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP02 | 3.50 | 11 | 12/11/2020 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP03 | 0.50 | 14 | 12/11/2020 | **General Description (Bulk Analysis)** | soil.stones |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP03 | 1.50 | 17 | 12/11/2020 | **General Description (Bulk Analysis)** | soil.stones |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |
| | | | | | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |
| 20/15139 | 1 | R12-CP03 | 2.50 | 20 | 12/11/2020 | **General Description (Bulk Analysis)** | soil.stones |
| | | | | | 12/11/2020 | **Asbestos Fibres** | NAD |
| | | | | | 12/11/2020 | **Asbestos ACM** | NAD |

**Client Name:** Ground Investigations Ireland
**Reference:** 20/07/9754
**Location:** BusConnects Route 12
**Contact:** John Duggan

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 20/15139 | 1 | R12-CP03 | 2.50 | 20 | 12/11/2020 | **Asbestos Type** | NAD |
| | | | | | 12/11/2020 | **Asbestos Level Screen** | NAD |

**Client Name:** Ground Investigations Ireland
**Reference:** 9754-07-20
**Location:** BusConnects Route 12
**Contact:** John Duggan

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 20/15139 | | | | | | |

**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.:*** 20/15139

**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 overesitimate 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.

**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 |

**EMT Job No:** 20/15139

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | 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:** 20/15139

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | 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 |
| 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 (comparabl | 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 (comparabl | 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:** 20/15139

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | 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. | | | | |
| 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 | |
| | | | | | | | |
| | | | | | | | |

# **APPENDIX 4** – Groundwater Monitoring

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
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Co. Dublin.
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# GROUNDWATER MONITORING

## Bus Connects Stage 1 Lot 1 - Route 12

| BOREHOLE | DATE | TIME | GROUNDWATER (m BGL ) | Comments |
|---|---|---|---|---|
| | | | | |
| **R12-CP02** | 31/03/2021 | 16:50 | 2.13 | |
| **R12-CP03** | 31/03/2021 | 17:00 | 3.15 | |
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