Appendix E
Ground Investigation Report

National Transport Authority

Templeogue/ Rathfarnham to City Centre Core Bus Corridor Scheme

Ground Investigation Report

268401-00

Issue | 06 January 2023

Job number 268401-00

Ove Arup & Partners Ireland Ltd

Arup
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland
www.arup.com

ARUP

Contents

Appendices

Appendix A

GI Layout Plan and GSI Maps

Appendix B

In-Situ Testing Figures

Appendix C

Laboratory Testing Figures

Appendix D

Factual Ground Investigation Report

Appendix E

Historical Ground Investigation Data

Appendix F

Geotechnical Risk Register

1 Introduction

1.1 Project Overview

The BusConnects Dublin - Core Bus Corridors Infrastructure Works (herein after called the 'CBC Infrastructure Works') involves the development of continuous bus priority infrastructure and improved pedestrian and cycling facilities on sixteen radial core corridors in the Greater Dublin Area (GDA), across the local authority jurisdictions of Dublin City Council (DCC), South Dublin County Council (SDCC), Dún Laoghaire-Rathdown County Council (DLRCC), Fingal County Council (FCC), and Wicklow County Council (WCC). Overall, the CBC Infrastructure Works encompass the delivery of approximately 230km of dedicated bus lanes and 200km of cycle tracks along 16 of the busiest corridors in Dublin.

1.2 The Proposed Scheme – Templeogue/ Rathfarnham to City Centre Core Bus Corridor

The Templeogue / Rathfarnham to City Centre Core Bus Corridor Scheme (hereinafter called 'the Proposed Scheme') consists of two sections, namely:

- The Templeogue to Terenure section; and
- The Rathfarnham to City Centre section.

The Templeogue to Terenure section of the Proposed Scheme commences on the R137 Tallaght Road, east of the M50 junction 11 interchange. From here, the Proposed Scheme is routed, via the R137, along Tallaght Road and Templeogue Road, through Templeogue Village, to Terenure Cross, where it joins the Rathfarnham to City Centre section of the Proposed Scheme.

The Rathfarnham to City Centre section of the Proposed Scheme commences on the R821 Grange Road at the junction with Nutgrove Avenue. It is routed along the R821 Grange Road, the R115 Rathfarnham Road, the R114 Rathfarnham Road, Terenure Road East, Rathgar Road, Rathmines Road Lower, Richmond Street South, Camden Street Upper and Lower and Wexford Street as far as the junction with the R110 at Kevin Street Lower and Cuffe Street where priority bus lanes end. From Cuffe Street to Dame Street along Redmond's Hill, Aungier Street, and South Great George's Street, the route includes a traffic lane and a cycle track in both directions and it joins the prevailing traffic management regime in the city centre.

The proposed scheme does not include the construction of any new structures, but consists only of widening and upgrade of the existing road infrastructure.

Figure 1 shows the layout of the Proposed Scheme.

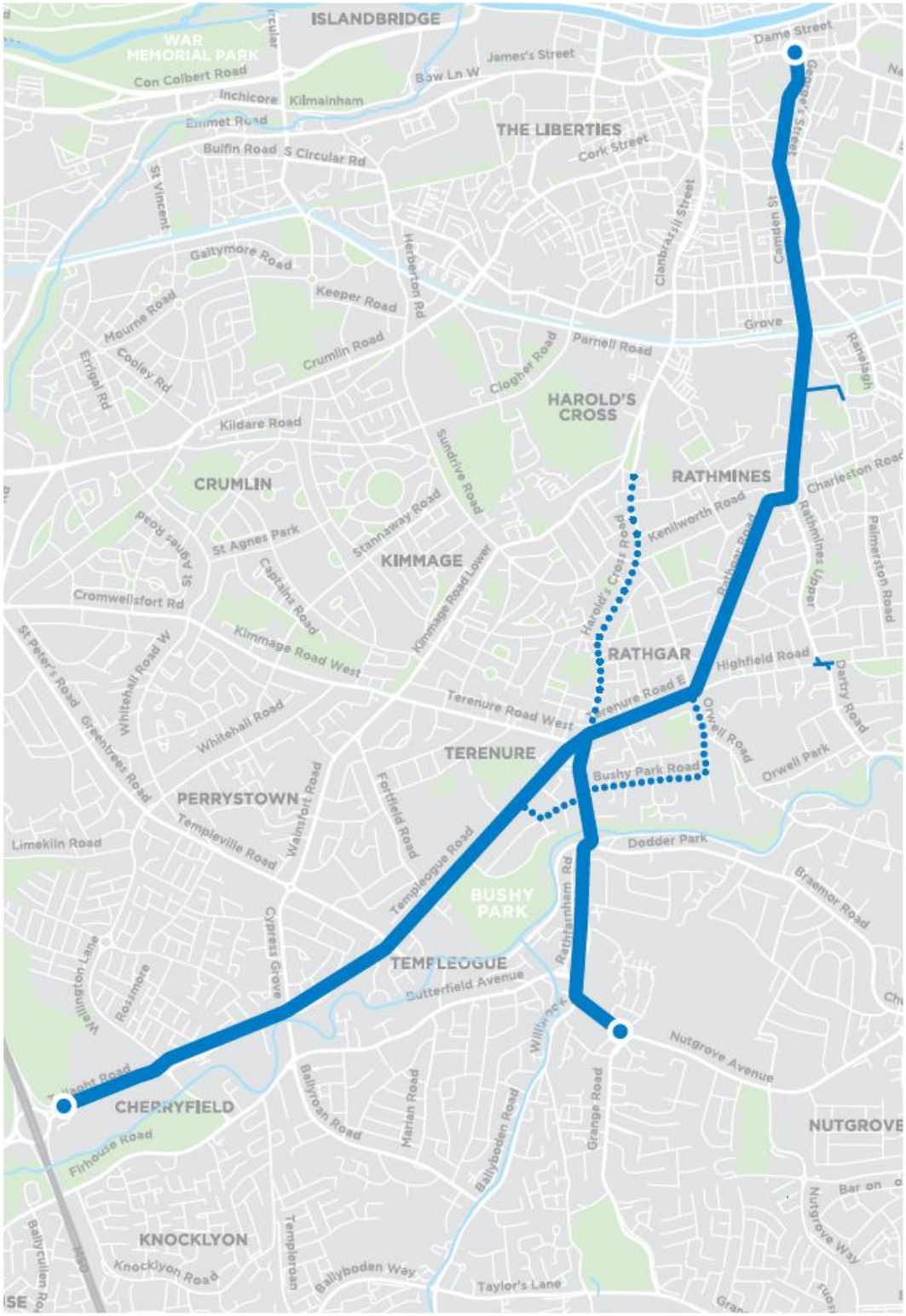


Figure 1: Templeogue/Rathfarnham to City Centre CBC Scheme

(Ordnance Survey Ireland Licence No EN0082121, © Ordnance Survey Ireland Government of Ireland)

1.3 Scope and Objective of the Report

This Ground Investigation Report (GIR) has been prepared in accordance with IS EN 1997-1:2005 'Eurocode 7: Geotechnical Design – Part 1: General Rules' and IS EN 1997-2: 2007 'Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and testing'. This GIR contains information for Templeogue/ Rathfarnham to City Centre Core Bus Corridor (the Proposed Scheme).

The purpose of the GIR is to:

- Present a review of desk study information and existing ground investigation data relevant to the project.
- Present the interpreted ground conditions and material properties for the main geological units encountered across the scheme.

This GIR has been prepared for preliminary design and is not intended to be used for detailed design.

1.4 Geotechnical Category of the Project

The project has been identified as a Geotechnical Category 2 scheme in accordance with IS EN 1997-1:2004. Geotechnical Category 2 is defined as a project which includes "conventional types of geotechnical structures, earthworks and activities, with no exceptional geotechnical risks, unusual or difficult ground conditions or loading conditions".

1.5 Study Area

The Proposed Scheme comprises of four sections:

- Section 1: Tallaght Road, Templeogue Road to Rathfarnham Road
- Section 2: Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road
- Section 3: Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road
- Section 4: Charleville Road to Dame Street

1.6 Symbols and Abbreviations

The following symbols and abbreviations are used to define the ground properties:

NMC – Natural moisture content, as encountered on-site in the soil, in %

MC – Moisture content, in %

LL – Liquid Limit, in %

PL – Plastic Limit, in %

I_p - the soils plasticity index in %

c_u – undrained shear strength, in kPa

f' – effective angle of shearing resistance, in degrees

f'_p – peak effective angle of shearing resistance, in degrees

f'_{cv} is the soils constant volume angle of shearing resistance, in degrees

f'_{dil} is the contribution to φ'_{pk} from soil dilatancy, in ° (degrees)

c' – drained cohesion, in kPa

γ –unit weight density, in kN/m^3

γ' –submerged unit weight density, in kN/m^3

γ_{sat} –submerged unit weight density, in kN/m^3

γ_b –bulk unit weight density, in kN/m^3

m_v – Coefficient of volume compressibility, in m^2/MN

E – Young modulus, Elastic modulus, in MPa

E_{uv} – Undrained elastic modulus, in MPa

E'_v – Drained Young modulus, in MPa

M – Constrained modulus, in MPa

u – Poisson's ratio, unitless

SPT – Standard Penetration Test, results expressed using "N"

N – uncorrected SPT readings, in blows/300mm.

CBR – California Bearing Ratio, results expressed in %

DCP – Dynamic Cone Penetrometer

DPH – Dynamic Probe Heavy, results expressed using "N_{100}"

DPSH – Dynamic Probe Super-Heavy, results expressed using "N_{100}"

N_{100} - in blows/100mm.

2 Existing Information

2.1 Sources of Information

Geotechnical information for the site was interpreted from publicly available information and from project-specific ground investigation data.

The publicly available sources of information reviewed are:

- Geological Survey of Ireland (GSI) (*www.gsi.ie)*:
  - Bedrock map
  - Quaternary Sediments
  - Quaternary Geomorphology
  - GeoUrban Unconsolidated Sediments
  - GeoUrban Depth to Bedrock
  - Groundwater Aquifer
  - Groundwater Recharge Map
  - Groundwater Well Database
  - Groundwater Vulnerability
  - Subsoil Permeability Map
  - Karst Landforms Database
  - Mineral Locations Map
  - Quarry Locations Map
  - Historical Geotechnical Boreholes.
- Environmental Protection Agency (EPA) Map Viewer (https://gis.epa.ie/EPAMaps/):
  - Soils (National)
  - Subsoils (National)
  - River Waterbodies
- Aerial images and mapping:
  - Ordnance Survey of Ireland (http://map.geohive.ie/mapviewer.html) mapping
  - Bing maps (www.bing.com/maps) aerial photography and mapping (licensed)
  - Google maps (www.google.com/maps) aerial photography online mapping
  - Rivers of Dublin (C.L. Sweeney, 1991)

2.2 Topography

2.2.1 Section 1 - Tallaght Road to Rathfarnham Road

This section of the Proposed Scheme will begin at Tallaght Road, east of the M50 interchange.

According to the OSI 10m contours, the elevation at this point is between 70mOD and 80mOD and gradually falls to between 40mOD and 50mOD at the Rathfarnham Road. The Proposed Scheme will run roughly parallel to the River Dodder.

2.2.2 Section 2 - Nutgrove Avenue to Terenure Road North

This section of the Proposed Scheme will lie at approximately 50mOD at Nutgrove Avenue before gradually falling towards Terenure Road North at approximately 40mOD. The Proposed Scheme will cross the River Dodder in Rathfarnham.

2.2.3 Section 3 - Terenure Road North to Charleville Road

This section of the Proposed Scheme will gradually fall from approximately 40mOD at Terenure Road North to between 20mOD and 30mOD at Charleville Road.

2.2.4 Section 4 - Charleville Road to Dame Street

The Proposed Scheme is between 20mOD and 30mOD along Charleville Road and gradually falls to between 0mOD and 10mOD at Dame Street. The Proposed Scheme will cross the Grand Canal at the junction of Rathmines Road Lower and Richmond Street South.

2.3 Geological Maps and Memoirs

2.3.1 Quaternary Sediments

2.3.1.1 Section 1 - Tallaght Road to Rathfarnham Road

The GSI Quaternary Geomorphology map shows a deposit of hummocky sand and gravel associated with the Greenhills Esker identified where the proposed scheme crosses the M50 interchange and glacial meltwater channels associated with the River Dodder.

The GSI Quaternary Subsoil map shows predominately glacial tills derived from limestone. Both fine and coarse-grained alluvial deposits surround the River Dodder and gravels derived from limestones are located where the proposed scheme crosses the M50 interchange. Bedrock outcrops are identified along Springfield Avenue at Springfield Park and along the banks of the River Dodder.

2.3.1.2 Section 2 - Nutgrove Avenue to Terenure Road North

The GSI Quaternary Geomorphology map shows hummocky sand and gravel along Nutgrove Avenue as far as Willbrook Road. It also shows a glacial meltwater channel surrounding the River Dodder and Owendoher River.

The GSI Quaternary Subsoil map shows predominately glacial tills derived from limestone. Localised pockets of gravels derived from limestones, alluvium and alluvium gravelly deposits are also identified. Both fine and coarse-grained alluvial deposits are associated with the River Dodder along Springfield Avenue, Rathfarnham Castle. Gravels derived from limestones are located along Nutgrove Avenue and Grange Road.

2.3.1.3 Section 3 - Terenure Road North to Charleville Road

The GSI Quaternary Geomorphology map does not show notable geomorphology within this section of the study area.

The GSI Quaternary Subsoil map shows predominately glacial tills derived from limestone. Localised pockets of bedrock outcrop are also noted around Rathgar Park.

2.3.1.4 Section 4 - Charleville Road to Dame Street

The GSI Quaternary Geomorphology map shows hummocky sand and gravel deposits are identified along King Street South and at Saint Patricks Close.

The GSI Quaternary Subsoil map shows predominately glacial tills derived from limestone and made ground (urban) deposits. Localised pockets of alluvial deposits and gravels derived from limestones are also identified within the study area. Made ground (urban) deposits are identified from Rathmines Road Lower to Richmond Street South and from Camden Row to Dame Street. Alluvial deposits are identified at Saint Patrick's Close, Eustace Street and Anglesea Street. Gravels derived from limestones are identified at Saint Patrick's close and King Street South.

2.3.2 Solid Geology

The GSI Bedrock Geology 100k map states that the rock type along the examined routes is limestone of Lucan Formation (locally known as Calp Limestone).

No major structural bedrock features were identified within the study area.

There are no karst features are identified in the GSI karst database near the Proposed Scheme.

2.4 Historical Maps and Aerial Photos

2.4.1 Reference

Historical maps of the site and surrounding area available from the Ordnance Survey of Ireland (OSI). They have been reviewed to provide historical information for the project. The maps can be viewed online with Ordnance Survey Ireland's map viewer (http://map.geohive.ie/mapviewer.html). The following maps have been studied:

- Ordnance Survey of Ireland (OSI) 6 inch mapping series, 1:5000, 1837-1842.
- Ordnance Survey of Ireland (OSI) 25 inch mapping series, 1:5000, 1888-1913.
- Ordnance Survey of Ireland (OSI) 6 inch Cassini mapping series, 1:5000, 1830-1930.
- Ordnance Survey of Ireland (OSI) 1995 aerial photography
- Ordnance Survey of Ireland (OSI) 2000 aerial photography

- Ordnance Survey of Ireland (OSI) 2005 aerial photography

2.4.2 Section 1 - Tallaght Road to Rathfarnham Road

The historic mapping indicates that the land in this section was primarily used for agricultural, industrial and residential areas, and parkland.

Based on the OSI 6-inch mapping (between 1837 and 1842), the area within this section of the study area was predominantly agricultural land with some local industrial activities present. A mill race intersected the Proposed Scheme near the junction of Templeogue Road and Wellington Lane and a flour mill was present at Hill Crest.

The OSI 25-inch mapping (between 1888 and 1913) shows the predominant land use within this section of the study area was agricultural. The Dublin and Blessington steam tramway ran in the vicinity of to the proposed scheme with a tram depot located in the vicinity of to the Proposed Scheme at Templeogue Tennis Club. The 25-inch maps also show an old quarry in the vicinity of in the vicinity of to the proposed scheme (approximately 200m away) near the intersection of Templeogue Road and Wellington Lane.

The aerial photography (Geohive) for this section of the study area shows a number of residential developments were constructed between 1995 and 2005.

2.4.3 Section 2 - Nutgrove Avenue to Terenure Road North

The historic mapping indicates that the land along the Proposed Scheme was predominantly mixed use agricultural, industrial and residential.

Based on the OSI 6-inch mapping (between 1837 and 1842), an old mill was located in the vicinity of Nutgrove Avenue (approximately 100m away). An old pond and creek, and possibly a mill race, intersected the Proposed Scheme at Butterfield Avenue and Rathfarnham Road. An old mill pond was located in the vicinity of Springfield Avenue and an old cloth factory was located at the intersection of the Rathfarnham Road and Springfield Avenue.

The OSI 25-inch mapping (between 1888 and 1913) shows further residential developments within this section of the study area.

The aerial photography (Geohive) for this section of the study area shows a number of residential developments were constructed between 1995 and 2005.

2.4.4 Section 3 - Terenure Road North to Charleville Road

The historic mapping indicates that the land along the Proposed Scheme was predominantly mixed use industrial and residential.

The OSI 6-inch mapping (between 1837 and 1842) shows an old quarry was located in the vicinity of to this section of the study area at Rathgar Park (approximately 150m away).

The OSI 25-inch mapping (between 1888 and 1913) shows further residential developments within this section of the study area. An old tram depot was located at the junction of Terenure Road North and Terenure Road East. The quarry at Brighton Green was developed into an engineering works building and the quarry at Rathgar Park developed further.

The aerial photography (Geohive) for this section of the study area shows a number of residential developments were constructed between 1995 and 2005.

2.4.5 Section 4 - Charleville Road to Dame Street

The historical mapping indicates that the land along the Proposed Scheme was predominantly residential land and green areas.

The OSI 6-inch mapping (between 1837 and 1842) shows this section of the study area was mainly residential and green areas. The OSI 25-inch mapping (between 1888 and 1913) shows a tramway from Charleville Road to Dame Street.

The aerial photography (Geohive) for this section of the study area shows a number of residential developments were constructed between 1995 and 2005 and tramway was replaced with existing road.

2.5 Records of Mines and Mineral Deposits

2.5.1 Active mines and mineral localities

The GSI Bedrock Active and Historic Pits and Quarries database states that there are no active pits, mines or quarries located near the Proposed Scheme.

The GSI Mineral Localities database states that there are two mineral localities within the study area: a limestone mineral locality associated with a limestone quarry which was active in the 1830’s in Rathgar (approximately 200m away) and a metallic mineral locality in the vicinity of Rathfarnham village along the River Dodder (approximately 450m away).

2.5.2 Aggregate potential

2.5.2.1 Section 1 - Tallaght Road to Rathfarnham Road

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area is generally low.

Areas of moderate to very high crushed rock aggregate potential are identified around Templeogue, Hyde Park and Springfield Road and are generally associated with the River Dodder.

The GSI aggregate potential mapping shows the granular aggregate potential ranges from very low to very high along the banks of the River Dodder.

2.5.2.2 Section 2 - Nutgrove Avenue to Terenure Road North

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area is generally low. Areas of moderate to high crushed rock aggregate potential are identified in Rathfarnham Village and is generally associated with the River Dodder.

The GSI aggregate potential mapping shows the granular aggregate potential ranges from very low to high along the banks of the River Dodder and Owendoher River.

2.5.2.3 Section 3 - Terenure Road North to Charleville Road

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area ranges from low to very high. Terenure Village generally has low crushed rock aggregate potential and it increases from moderate to very high crushed rock aggregate along Terenure Road north to Brighton Square and reduces to moderate crushed rock potential approaching Harold's Cross. The crushed rock aggregate potential from Terenure Road east to Orwell Road ranges from moderate to very high. The crushed rock aggregate potential is moderate along Rathgar Road as far as Charleville Road.

The GSI aggregate potential mapping shows no granular aggregate potential was identified along this section of the Proposed Scheme.

2.5.2.4 Section 4 - Charleville Road to Dame Street

The GSI aggregate potential mapping shows that the crushed rock aggregate potential is generally moderate. A localised pocket of high to very high crushed rock aggregate potential is identified in the vicinity of to South Great Georges Street.

The GSI aggregate potential mapping shows the granular aggregate potential is very low to moderate in the vicinity of to South Great Georges Street.

2.6 Land Use Information

2.6.1 Section 1 - Tallaght Road to Rathfarnham Road

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric with pockets of green urban areas within Dodder Valley Park, Tymon Park and Bushy Park.

Dodder Valley Park and Tymon Park are located between the M50 interchange and the R137 as far as Hillcrest. Bushy Park is located along the R137 between Bushy Park House and Olney Grove.

2.6.2 Section 2 - Nutgrove Avenue to Terenure Road North

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric with pockets of green urban areas and sport and leisure facilities.

Green urban areas are associated with Bushy Park which is located in the vicinity of the Dodder Park Road. The sport and leisure facility identified is the Castle Golf Course located in the vicinity of to Nutgrove Avenue.

2.6.3 Section 3 - Terenure Road North to Charleville Road

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric along the section.

2.6.3.1 Section 4 - Charleville Road to Dame Street

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric south of the Grand Canal and as continuous urban fabric north of the Grand Canal.

2.7 Archaeological and Historical Sites

The National Inventory of Architectural Heritage (NIAH) database states that there are:

- 5 No. NIAH sites within 30m of the proposed scheme (Section 1)
- 18 No. NIAH sites within 30m of the proposed scheme (Section 2 to Section 4)

The National Monuments (DAHG) database states that there are:

- 6 No. DAHG sites within 30m of the proposed scheme (Section 1), all of which are located at the Templeogue Cemetery
- 8 No. DAHG sites within 30m of the proposed scheme (Section 2 to Section 4).

2.8 Hydrology and Hydrogeology

2.8.1 Aquifers

The GSI Groundwater Aquifer map indicates the Proposed Scheme overlies a locally important aquifer described as bedrock which is moderately productive only in local zones.

The GSI Gravel Aquifer map shows there are no gravel aquifers within the study area.

2.8.2 Groundwater vulnerability

2.8.2.1 Section 1 - Tallaght Road to Rathfarnham Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability potential along this section of the study area is generally low.

Areas of moderate to extreme vulnerability (rock at or close to the surface) were identified around Templeogue, Hyde Park and Springfield Road and are generally associated with the River Dodder.

2.8.2.2 Section 2 - Nutgrove Avenue to Terenure Road North

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area is generally low. Areas of moderate to extreme groundwater vulnerability were identified in Rathfarnham Village and are generally associated with the River Dodder and Owendoher River.

2.8.2.3 Section 3 - Terenure Road North to Charleville Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from low to extreme rock at or near the surface. Terenure village is generally low groundwater vulnerability and it increases from moderate to extreme rock at or near the surface groundwater vulnerability along Terenure Road north to Brighton square and again from Terenure Road east to Rathgar Road. The higher groundwater vulnerability is associated with historic quarries within the study area.

2.8.2.4 Section 4 - Charleville Road to Dame Street

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study is generally moderate. Localised pockets of high to extreme groundwater vulnerability are identified in the vicinity of to the Proposed Scheme at South Great Georges Street and the Bank of Ireland at Westmoreland Street.

2.9 Contaminated Land

There are no licensed facilities within the study area that are either currently licensed or previously licensed with the EPA for waste, industrial emissions and integrated pollution control.

A ground investigation was carried out from October 2020 to November 2021 by GII Ltd. (Report reference - Project No:9754-07-20 R12, Final, 01.April.2021). Geo-environmental testing was undertaken on seven samples, in natural ground and made ground, from two ground investigation locations.

These results suggest an ‘Inert’ Waste Acceptance Criteria (WAC) classification. No signs of contamination were noted on ground investigation logs.

In the historical ground investigation data, contamination was not described and WAC classification was not carried out.

However, contaminated land is possible in made ground in the urban environment. The ground investigations do not cover the whole alignment and contamination may be present. Potential sources are listed below and presented in Appendix A.

Section 1 - Tallaght Road to Rathfarnham Road

- Paper Mill
- Dennings Crash repairs
- Spawell Service Station
- Mill Race
- Spawell Carpark
- Ford Site
- Flour Mill
- Dublin & Blessington Steam Tramway
- Maxol Service Station
- Tramway Depot
- Old Quarry
- Mitsubishi
- Terenure Place Carpark
- Railway Tram
- Farmland and parklands

Section 2, 3 and 4 - Nutgrove Avenue to Dame Street

- Old Mill
- Big Br. Ely Cloth Factory
- Quarry
- Tramway Depot
- Circle K Grosvenor
- Barnes AutoHouse
- Petrol Station
- Texaco
- Old Engineering Works Building

2.10 Seismicity of the Area

Ireland lies in an area of very low tectonic activity with few seismic events in the last 30 years. From the data collected by the Irish National Seismic Network (INSN) the following number of seismic events have been registered since 1980 in Ireland and nearby areas in the UK:

- 32 No. Negligible ($M_L \leq 1.0$)
- 50 No. Micro ($1.0 < M_L \leq 1.9$)
- 24 No. Minor ($2.0 < M_L \leq 3.9$)
- 2 No. Light ($4.0 < ML \leq 4.9$)
- 1 No. Moderate ($5.0 < M_L \leq 5.9$) – M_L=5.4 in Lleyn Peninsula, Wales, 1984

Where M_L is the Richter magnitude scale of the earthquake.

Based on the information above, the area presents a low risk for seismic events affecting the planned development and there is no further assessment required regarding seismicity of the site.

3 Field and Laboratory Studies

3.1 Historical Ground Investigation

Historical ground investigations were carried out between 1980 to 2003. Some historical ground investigation dates are unknown. The ground investigations available for the site are listed in the table below and shown in Appendix A and boreholes and laboratory test are given in Appendix E.

Table 1: Summary of Historical Ground Investigations

GSI Report ID	Title	Year	Author	Location	Used GI
R3246	M50 Tallaght By-pass	Unknown	Unknown	Tallaght, Dublin 24	One trial pit
R3774	Our Lady's School Residential Development	Unknown	Unknown	Bushy Park	Six cable percussion boreholes
R5464	Proposed Apartment Development	IGSL	2003	3A Rathgar Avenue	One cable percussion borehole

GSI Report ID	Title	Year	Author	Location	Used GI
					2 Moisture Content and Atterberg limits 1 PSD
R1364	Development	1986	IGSL	Butterfield Avenue	Six cable percussion 10 Moisture Content and Atterberg limits
R841	College Of Technology, Kevin St	1982	Unknown	College of Technology, Kevin St	One cable percussion 1 Moisture Content and Atterberg limits
R989	PORTOBELLO BARBOUR	1989	IGSL	17, Portobello Harbour	One cable percussion 2 Moisture Content
R137	Church Lane, Rathfarnham	1995	IGSL	Church Lane, Rathfarnham	Four cable percussion
R2900	Proposed Social & Services Community Centre	1996	IGSL	Aungier Street / Longford Lane,	Three cable percussion
R2227	58 DAME STREET	1993	IGSL	58 Dame Street	One cable percussion
R2371	DUBLIN LIGHT RAIL PROJECT TUNNEL LINK	1999	Wimtec Environmental	SANDYFORD TO BALLYMUN	One cable percussion
R2245	ZOE DEVELOPMENTS	1989	IGSL	PORTOBELLO,	Two cable percussion
R4883	YMCA Development,	2002	IGSL	Aungier St.	Seven cable percussion

GSI Report ID	Title	Year	Author	Location	Used GI
	Aungier St., Dublin				7 Moisture Content and Atterberg limits 4 PSD
R207	At Aungier Street , Dublin	1993	IGSL	Aungier St.	Two cable percussion
R962	The Swan Centre	1980	Irish Soils Laboratories Ltd.	Swan Centre Rathmines.	Four cable percussion and two trial pits
R179	Development	1992	IGSL	Richmond Street, Rathmines.	Three cable percussion
R3059	Proposed Development	1995	IGSL	Kelly's Corner, South Circular Road.	Three cable percussion 2 Moisture Content and Atterberg limits
R367	Camden Court Hotel	1996	Unknown	Camden St. Dublin.	Three cable percussion and two trial pits. 3 Moisture Content and Atterberg limits
R6455	Kevin Street Development	Unknown	Unknown	15a Bishop Street	One cable percussion borehole 2 Moisture Content and Atterberg limits 2 PSD
R167	Dublin Institute of Technology	1984	Unknown	Bishop Street / Peters Row	Nine cable percussion and three trial pits
R2114	Glanmire By-pass bridge	1987	IGSL	Bridge D-5 Glanmire by-pass	One rotary drilling borehole
R204	Brighton Square Housing	1995	Carew and Associates / P.M.S.	Brighton Square, Terenure Dublin	Three cable percussion and two trial pits

GSI Report ID	Title	Year	Author	Location	Used GI
R3040	Site at Harold's Cross Dublin	1999	Site Investigation Limited	Harold's Cross Dublin	Three cable percussion

3.2 Recent Ground Investigation

This section details the recent ground investigation carried out from October 2020 to November in 2020 by GII Ltd. (Report Reference - Project No:9754-07-20 R12, Final, 01.April.2021).

The ground investigation was carried out only near Pearse bridge on the River Dodder in Section 2 of the Proposed Scheme to gather information for a proposed structure which was subsequently removed from the scheme.

Table 2, Table 3, and Table 4 summarise the exploratory holes, in situ testing and laboratory testing for the 2020 ground investigations, respectively. A specific assessment of the results is presented in further sections.

Table 2: Summary of exploratory holes carried out for the recent ground investigation

Exploratory Hole Type	Quantity
Cable Percussive Borehole with Rotary Core follow-on	3 No.
*2 No. standpipes were installed. One groundwater reading was carried out. *1 No. Cable Percussive Borehole refused at a shallow depth and another attempt was made adjacent to the first attempt. This shallow borehole is included in the table above.	

Table 3: Summary of in situ testing carried out for the recent ground investigation

In situ Testing	Quantity
Standard Penetration Test	6 no.

Table 4: Summary of laboratory testing carried out for the recent ground investigation

Laboratory Testing	Quantity
Moisture Content	4 no.
Particle Size Distribution	4 no.

Laboratory Testing	Quantity
Atterberg Limits	2 no.
Geo - Environmental Testing	7 no.

4 Preliminary Geotechnical Design Parameters

4.1 Overview

This section provides an interpretation of the ground conditions across the Proposed Scheme and outlines the methodology used to derive the different parameters. Results from previous works and published papers on Dublin Boulder Clays (Long & Menkiti, 2007a, Long & Menkiti, 2007b) and Irish Glacial soils (Hanrahan, 1977) were used to compare the obtained values and, in some cases, where the available data is limited, to derive the relevant values.

4.2 Topsoil

Topsoil is recorded present at surface in non-paved areas. Topsoil is encountered in 8No. out of 88 No. ground investigation locations.

The topsoil is generally described as brown slightly sandy slightly gravelly. The general thickness of the topsoil variable between 0.4 to 0.6m with local exceptions lower than 0.4m and higher than 0.6m.

4.3 Made Ground

4.3.1 Overview

Made ground is encountered at 85 No. out of 88 No. ground investigation locations. From the descriptions, it is likely reworked glacial till with waste material, such as brick, concrete and plastic. Waste is recorded in almost all the made ground descriptions. Made ground that does not contain waste could potentially be reused as fill, subject to an assessment of the material properties at each area of excavation.

The thickness of the made ground is variable between 1.5m to 3.9m with an average of 2.2m. Locally the thickness of the made ground is less than 1.5, at three locations thickness is 4m to 5m and in one area thickness is up to 9m:

- Near Grange Road (GSI report R1364)

- Near Kevin Street Lower (GSI report R841)
- Near Cuffe Street (GSI report R829)
- Near Brighton Green, Rathfarnham (GSI report R204)

A general description of the made ground is brown to grey, slightly sandy, slightly gravelly to gravelly clay with some angular to subangular cobbles, occasional boulders, occasional rootlets. Occasional fragments of plastic, rope, concrete, wood, cloth, tarmacadam, brick and organic matter are recorded.

At some locations the made ground is described as brown, gravelly, clayey, fine to coarse sand with occasional angular to subrounded cobbles, rootlets and occasional fragments of metal, plastic and red brick.

Due to the variability of the thickness and composition of the made ground, further ground investigation is recommended for to provide information for use in detailed design.

4.3.2 Classification

The laboratory testing for made ground, from the recent ground investigation, is presented in Appendix C.

The Natural Moisture Content (NMC) is determined from two samples and Atterberg limits are determined from one sample. The NMCs in made ground are 11% and 22%. The liquid limit is 32%. The plastic limit is 17%. The plasticity index is 15%. This test corresponds to a low plasticity clay.

A PSD test was carried out on one sample. The made ground has a fines content of 30% passing the 0.063mm sieve, with 50% gravel.

4.3.3 Unit Weight

In accordance with BS 8002:2015, a unit weight of 17kN/m^3 above the groundwater table and 18kN/m^3 below the groundwater table are suitable for made ground. At detailed design the characteristic unit weight should depend on the application. For instance, it should be higher if the made ground is supported by a retaining structure and lower if the made ground is supporting a shallow foundation.

4.3.4 Standard Penetration Tests

Standard Penetration Tests (SPT) were carried out on the made ground and the range of SPT ‘N’ values recorded are presented in Appendix B.

The SPT ‘N’ values ranged from 2 to refusal. SPTs are typically between 5 to 10 for the first 2m and 10 to 20 below 2m. The design SPT value for made ground is conservatively considered to be 5.

4.3.5 Undrained Shear Strength

Laboratory strength testing was not conducted on samples of made ground. Therefore, reference was made to Table 9 of BS 5930:2015 and Stroud and Butler (1975). The undrained shear strength has been estimated based on the following:

- cu = f1 x N (kPa) (f1 has conservatively been taken as 5kPa based on the range of plasticity index test results).

The design value for undrained shear strength (cu) is determined as 25kPa.

4.3.6 Effective Stress Parameters

Laboratory strength testing was not conducted on samples of made ground. Therefore, reference was made to Kenney (1959).

An effective angle of shearing resistance of 30˚is recommended, based on the available plasticity index test results.

4.3.7 Soil Stiffness

The soil undrained stiffness (E_u) can be calculated based on a relationship with undrained shear strength. Jamiolkowski (1979) suggests a value of E_u between $200c_u$ and $1000c_u$. For preliminary design, E_u may be calculated as follows:

$E_u = 200 \times c_u = 5MPa$

The drained stiffness (E´) can be approximated by taking 80% of this value which leads to a value of:

E’ = 4MPa

4.4 Alluvium

Alluvium is not identified in the available ground investigation data. However, it is presented in the GSI Quaternary map and will likely be encountered near the rivers.

Alluvium is described as gravelly in the GSI web page.

Parameters have not been determined for alluvium because they were not encountered in the ground investigation.

4.5 Glacial Till

4.5.1 Overview

Local glacial till is known as Dublin Boulder Clay which is a subdivision of till derived from limestone. It is encountered at 80 No. out of 88 No. ground investigation locations.

A general description of the glacial till is firm to very stiff, brown to grey, slightly sandy to sandy, slightly gravelly to gravelly clay with occasional cobbles and hard grey black silty stony clay. The thickness of the glacial till is variable between 0.3 m to 7.5m.

4.5.2 Classification

The laboratory testing for glacial till, is presented in Appendix C.

The Natural Moisture (NMC) is determined from 28 samples. The NMC of the glacial till deposits ranges from 8% to 21%. The average NMC is 13%.

The Atterberg limits were determined for 26 No. samples. The average liquid limit is 30% with a minimum limit of 24% and maximum of 37%. The average plastic limit is 17% with a minimum limit of 10% and a maximum of 22%.

The average plasticity index is 14% with a minimum plasticity index of 9% and a maximum of 17%. Glacial till is classified as low plasticity clay.

PSD tests were carried out for six samples. The glacial till has a fines content between 25% and 70% (passing the 0.063mm sieve), with 20% to 55% gravel. Typical fine content is between 25% and 40%.

4.5.3 Unit Weight

In accordance with BS 8002:2015, a clay with medium to high undrained shear strength, like the one examined herein, has a weight density which typically varies from 16 kN/m^3 to 22kN/m^3. A value of 20kN/m^3 is adopted.

4.5.4 Standard Penetration Tests

Standard Penetration Tests (SPT) were carried out on the glacial till in boreholes. The range of SPT ‘N’ values recorded are presented in Appendix B.

The recorded SPTs values shown at the borehole logs are variable between 6 to refusal. SPT values increase with depth. The typical SPT range for glacial till deposits is:

- 1m to 4m below ground level, SPT is variable between 10 to 30, the design SPT value (moderately conservative) is considered to be 15.
- After 4m below ground level, SPT is variable is between 25 to refusal, the design SPT value (moderately conservative) considered to be 25.

4.5.5 Undrained Shear Strength

Laboratory strength testing was not conducted on samples of glacial till. Therefore, reference was made to Table 9 of BS 5930:2015 and Stroud and Butler (1975). The undrained shear strength has been estimated based on the following:

- $c_u = f_1 \times N$ (kPa) (f_1 has conservatively been taken as 5.5 kPa based on the range of plasticity index test results).

Taking the above into account:

- C_u value for 0m to 1m, 50kPa is recommended for preliminary design (based on experience with these materials, since there are no SPT results within 1m of surface)
- C_u value for 1m to 4m, 80kPa is recommended for preliminary design
- C_u value for below 4m, 130kPa is recommended for preliminary design

4.5.6 Effective Stress Parameters

No effective stress shear strength laboratory testing was carried out on samples of glacial till as part of this project.

Long and Menkiti (2007) report a value of 44° for the peak compressive angle of shearing resistance (φ'_p) for all formations of the Dublin Boulder Clay. Long and Mentiki (2007) also report a value of 36° for the critical state angle of shearing resistance (φ'_{cs}).

This value of φ'_{cs} compares favourably with the findings of Lehane and Faulkner (1998) and Farrell and Wall (1990) who report values of 34°±1° and 35° respectively. In all cases a $c' = 0$kPa is recommended. Taking the above into account a value of $\varphi'_p = \varphi'_{cs} = 32°$ is recommended for preliminary design.

4.5.7 Soil Stiffness

For stiff, consolidated clays, the soil undrained stiffness (E_u) can be calculated based on a relationship with undrained shear strength. Published data suggests a value of E_u between $500c_u$ and $1000c_u$. In the examined case, the E_u may be calculated as follows:

$E_u = 500 \times c_u$

Therefore:

- E_u value for 0m to 1m is chosen as 25MPa for design
- E_u value for 1m to 4m is chosen as 40MPa for design
- E_u value for below 4m is chosen as 65MPa for design

The drained stiffness (E´) can be approximated by taking 80% of this value which leads to:

- 20MPa for 0m to 1m below ground level
- 30MPa for 1m to 4m below ground level
- 50MPa after 4m below ground level

4.6 Granular Deposits

The granular deposits are encountered in 22 No. of 88 No. ground investigation locations. The granular deposits are glacial gravel.

Granular deposits are generally interbedded with glacial till deposits, except one ground investigation location at the intersection of Aungier Street and Stephen Street Upper and at Terenure Road North. Here, granular deposits are directly under the made ground.

The description of granular deposits is medium dense to dense, brownish grey to grey, sandy, clayey, subangular to subrounded, fine to coarse gravel. The thickness of the granular deposits is variable between 0.3m to 3.5m with an average of 1m.

The thickness of granular deposits is greater than 3.5m only at the intersection of Aungier Street and Stephen Street Upper. The granular deposits here start from 4m below ground level and thickness is 13.5m.

4.6.1 Classification

The laboratory testing for granular deposits is presented in Appendix B.

The Natural Moisture Content (NMC) was determined for three samples. The NMC of the granular deposits ranges from 2% to 9%. The average NMC is 6%. The Atterberg limits were determined for one sample.

The liquid limit is 37%. The plastic limit is 26% and the plasticity index is 11%. Cohesive material in the granular deposits is described as intermediate plasticity silt.

PSD testing was carried out on three samples, taken from two boreholes drilled in the same location. The PSD curves for the granular deposits have 1% to 15% passing the 0.063mm sieve, with 60% to 99% gravel.

4.6.2 Unit Weight

Based on the available GI results, this stratum is typically described as gravel or sand below groundwater level. Most of the SPT N values are above 30 which, according to BS 5930, corresponds to a dense layer. This leads to a γ value ranging between 19 to 23kN/m^3 (BS8002: 2015). A value of 20kN/m^3 is adopted.

4.6.3 Standard Penetration Tests

In total, 14 No. Standard Penetration Tests (SPTs) were carried out on the granular deposits in boreholes. The range of SPT ‘N’ values recorded are presented in Appendix B.

The SPT ‘N’ values typically ranged from 30 to refusal. Only one SPT is lower than 30. The design SPT value conservatively considered to be 30.

4.6.4 Effective Stress Parameters

Peck *et al* established a relationship between the SPT N and critical state friction angle ($\varphi'_{cv,k}$) for coarse grained soils. Following from that, a graph was introduced correlating the above parameters.

The SPT N band is between 30 to 40. An SPT N value of 30 according to the graph mentioned above, corresponds to a $\varphi'_{cv,k}$ of approximately 36°.

A $\varphi'_{cv,k}$ value of 32° is recommended for preliminary design. Due to the nature of this layer (coarse-grained) c´= 0kPa.

4.6.5 Soil Stiffness

For the estimation of the stiffness the following empirical relationship will be used:

E´ = 1.5 SPT N (in MPa) which leads to an E´ of 45MPa.

4.6.6 In-situ Stress

No in situ testing or laboratory testing in which K_0 is directly or indirectly measured was carried out as part of the GI.

In situ stress is determined with the approach presented in BS EN 1997-1:2004+A1:2013

$K_0 = 1 - \sin\varphi = 0.47$*

*φ value is presented above as $\varphi'_{cv,k}$

4.7 Rock

Bedrock was encountered in some of the historical ground investigations and all the recent ground investigation locations. The top of the bedrock is variable between 5m to 8m below ground level.

The bedrock is mainly described as grey to dark grey, strong, thinly laminated fine grained limestone.

Depth to bedrock map presented in “GeoUrban Depth to Bedrock (GSI)” is usually consistent with the top of the bedrock determined from the borehole logs.

Based on the latest scope the proposed development includes works which will be limited close to the existing ground level. Therefore, derivation of design parameters for the underlying Limestone will not be provided.

4.8 Stratigraphic Profile

The stratigraphic profile for the proposed scheme is summarised in Table 5 below.

Table 5: Summary of stratigraphic profile

Stratum	**Typical Depth (m BGL)**	**Typical Thickness (m)**
Topsoil	0.0	0.2 to 1 (avr. 0.5)

Stratum	Typical Depth (m BGL)	Typical Thickness (m)
Made Ground	0 to 0.8	0.3 to 3.9 (avr. 2.5)
Glacial Till	0.3 to 5	0.3 to 7.5 (avr. 3.5)
Granular Deposits	0.15 to 5	0.3 to 3.5 (avr. 1.5)
Bedrock	5.5 to 8	N/A
*Alluvium deposits are likely to be encountered in the vicinity of rivers/streams		

4.8.1 Groundwater

Groundwater monitoring data is presented in Table 6.

Table 6: Groundwater monitoring data

Borehole	Date	Groundwater Level (m BGL)	Standpipe / Water strike/Observation Reading
R12-CP02	31/03/2021	2.1	Standpipe
R12-CP03	31/03/2021	3.1	Standpipe
R1364/B67503	17/12/1986	5.0	Observation
R1364/B67505	18/12/1986	4.0	Observation
R1364/B67505	18/12/1986	3.6	Observation
R137/B51398	26/11/1995	7.0	Observation
R167/B51620	27/10/1983	3.3	Observation
R167/B51626	18/10/1983	3.2	Observation
R167/B51627	21/10/1983	3.5	Observation
R167/B51632	28/10/1983	3.0	Observation

Borehole	Date	Groundwater Level (m BGL)	Standpipe / Water strike/Observation Reading
R167/B51636	26/10/1983	3.5	Observation
R167/B51642	19/10/1983	2.6	Observation
R207/B51955	02/10/1993	3.3	Observation
R2214/B85117	01/03/1990	3.8	Observation
R2227/B85210	13/11/1993	3.5	Observation
R2245/B85274	22/05/1989	1.6	Observation
R2245/B85275	22/5/1989	4.3	Observation
R2900/B93114	08/06/1996	4.2	Observation
R3059/B95099	10/01/1995	3.6	Observation
R3059/B95100	12/01/1995	4.5	Observation
R367/B58185	24/05/1996	5.6	Observation
R4883/B128727	21/01/2002	5.0	Observation
R5464/B134039	23/06/2003	2.50	Observation
R6455/B142521	12/05/2006	3.6	Observation
R73/B50995	23/03/1994	2.6	Observation
R73/B50996	23/03/1994	3.6	Observation
R841/B62002	23/08/1982	4.7	Observation
R876/B62175	01/1/1990	1.8	Observation
R960/B62752	13/0/1992	1.7	Observation
R960/B62753	14/02/1992	1.4	Observation

Borehole	Date	Groundwater Level (m BGL)	Standpipe / Water strike/Observation Reading
R962/B62763	20/08/1980	4.0	Observation
R962/B62764	16/08/1980	5.0	Observation
R962/B62767	22/09/1980	4.0	Observation
R962/B62769	18/09/1980	5.0	Observation
R983/B62934	02/10/1993	3.3	Observation
R989/B62971	28/07/1989	4.0	Observation
R204/B51942	29/06/1995	2.0	Observation
R204/B51943	29/06/1995	1.5	Observation
R204/B51944	19/07/1995	1.4	Observation
R204/B51945	20/07/1995	1.4	Observation
R204/B51946	24/07/1995	1.3	Observation
R3040/B94930	01/12/1998	4.6	Standpipe
R3040/B94931	02/12/1998	5.5	Observation
R3040/B94932	03/12/1998	4.1	Standpipe

Based on these groundwater measures, groundwater level for preliminary design should be taken as 1m below ground level.

4.9 Summary of Preliminary Design Parameters

A summary of the interpreted characteristic parameters for each stratum is presented in Table 7.

Table 7: Summary of Ground Material Parameters

Stratum	**γ (kN/m³)**	**c_u (kPa)**	**φ (°)**	**c´ (kPa)**	**E_u (MPa)**	**E´ (MPa)**
Topsoil	No geotechnical parameters will be required for this layer					
Made Ground	17	25	27	0	5	4
Glacial Till 0mbgl to 1mbgl	20	50	32	0	25	20
Glacial Till 1mbgl to 4mbgl	20	80	32	0	40	30
Glacial Till Below 4mbgl	20	130	32	0	65	50
Granular Deposits	20	N/A	32	0	N/A	45
Limestone/Mudstone	No geotechnical parameters will be required for this layer					
*Alluvium deposits are likely to be encountered in the vicinity of rivers/streams. Parameters have not been determined for alluvium because they were not encountered in the ground investigation data.						

5 Geotechnical Risk Register

This geotechnical risk register in Appendix F has been completed based on available existing information including that gained from compilation of this GIR.

It highlights the geotechnical risks and the consequence of those risks occurring. It contains proposed measures to mitigate the risks.

It does not cover health and safety risks unless specifically related to the geotechnical works. Risk control measure will, whenever possible, reduce all risks to and acceptable ‘low’ level.

The following risk ratings have been adopted:

Low Risk (LOW): No action required by Designer or Contractor.

Medium Risk (MED): Action required unless good reason not to e.g. design change or construction mitigation measure.

High Risk (HIGH): Action required e.g. design change.

References

Bowles, J. E. (1997). Foundation Analysis and Design – International Edition, 5th edition. The McGraw-Hill Companies, Singapore.

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

C504, Engineering in glacial tills. CIRIA. 1999, London.

Farrell, E.R. (2016). Geotechnical Properties of Irish Glacial and Interglacial Soils. 1st Hanrahan lecture, The Institution of Engineers of Ireland.

Farrell, E.R., Lehane, B., O'Brien, S., and Orr, T. (1995). Stiffness of Dublin black boulder clay. 11th European conference on soil mechanics and foundation engineering, Vol 1; Measurement of soil/soft rock properties; 1995; Copenhagen.

Long, M., and Menkiti, C.O. (2007a). Characterisation and engineering properties of Dublin Bolder Clay. Characterisation and Engineering Properties of Natural Soils. 3. Pages 2003-2045.

Long, M., and Menkiti, C.O. (2007b). Geotechnical properties of Dublin Boulder Clay. Géotechnique 57, No. 7, pages 595-611.

Stroud, M. A., and Butler, F. G (1975). The standard penetration test and the engineering properties of glacial materials. In: Proceedings of the Symposium of glacial materials, University of Birmingham, April 1975.

Stroud, M.A. (1989). The Standard Penetration Test – Its application and interpretation. Proceeding of the ICE Geotechnical Conference, 1988, pages 29-49. Thomas Telford Limited, London.

Hoek & Marinos (2000). Practical Rock Engineering – Hook Brown

EN 1997-1:2005 Eurocode 7: Geotechnical Design – Part 1: General Rules

BS EN 1997-2: 2007 Eurocode 7: Geotechnical Design – Part 2 : Ground Investigation and testing

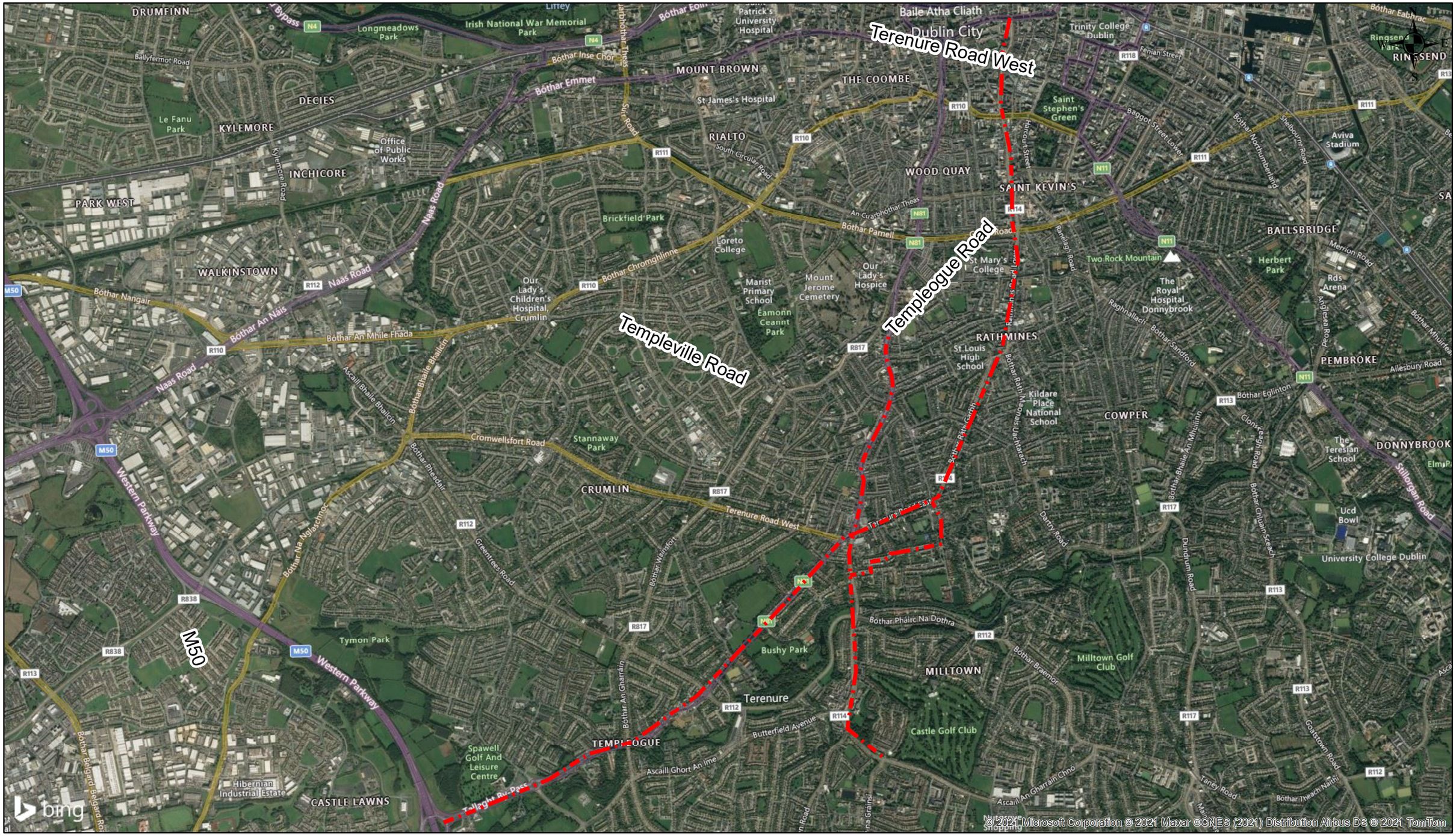
BS5930:2015. Code of Practice for Site Investigation

Hanrahan, E.T. (1977) "Irish glacial till: origin & characteristics" Foras Forbartha, Dublin. 164.

Appendix A

GI Layout Plan and GSI Maps

A1



Legend

Alignment

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Aerial View (Bing Map)

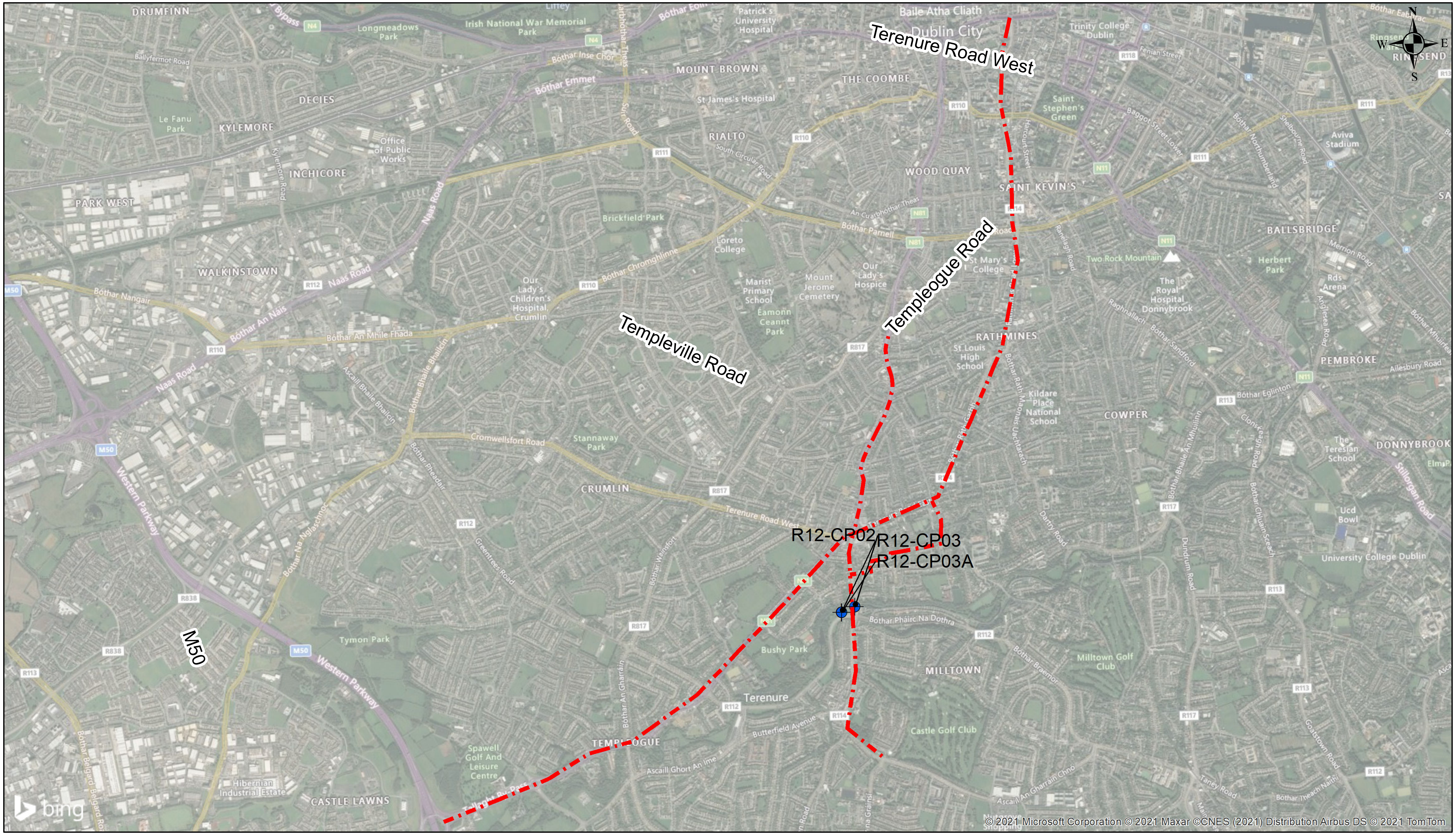
ARUP

1:27,500

0 250 500 1,000 1,500 Meters

268401

FIGURE **A01**



Legend

Alignment

Site Specific Ground Investigation

BH

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Site Specific Ground Investigation Location Plan

268401

FIGURE A02

Legend

- Alignment
- Historical Boreholes (GSI) Approximately 50m offset

ARUP

1:27,500

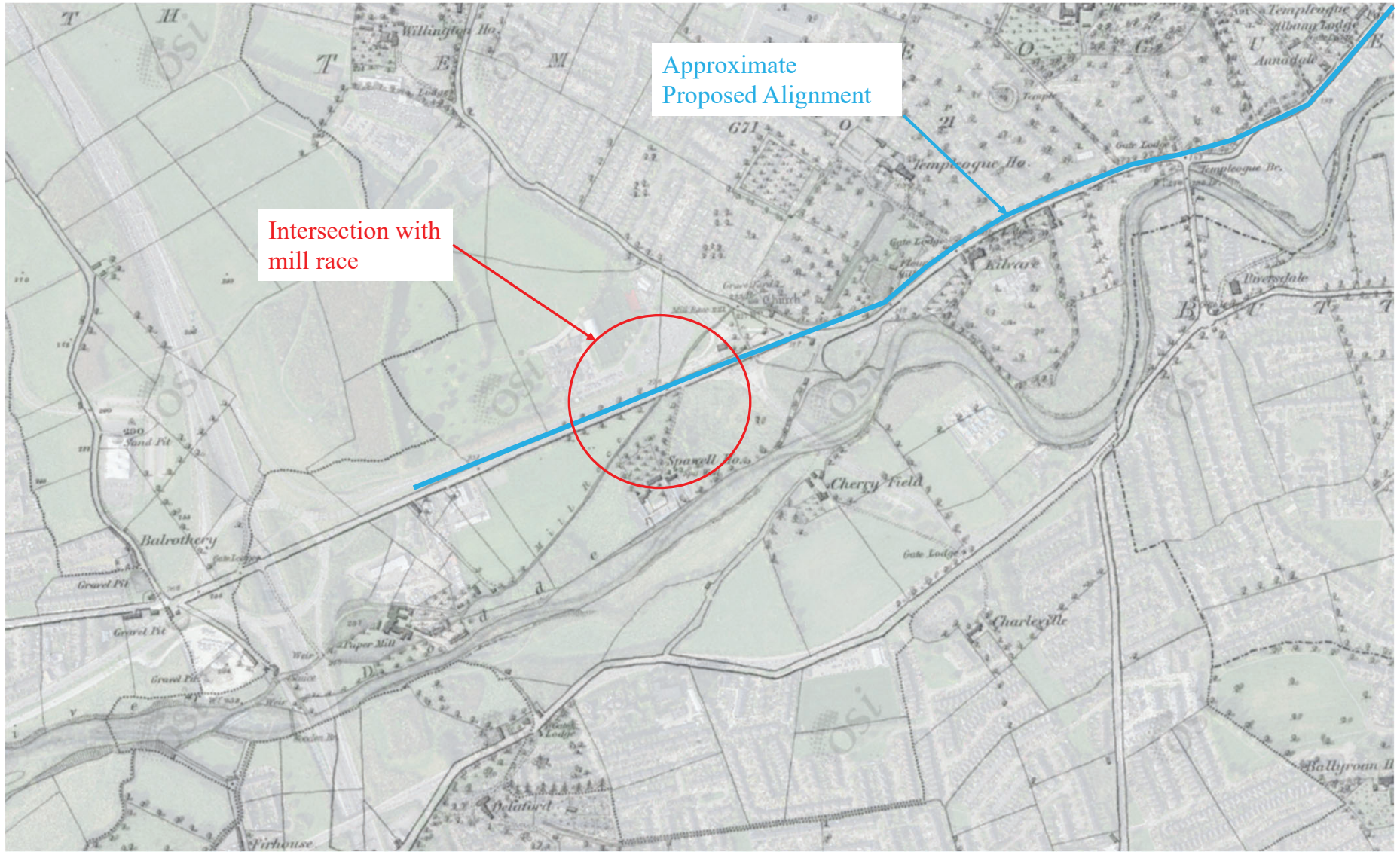
0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Historical Boreholes (GSI) ~50m Offset

268401

FIGURE **A03**



Legend

Busconnect - Route 10-12

Templeogue/Rathfarnham to City Centre Core Bus Corridor

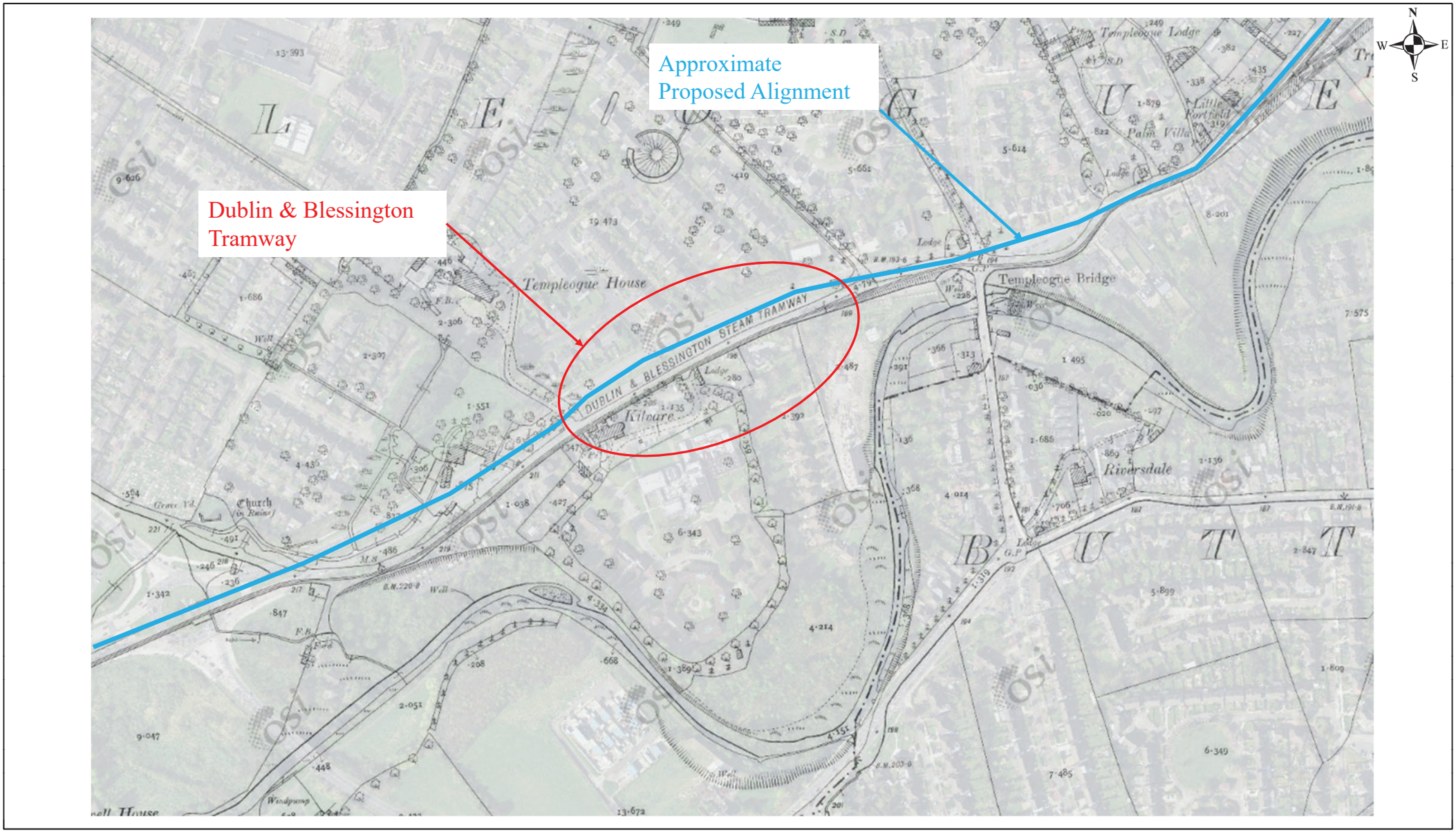
Mill Race - Historic Map
6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE 04



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

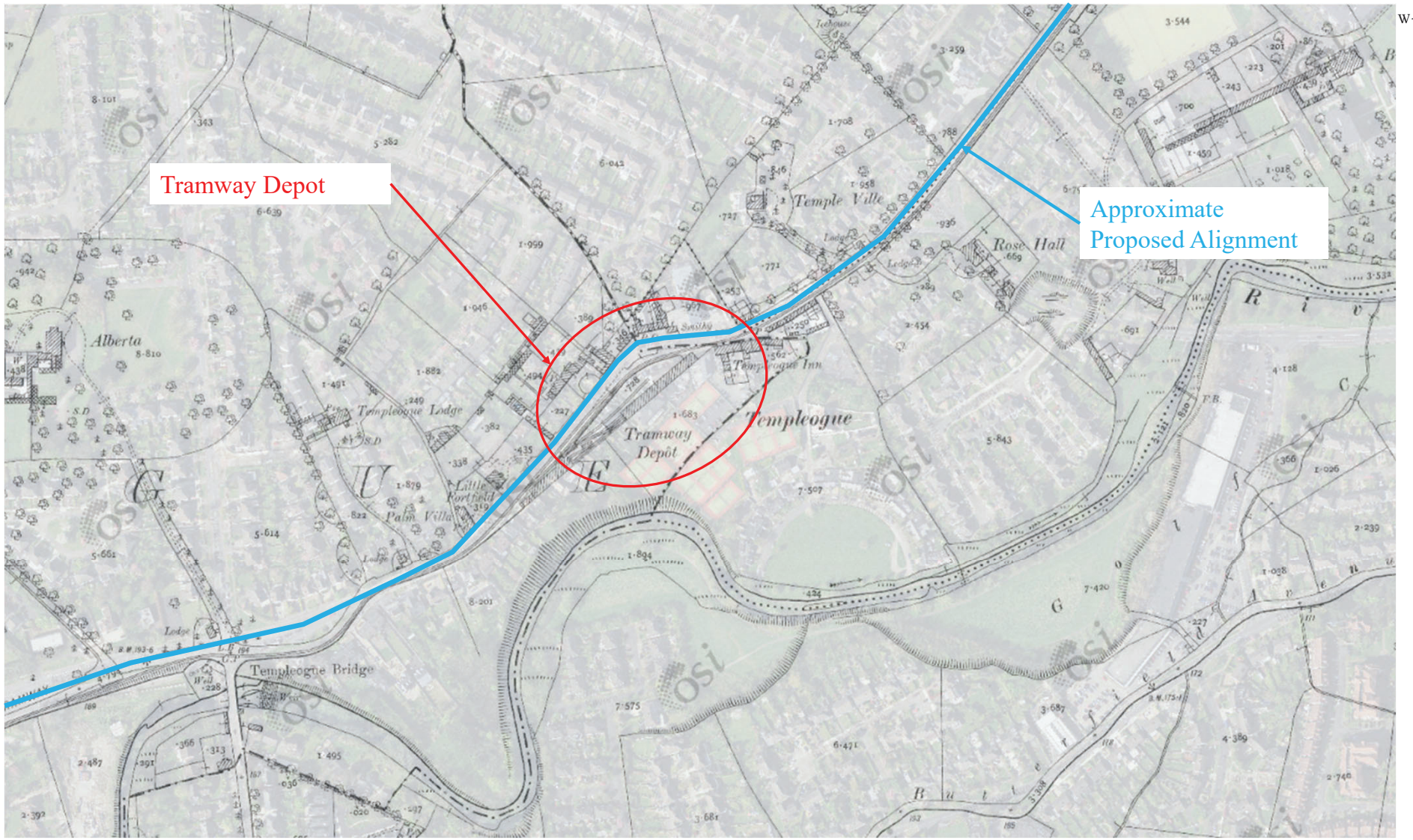
Dublin & Blessington Tramway - Historic Map 25 Inch (1888 - 1913)

ARUP

Not to Scale

268401

FIGURE 05



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Tramway Depot - Historic Map 25 Inch (1888 - 1913)

ARUP

Not to Scale

268401

FIGURE 06

Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

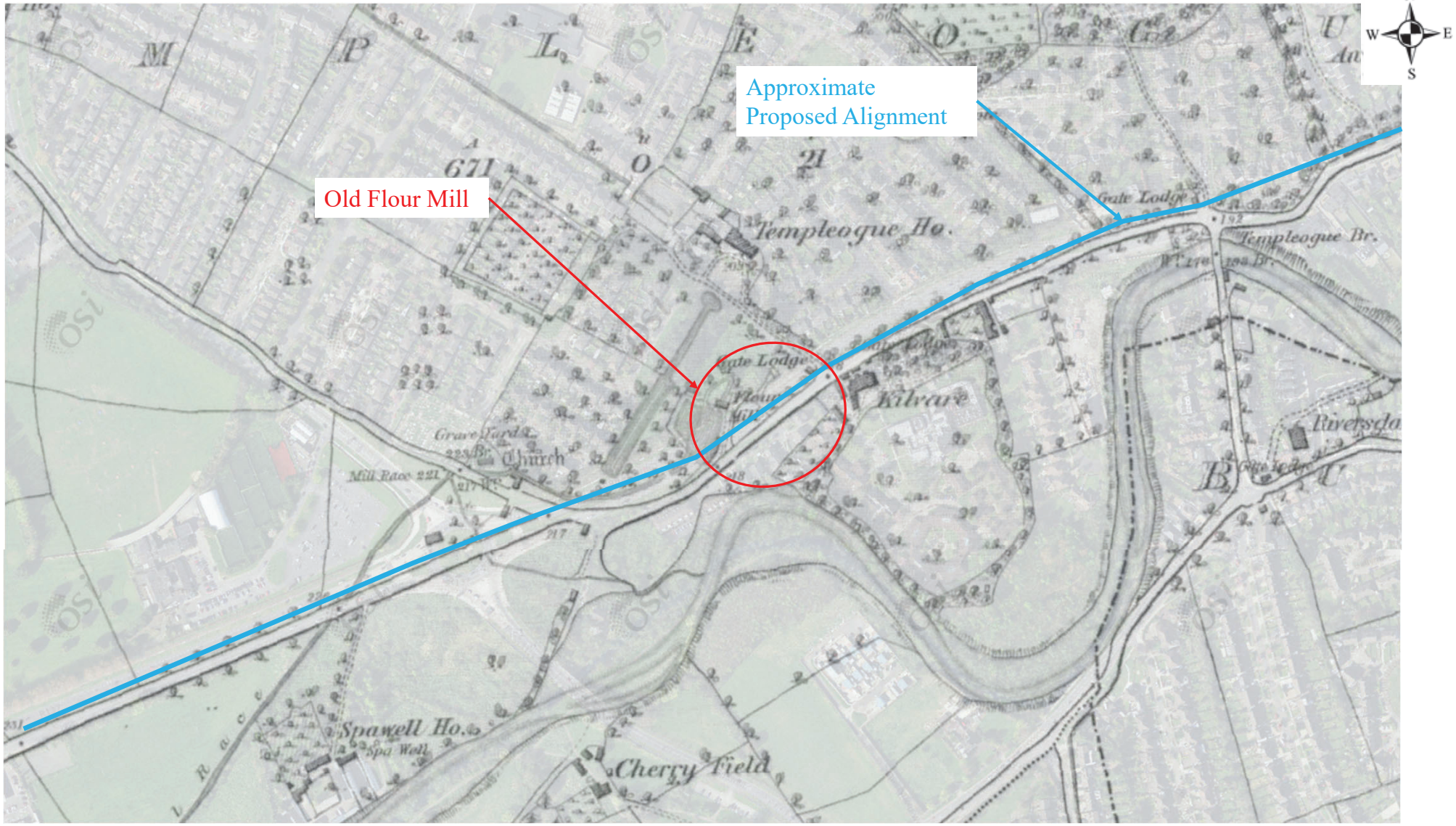
Old Quarry - Historic Map 6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE 07



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Old Flour Mill - Historic Map 6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE 08

Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

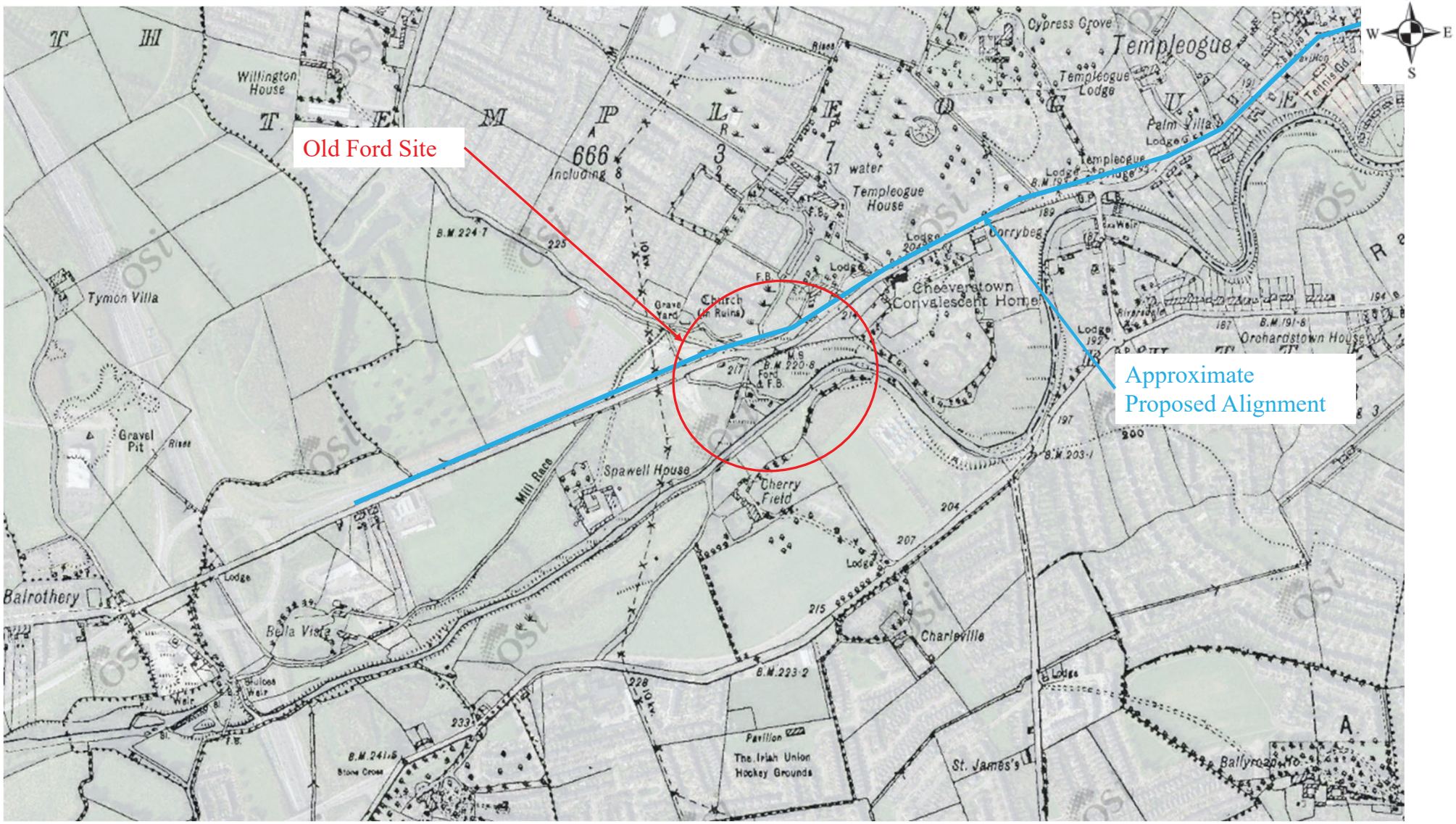
Old Paper Mill - Historic Map 6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE 09



COPYRIGHT

Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

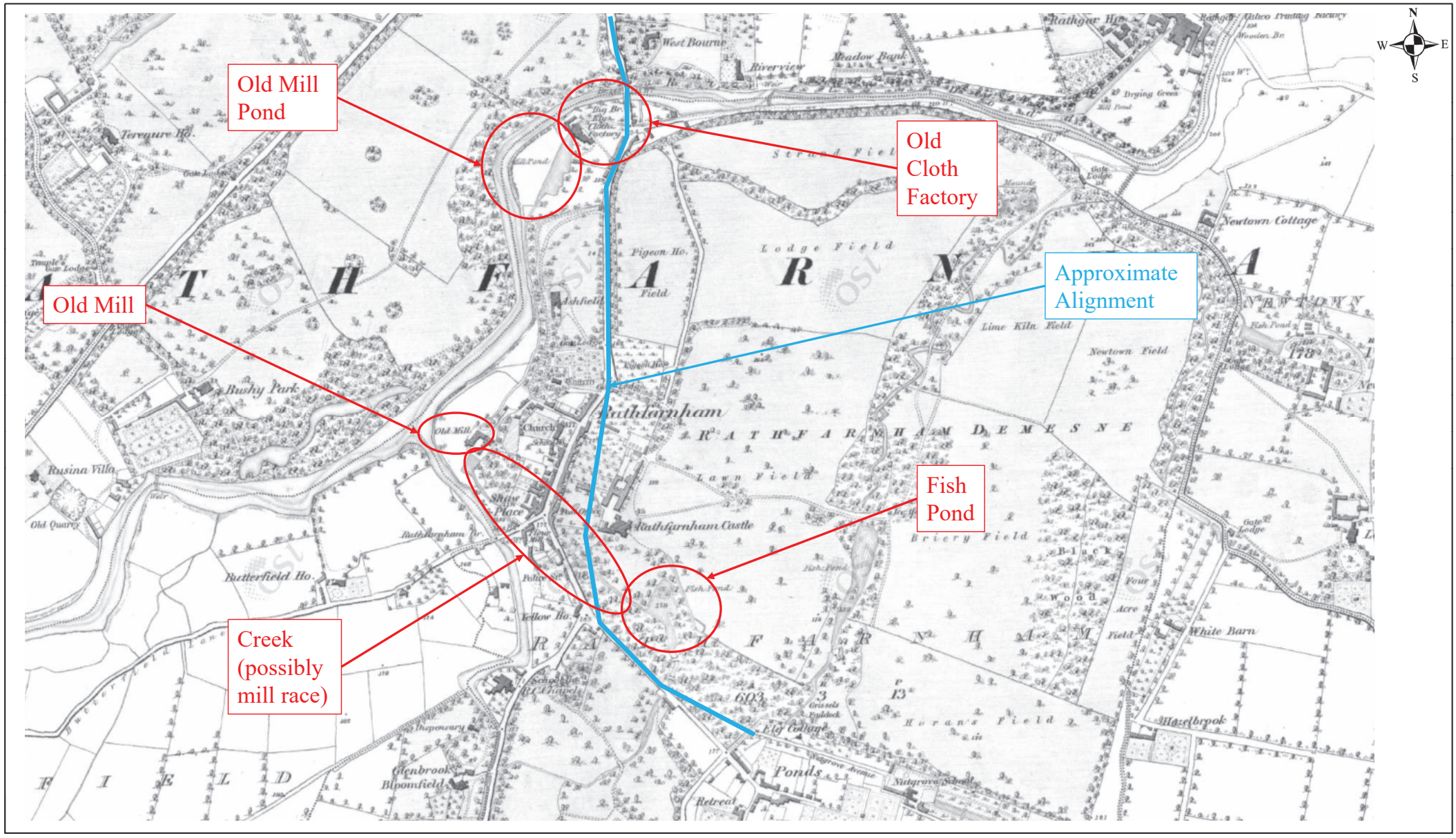
Old Ford Site -
6 Inch Cassini Map (1830 - 1930)

ARUP

Not to Scale

268401

FIGURE **10**



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

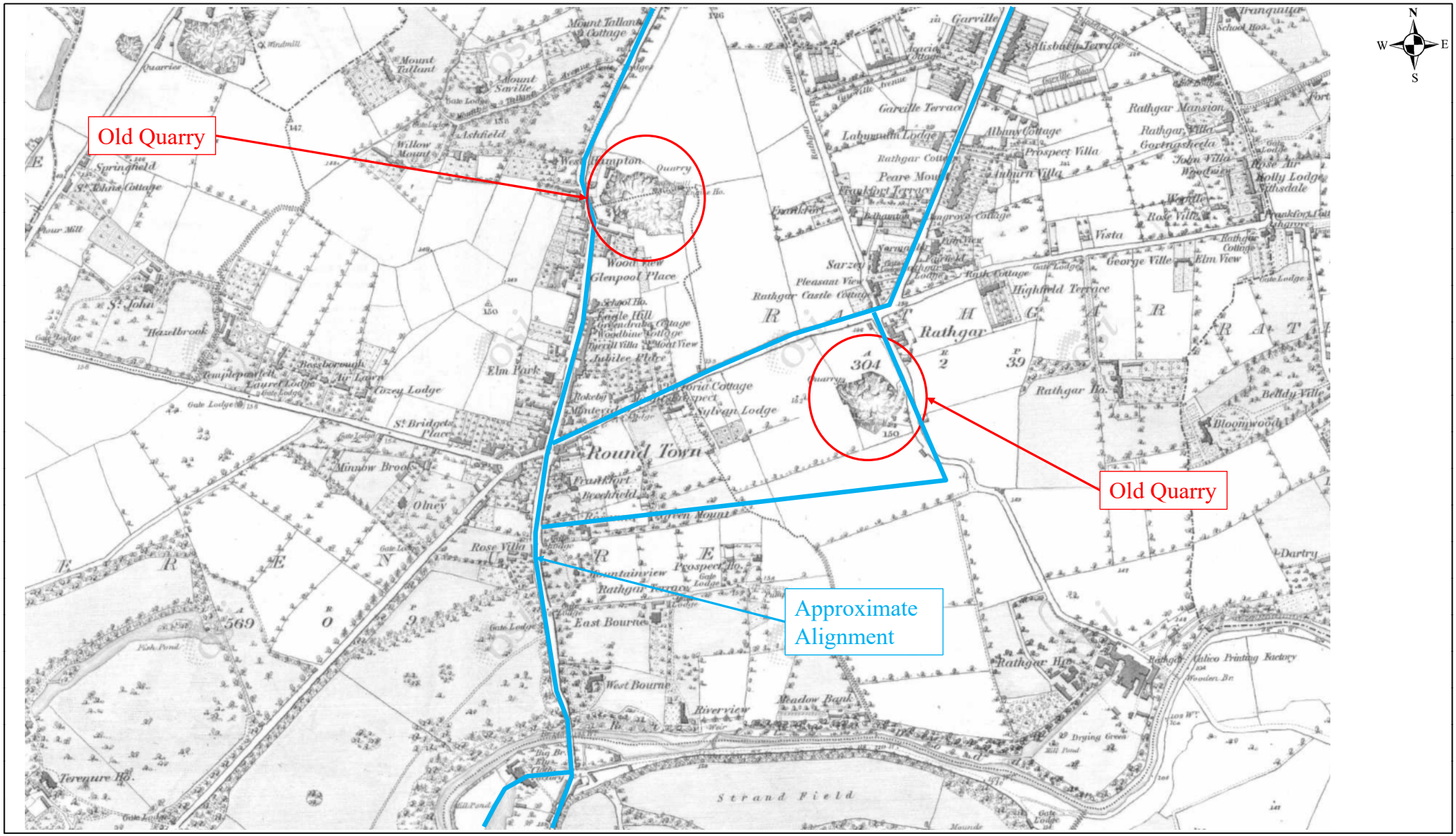
Historic Map 6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE 11



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

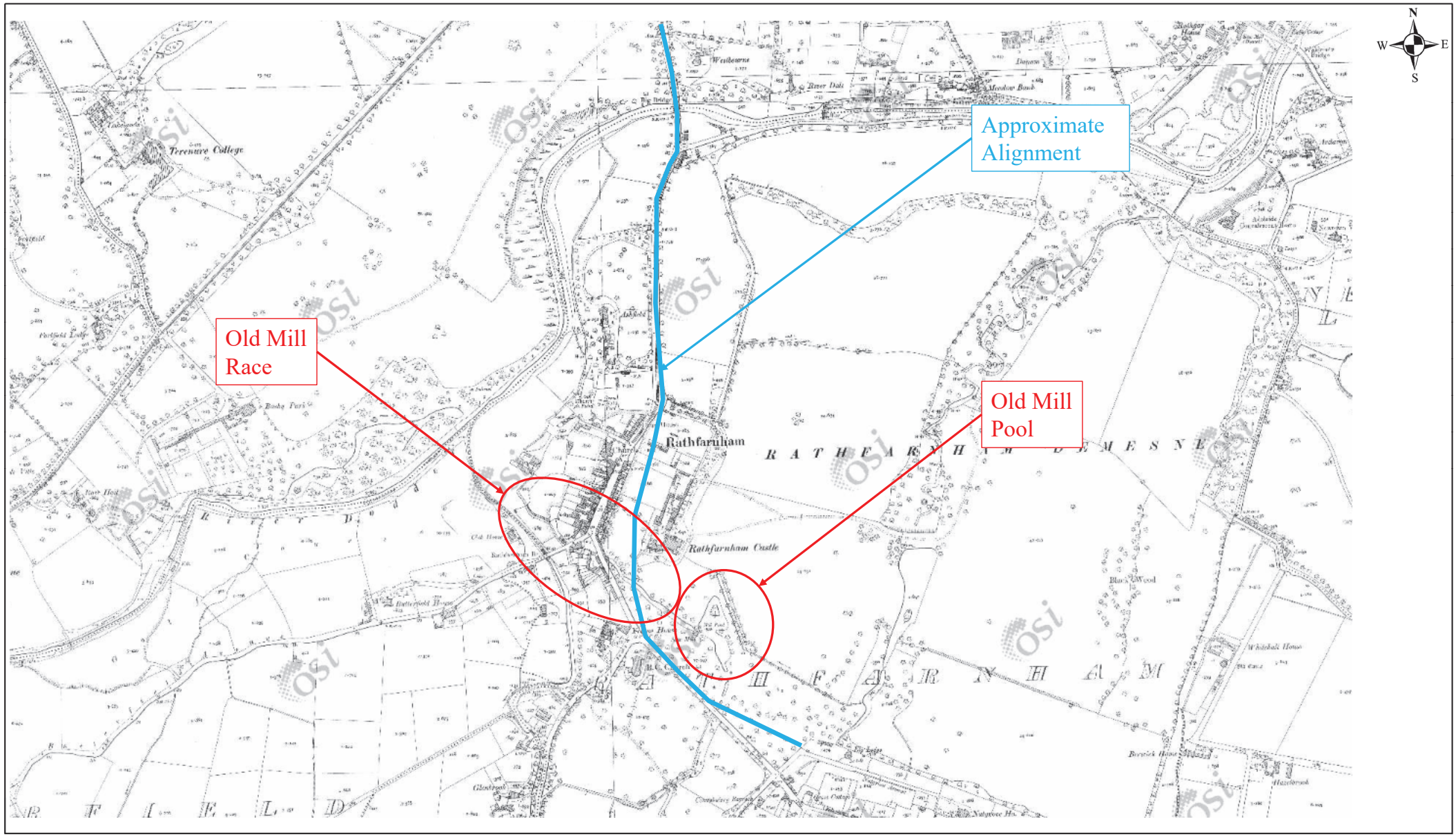
Historic Map 6 Inch (1837 - 1842)

ARUP

Not to Scale

268401

FIGURE **12**



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

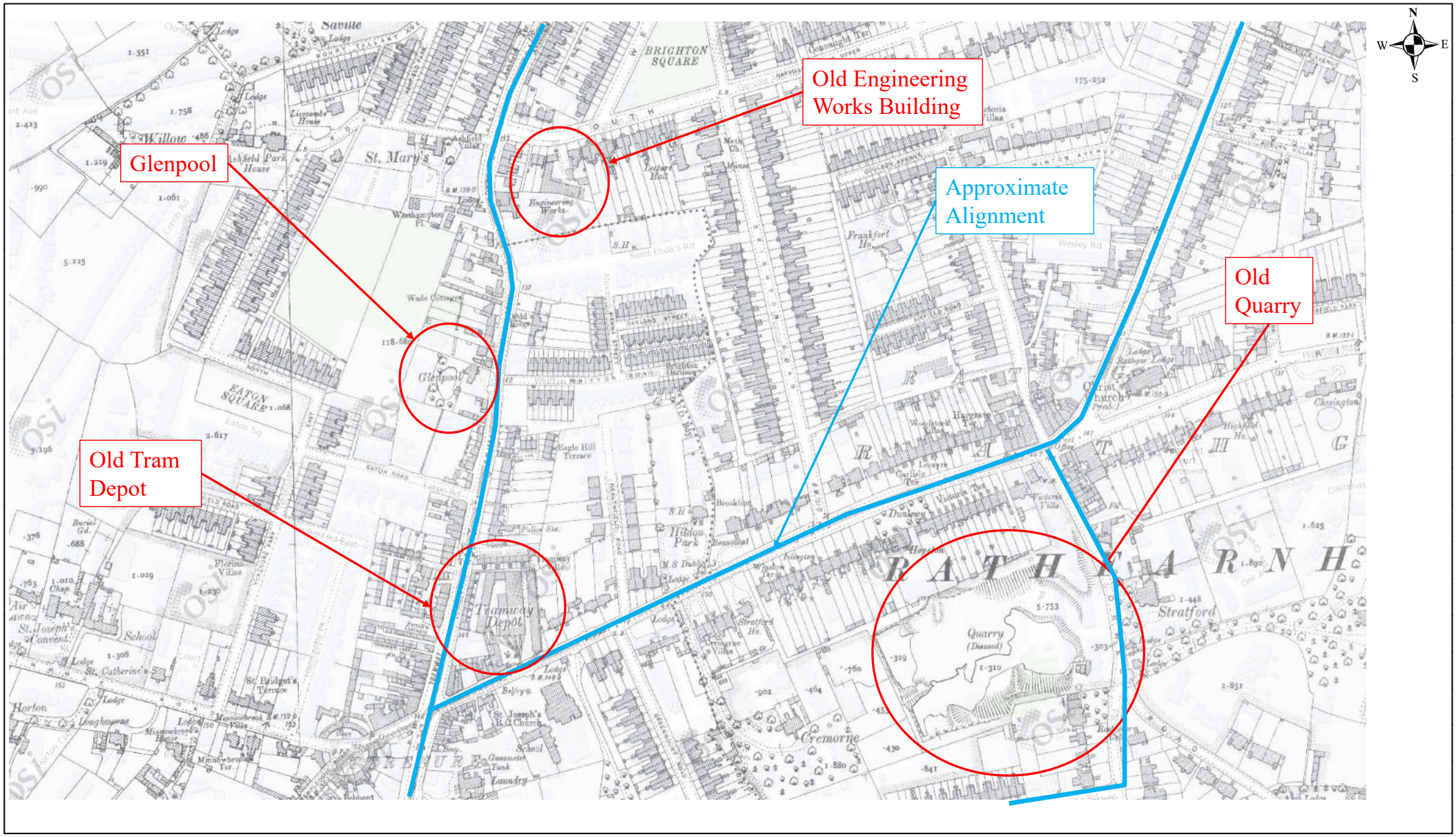
Historic Map 25 Inch (1888 - 1913)

ARUP

Not to Scale

268401

FIGURE 13



Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

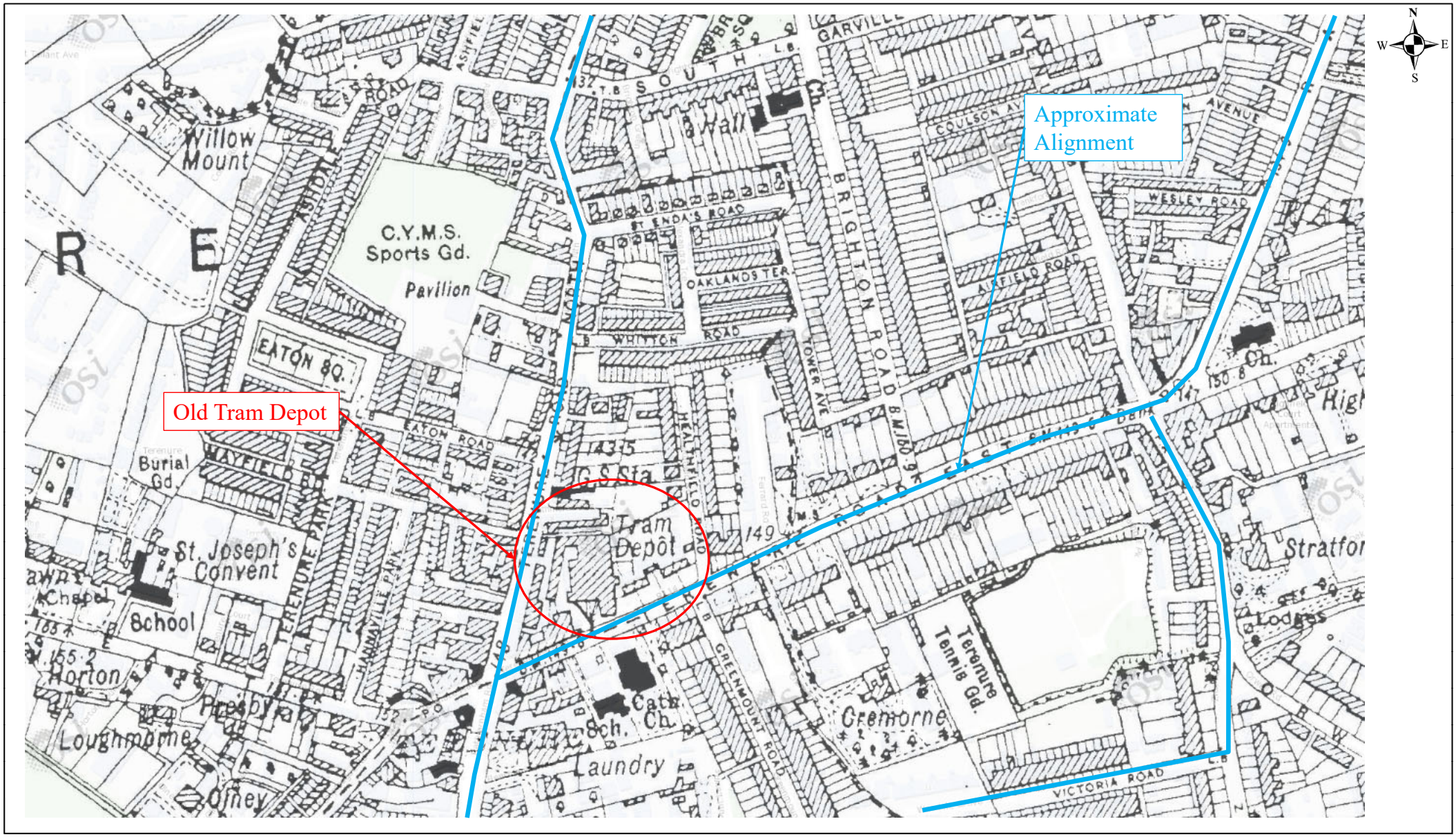
Historic Map 25 Inch (1888 - 1913)

ARUP

Not to Scale

268401

FIGURE **14**



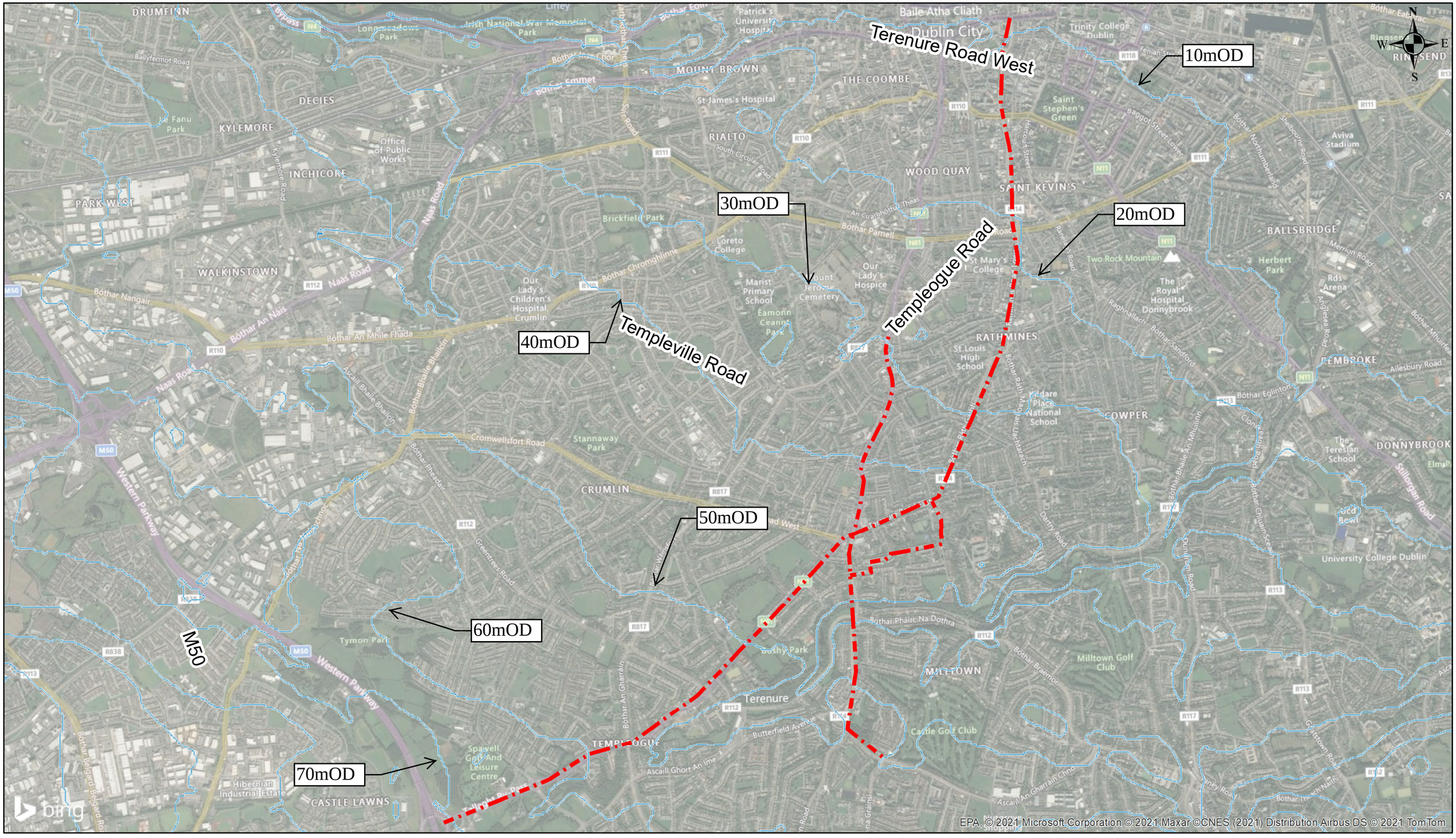
Legend

Templeogue/Rathfarnham to City Centre Core Bus Corridor

6 Inch Cassini (1830 - 1930)

ARUP

Not to Scale 268401 FIGURE **15**



COPYRIGHT

Legend

Alignment

Templeogue/Rathfarnham to City Centre Core Bus Corridor

EPA 20m Contour Map

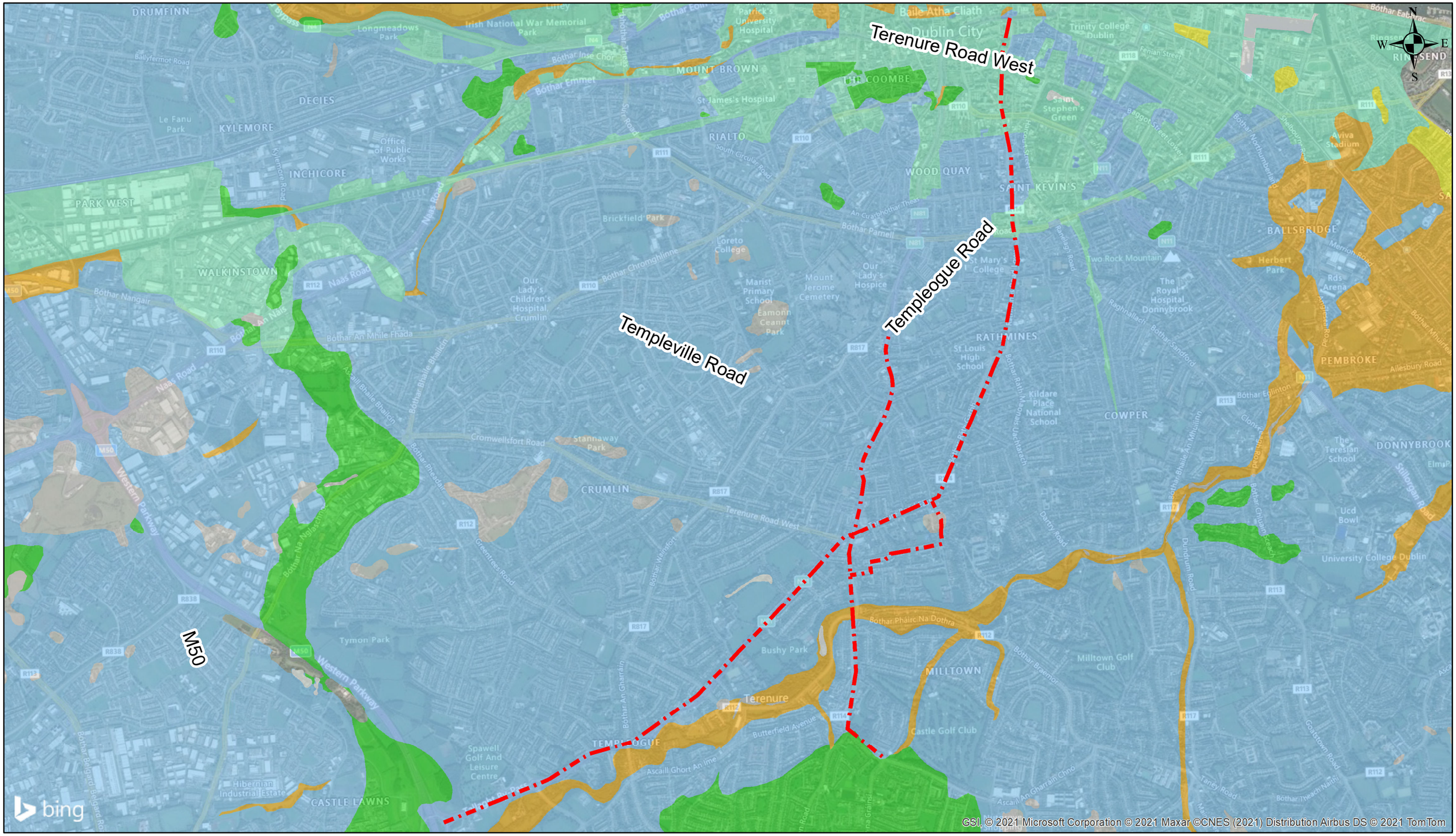
ARUP

1:27,500

0 250 500 1,000 1,500 Meters

268401

FIGURE **A16**



Legend

- Alignment
- A, Alluvium
- Ag, Alluvium (gravelly)
- GLs, Gravels derived from Limestones
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones
- Urban
- Water

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Quaternary Sediments

268401

FIGURE **A17**

Meltwater Channel

Meltwater Channel

Striae

Striae

Hummocky sand and gravel

Hummocky sand and gravel

Hummocky sand and gravel

Meltwater Channel

Terenure Road West

Templeogue Road

Templeville Road

Legend

Alignment

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Quaternary Geomorphology

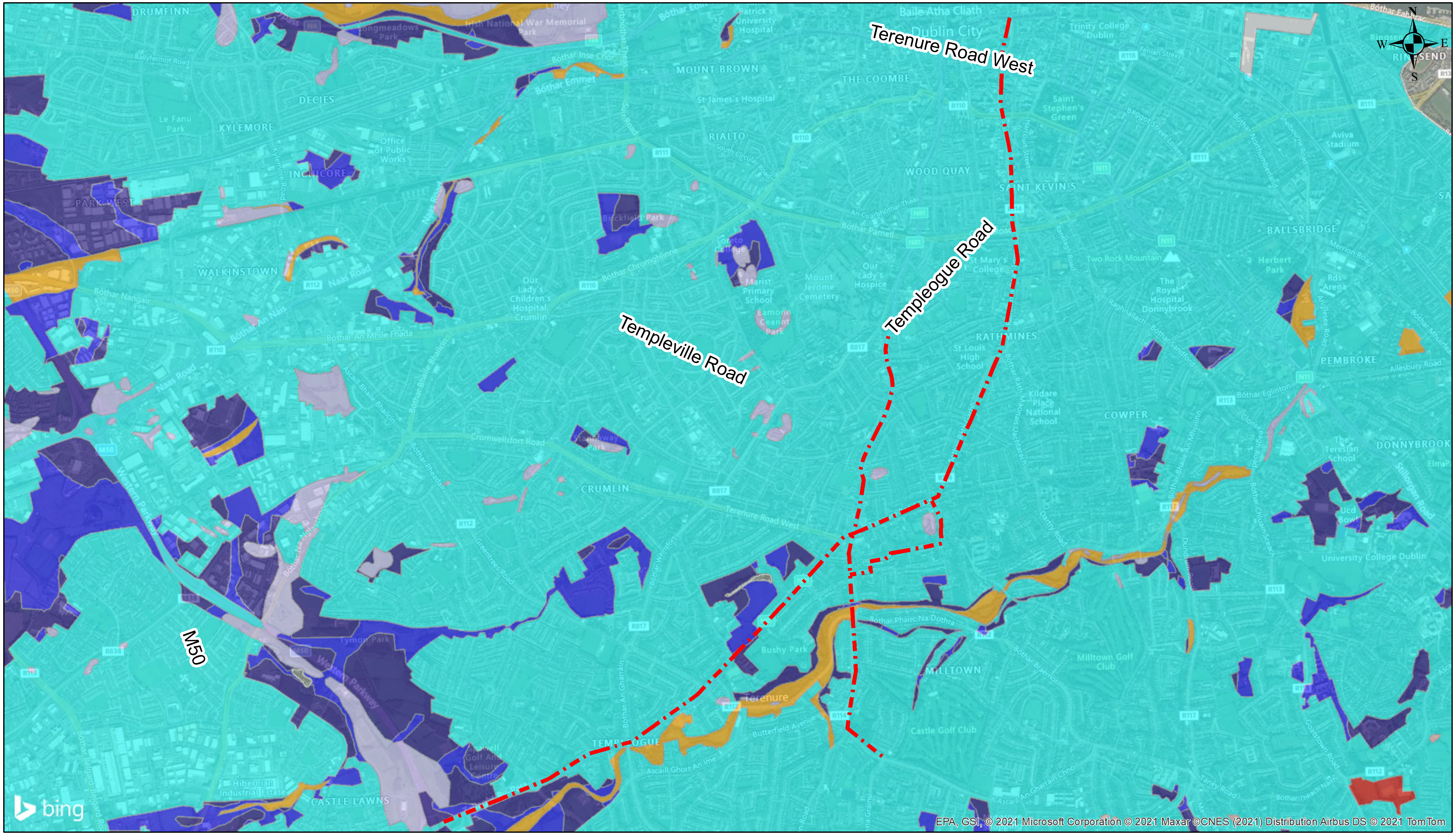
ARUP

1:27,500

0 250 500 1,000 1,500 Meters

268401

FIGURE A18



COPYRIGHT

Legend

Alignment

Alluvium

BminDW - Till derived chiefly from limestone

BminPD - Till derived chiefly from limestone

BminSW - Bedrock at Surface - Calcareous

Made Ground

ARUP

1:27,500

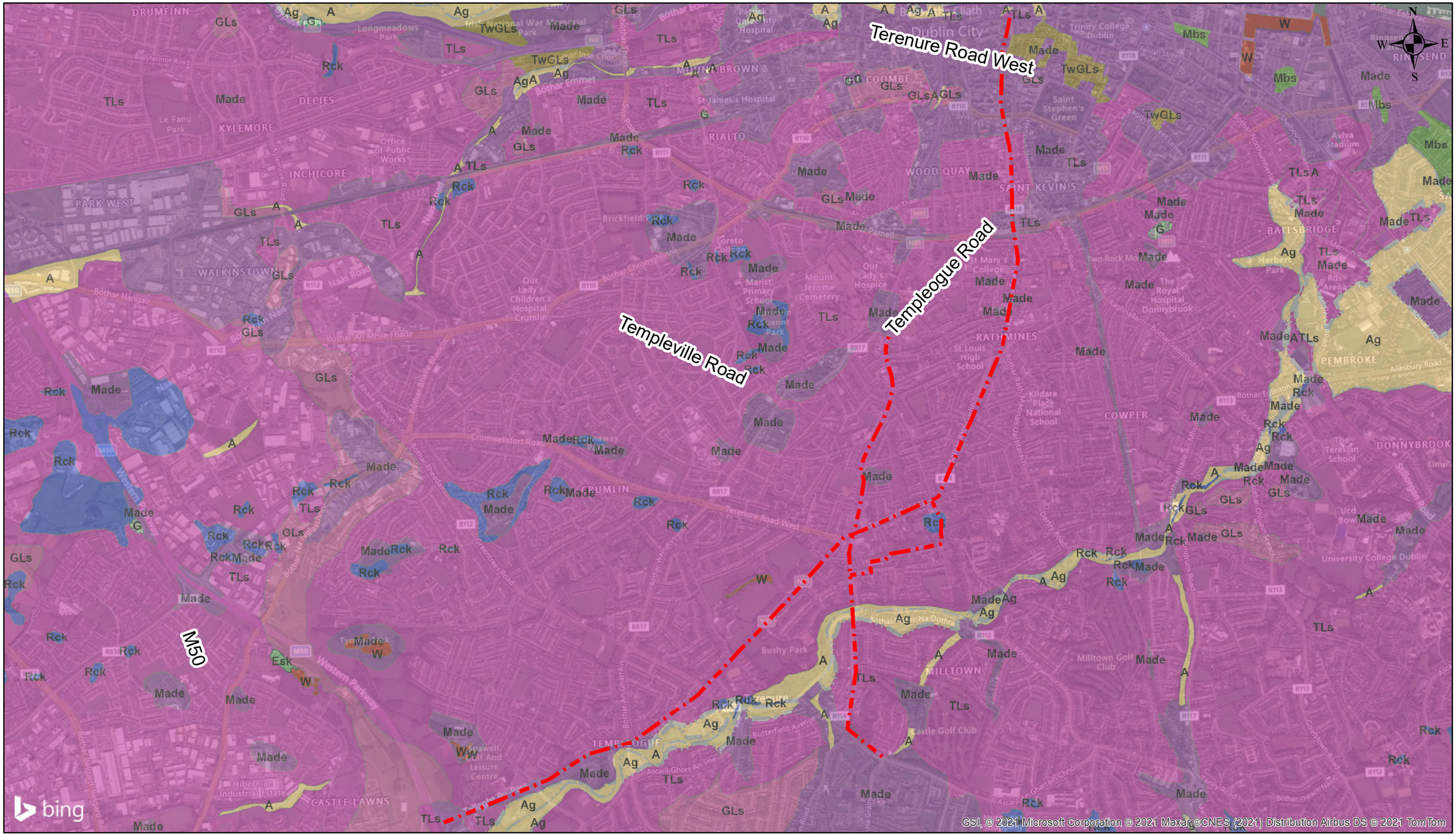
0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Groundwater Subsoils (Teagasc)

268401

FIGURE **A19**



Legend

- Alignment
- Ag - Sandy
- Made - Made Ground
- TLs - Limestone till (Carboniferous)
- TwGLs - Interstratified till with gravel derived from Lower Carboniferous Limestone

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI GeoUrban

Unconsolidated Sediments

268401

FIGURE **A20**

Terenure Road West

Templeogue Road

Templeville Road

© 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS © 2021 TomTom

Legend

- Alignment
- Strike and dip of bedding, right way up
- Strike of vertical first foliation
- Bedrock Outcrops 100 ITM 2018
- Fault
- Lucan Formation
- Type 2p microcline porphyritic

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Bedrock Geology 100k

268401

FIGURE A21

Legend

- Alignment

Karst Landforms

FTYPE

- Borehole
- Cave
- Dry Valley
- Enclosed Depression
- Spring
- Superficial Solution Features
- Swallow Hole
- Turlough

ARUP

1:27,500

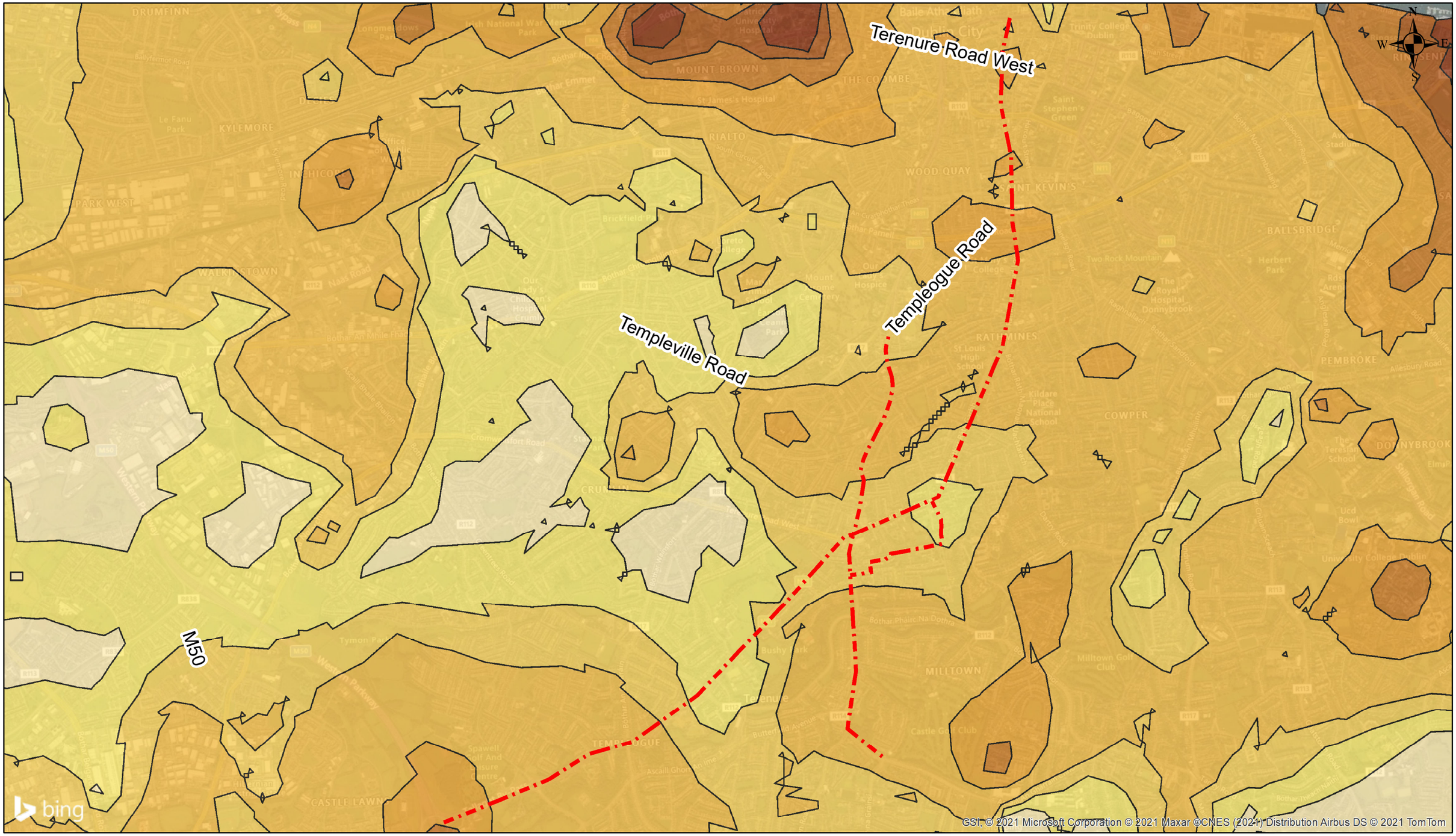
0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Karst Features

268401

FIGURE **A22**



Legend

- Alignment
- 0 to 1m
- 1 to 3m
- 3 to 5m
- 5 to 10m
- 10 to 15m
- 15 to 20m
- 20 to 25m
- 25 to 30m
- 30 to 45m

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

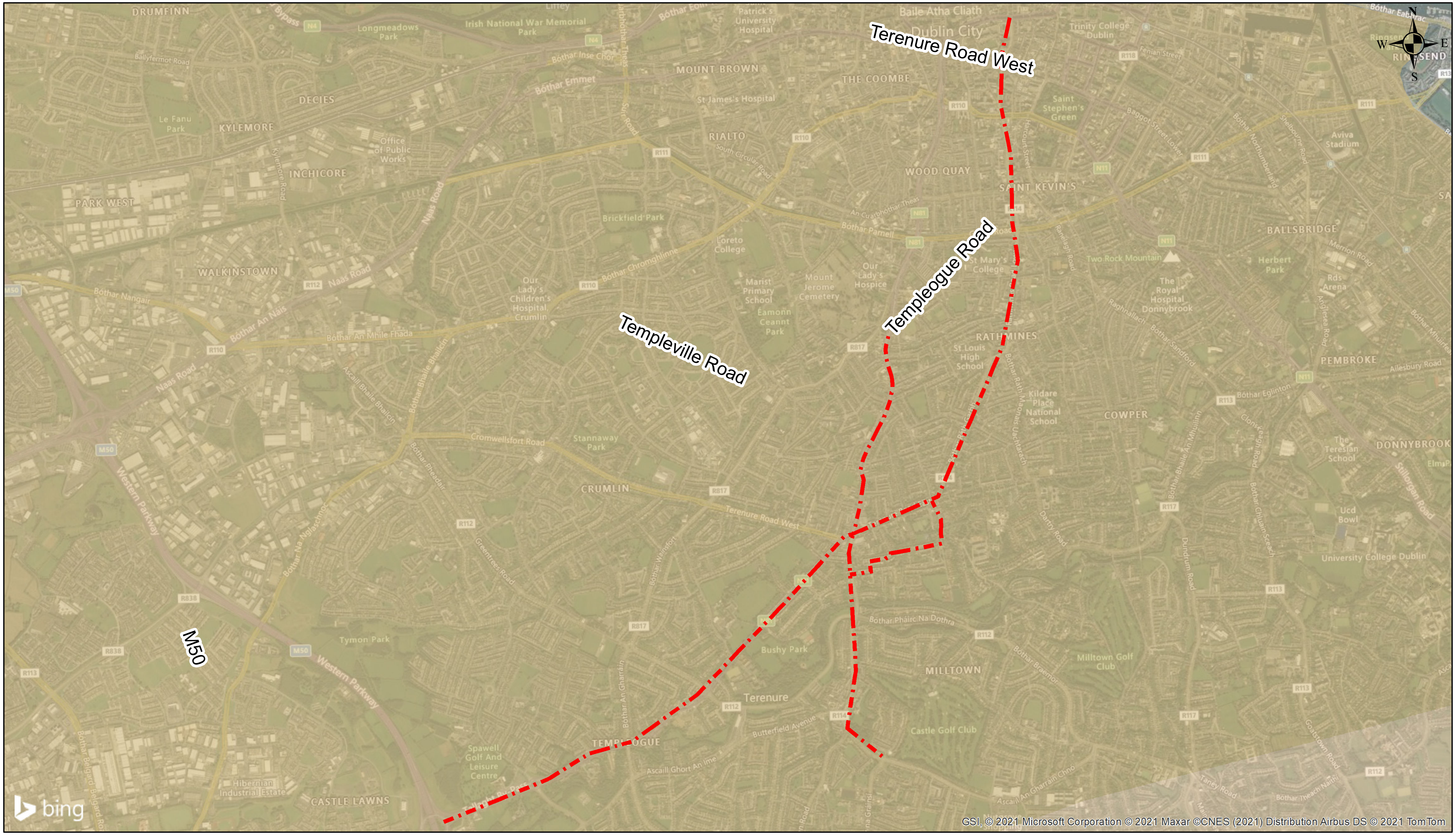
Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI GeoUrban

Depth to Bedrock

268401

FIGURE **A23**



Legend

- Alignment
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Bedrock Aquifer Faults

ARUP

1:27,500

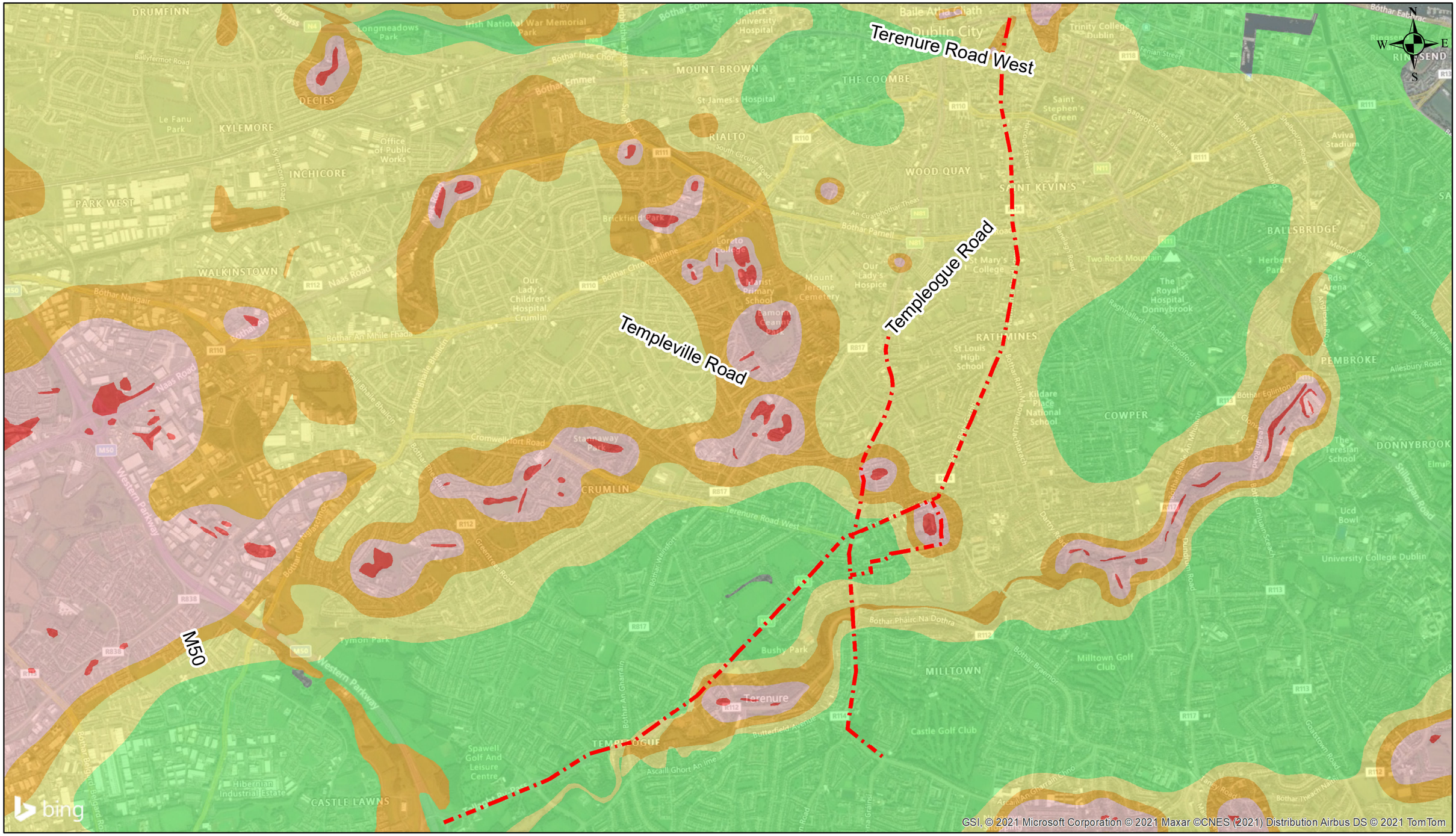
0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Groundwater Aquifer

268401

FIGURE **A24**



Legend

Alignment

Groundwater Vulnerability

Vulnerability Description

- X - Rock at or near surface or Karst
- E - Extreme
- H - High
- M - Moderate
- L - Low
- W - Water

ARUP

1:27,500

0 250 500 1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Groundwater Vulnerability

268401

FIGURE **A25**

Legend

- Alignment
- Groundwater Wells and Springs

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI GW Wells & Springs

ARUP

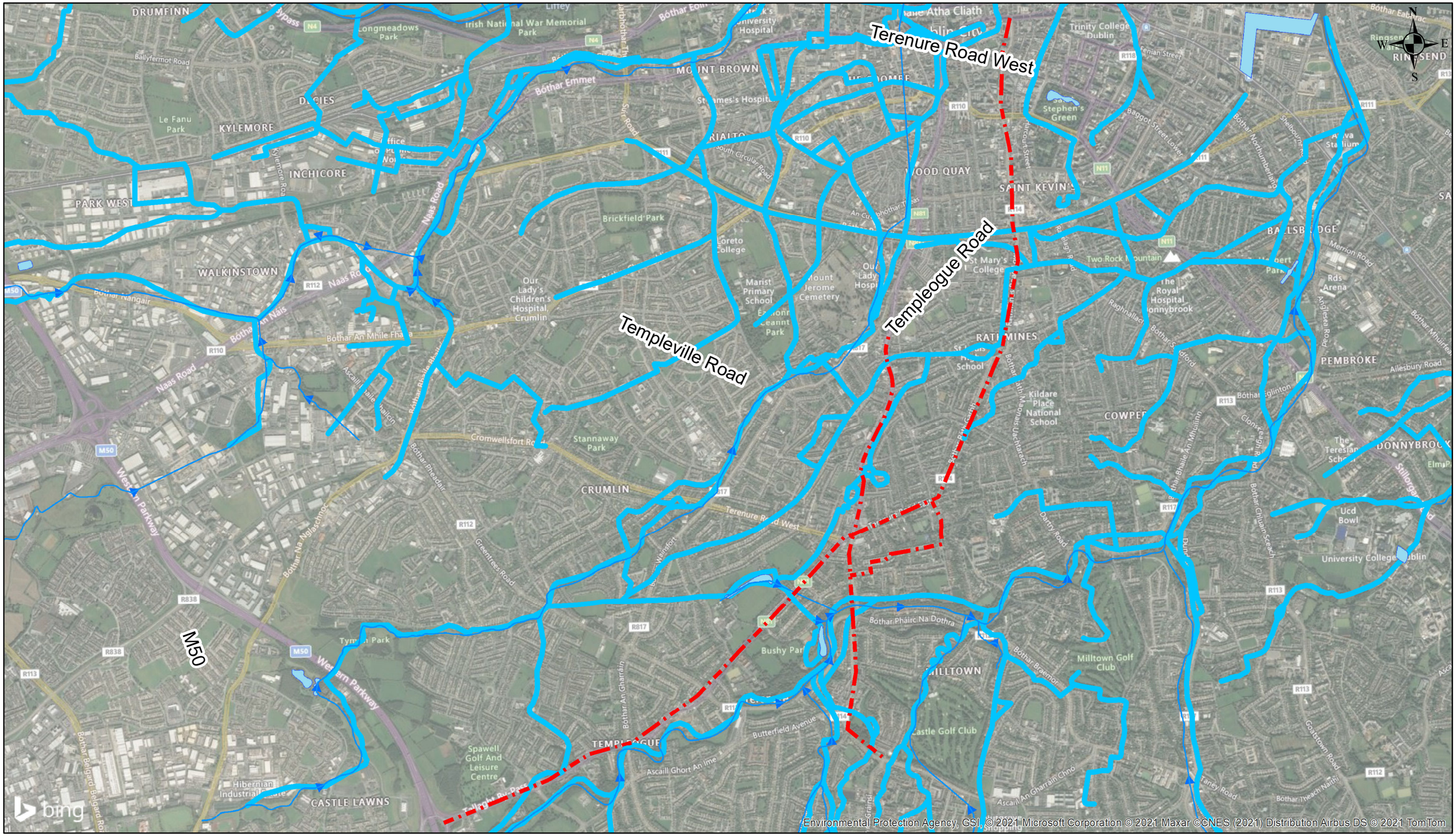
1:27,500

Meters

1,000 1,500

268401

FIGURE **A26**



Legend

- Alignment
- River Network and River Flow Direction Arrows
- Lake Segments

Estimated Historic Rivers and Streams

- Estimated Historic Rivers and Streams

ARUP

1:27,500

Meters

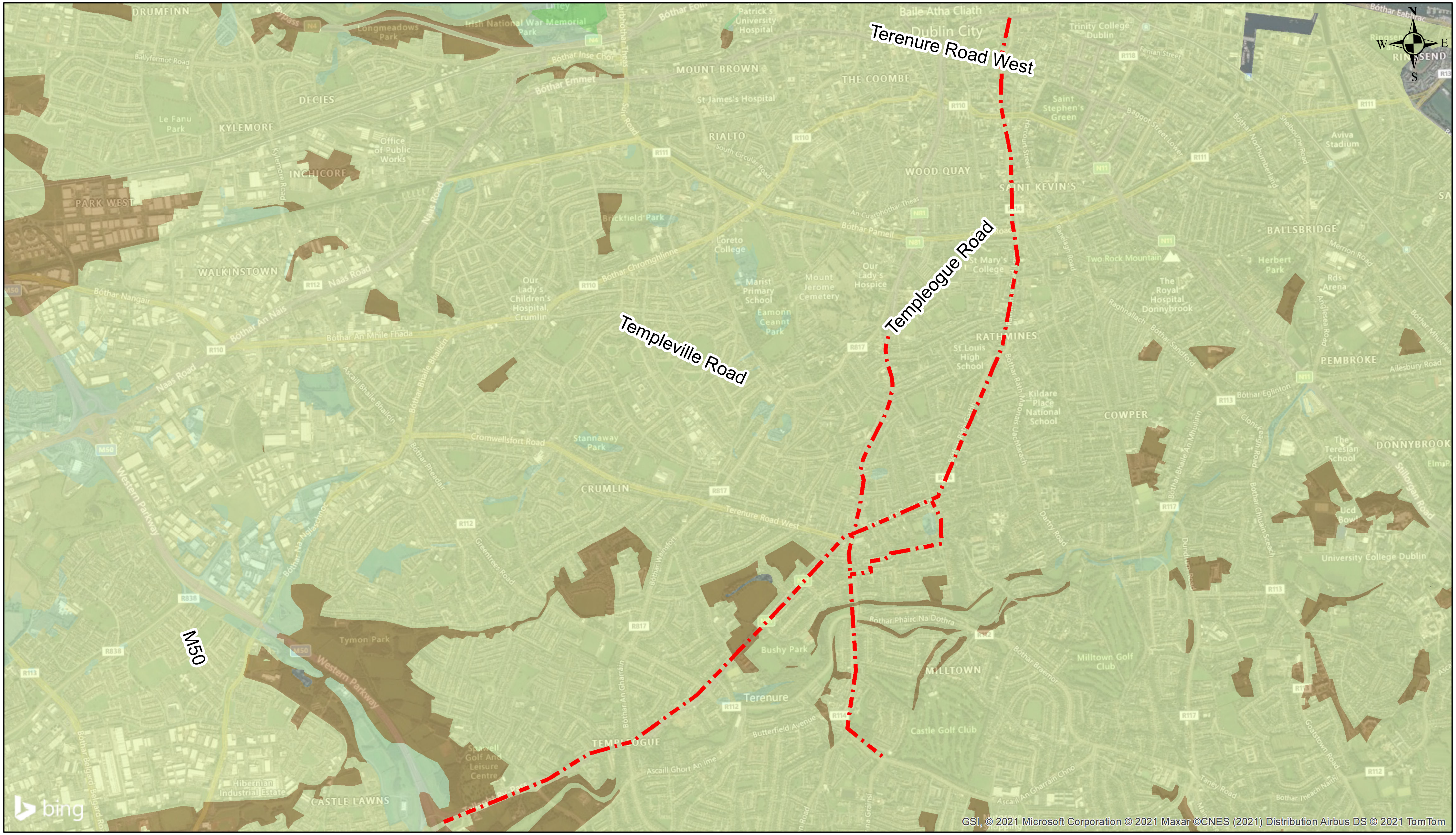
1,000 1,500

Templeogue/Rathfarnham to City Centre Core Bus Corridor

River of Dublin & EPA Waterbodies

268401

FIGURE **A27**



Legend

Alignment

Groundwater Recharge

Annual Recharge (mm)

- 0
- 1-50mm
- 51-100mm
- 101-150mm
- 151-200mm
- 201-250mm
- 251-300mm
- 301-350mm
- 351-400mm
- 401-450mm
- 451-500mm
- 501-550mm
- 551-600mm
- 601-700mm
- 701-800mm
- 801-900mm
- 901-1000mm
- 1001-1400mm
- 1401-2000mm
- Water

ARUP

1:27,500

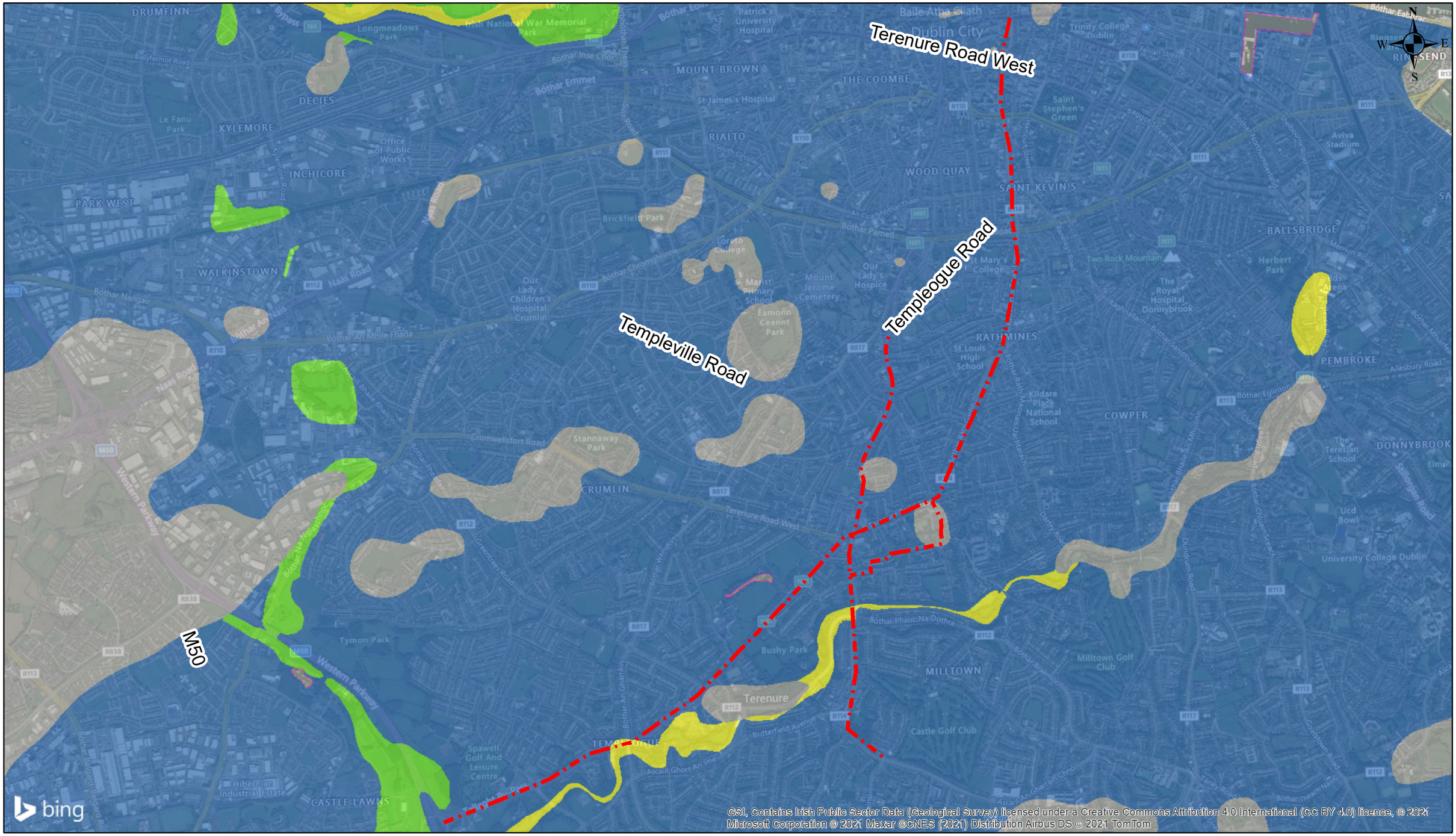
Meters
1,000 1,500

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Groundwater Recharge

268401

FIGURE **A28**



Legend

- Alignment

Subsoil Permeability

- High
- Moderate
- Low
- Water
- Not mapped

ARUP

1:27,500

Meters

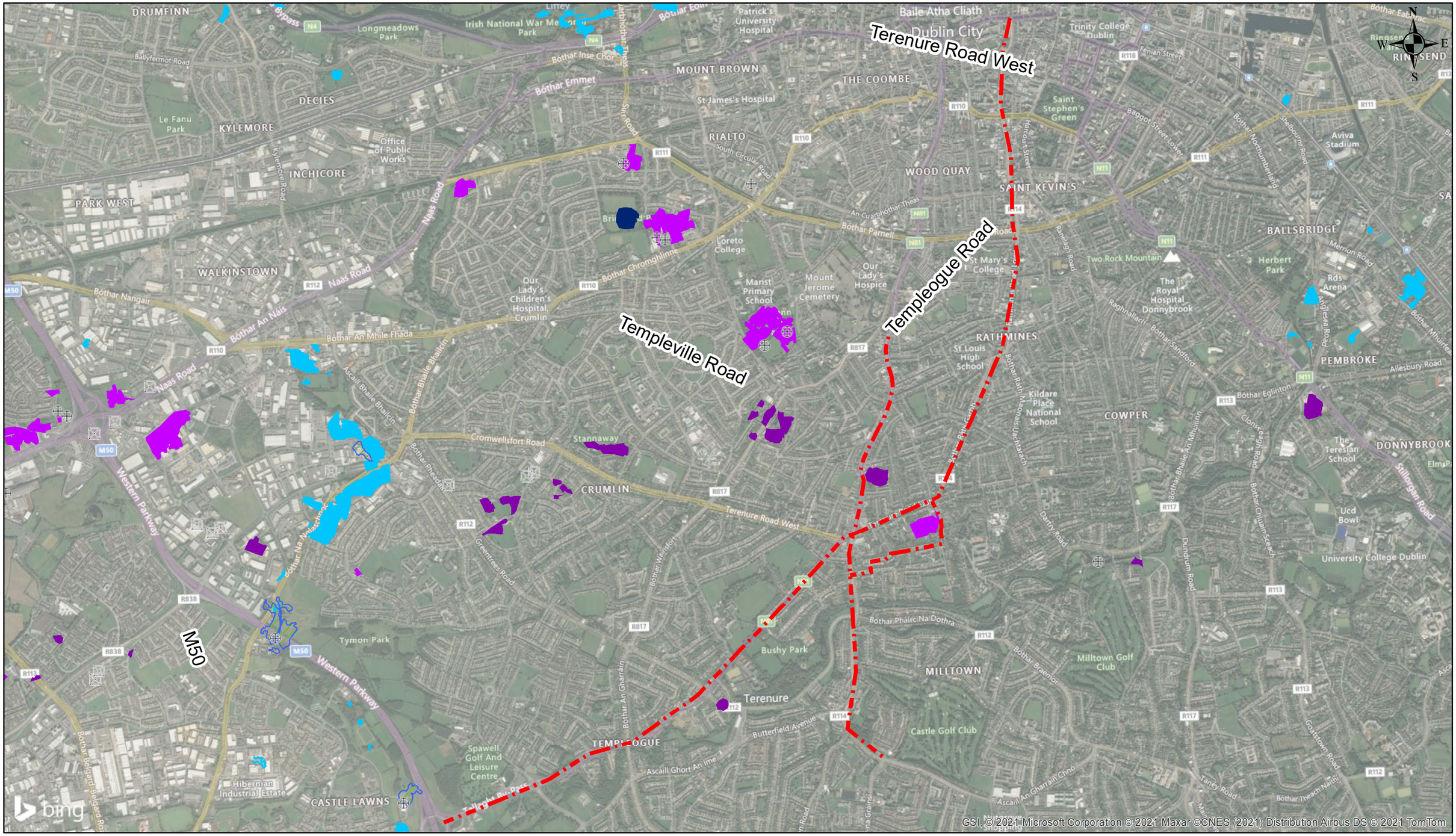
1,000 1,500

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Subsoil Permeablity

268401

FIGURE **A29**



Legend

- Alignment
- Pit
- Quarry
- Brickfields
- No Info
- Mid-20thC: Pits
- Early to Mid-20thC: Pits
- Mid-19thC: Pits
- Early to Mid-20thC: Quarries
- Mid-19thC: Quarries

ARUP

1:27,500

1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Active and Historic Pits & Quarries

268401

FIGURE **A30**

Legend

- Alignment
- Not Specified
- Both
- Metallic
- Non-metallic

ARUP

1:27,500

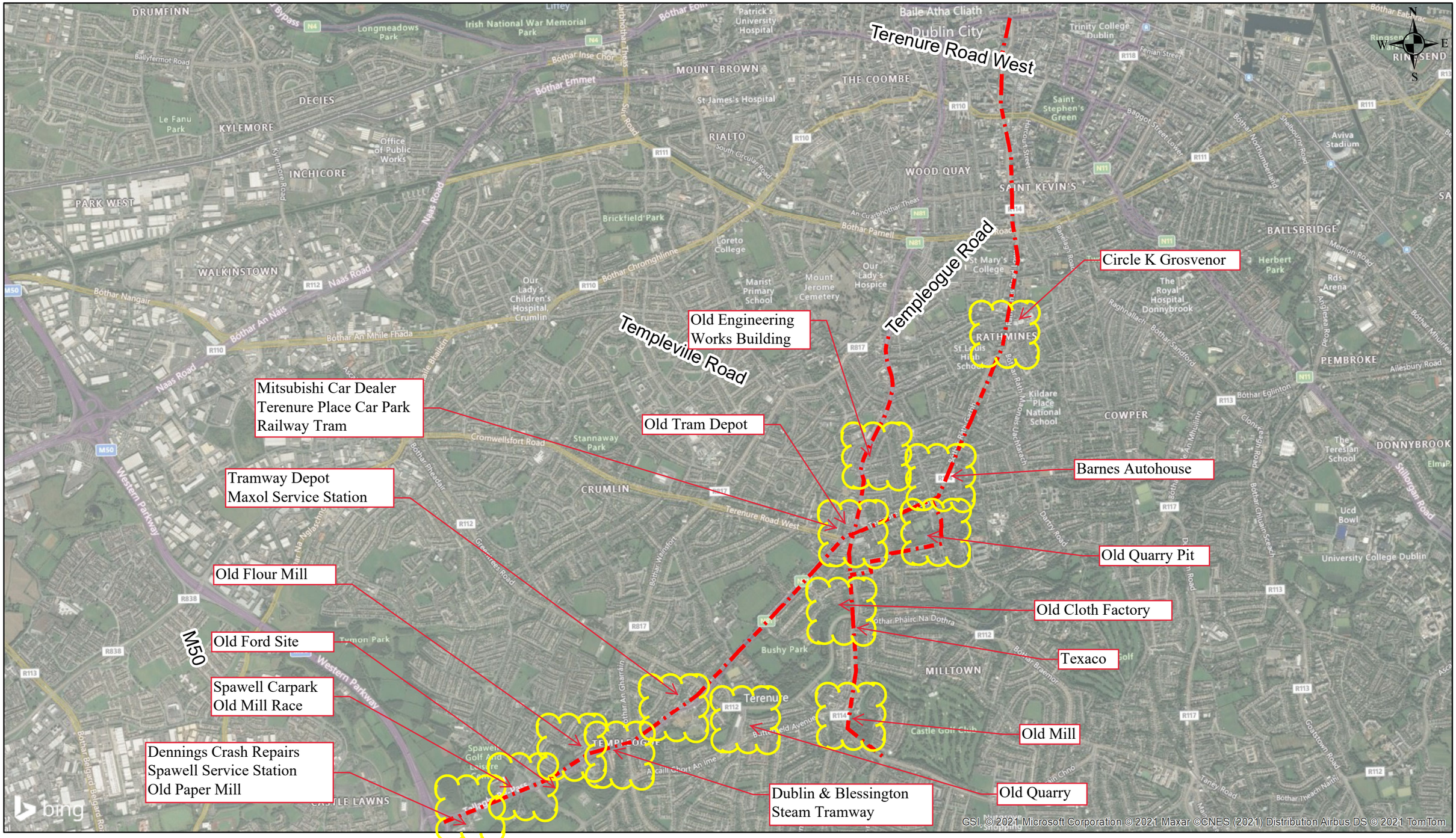
1,000 1,500 Meters

Templeogue/Rathfarnham to City Centre Core Bus Corridor

GSI Mineral Localities

268401

FIGURE **A31**



Legend

Alignment

Templeogue/Rathfarnham to City Centre Core Bus Corridor

Potential Sources of Contamination

ARUP

1:27,500

Meters

1,000 1,500

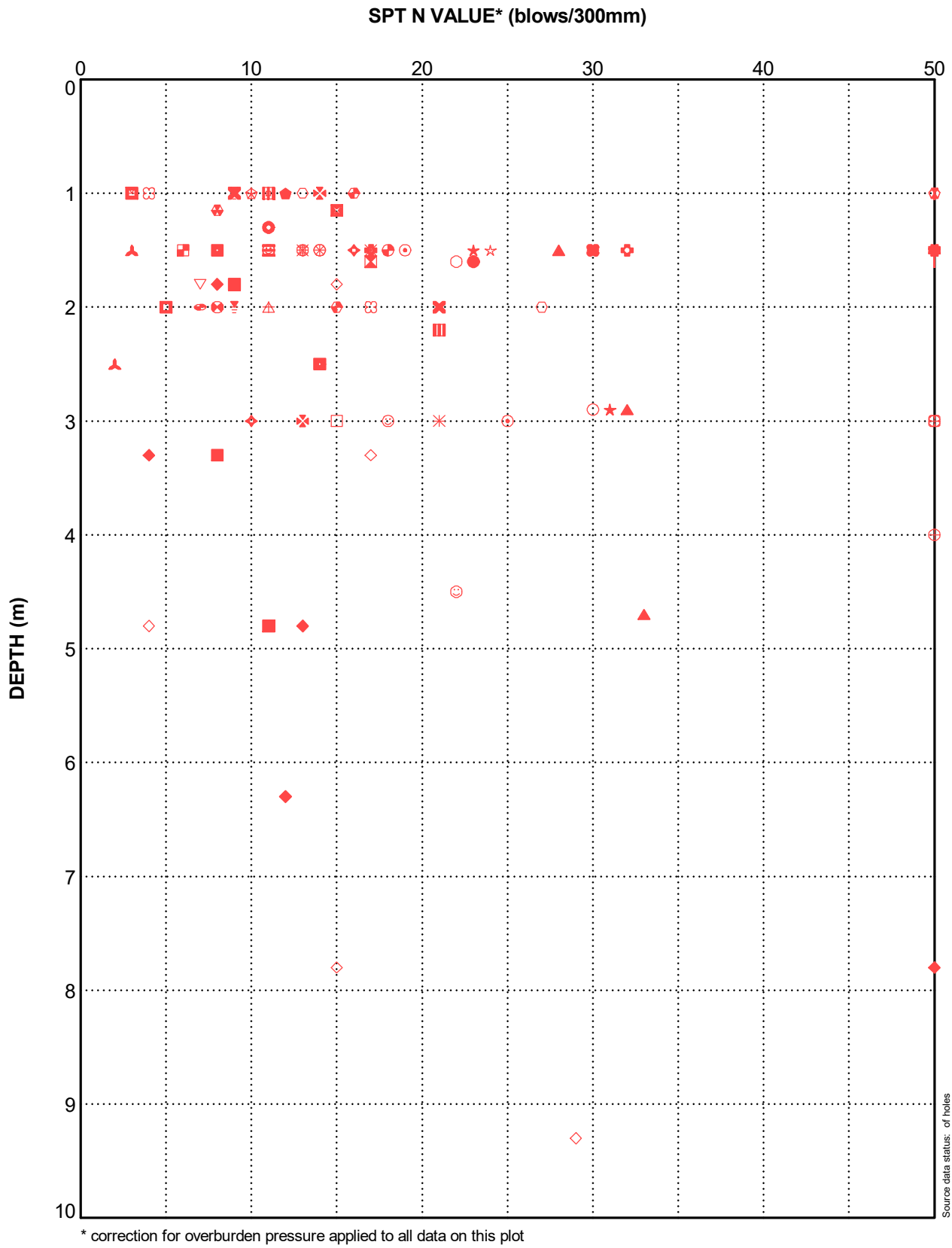
268401

FIGURE **A32**

Appendix B

In-Situ Testing Figures

B1



Topsoil
Rock
Granular Deposits
Made Ground
Glacial Till Deposits

R12-CP02
R12-CP03
R1364/B67503
R1364/B67504
R1364/B67505
R1364/B67506
R1364/B67507
R167/B51620
R167/B51623
R167/B51626
R167/B51632
R167/B51636
R179/B51703
R179/B51704
R179/B51705
R204/B51944
R204/B51945
R204/B51946
R207/B51955
R207/B51956
R2214/B85117
R2227/B85210
R2245/B85275
R2900/B93114
R2900/B93115
R2900/B93116
R3040/B94930
R3059/B95098
R3059/B95099
R3059/B95100
R367/B58185
R367/B58186
R367/B58188

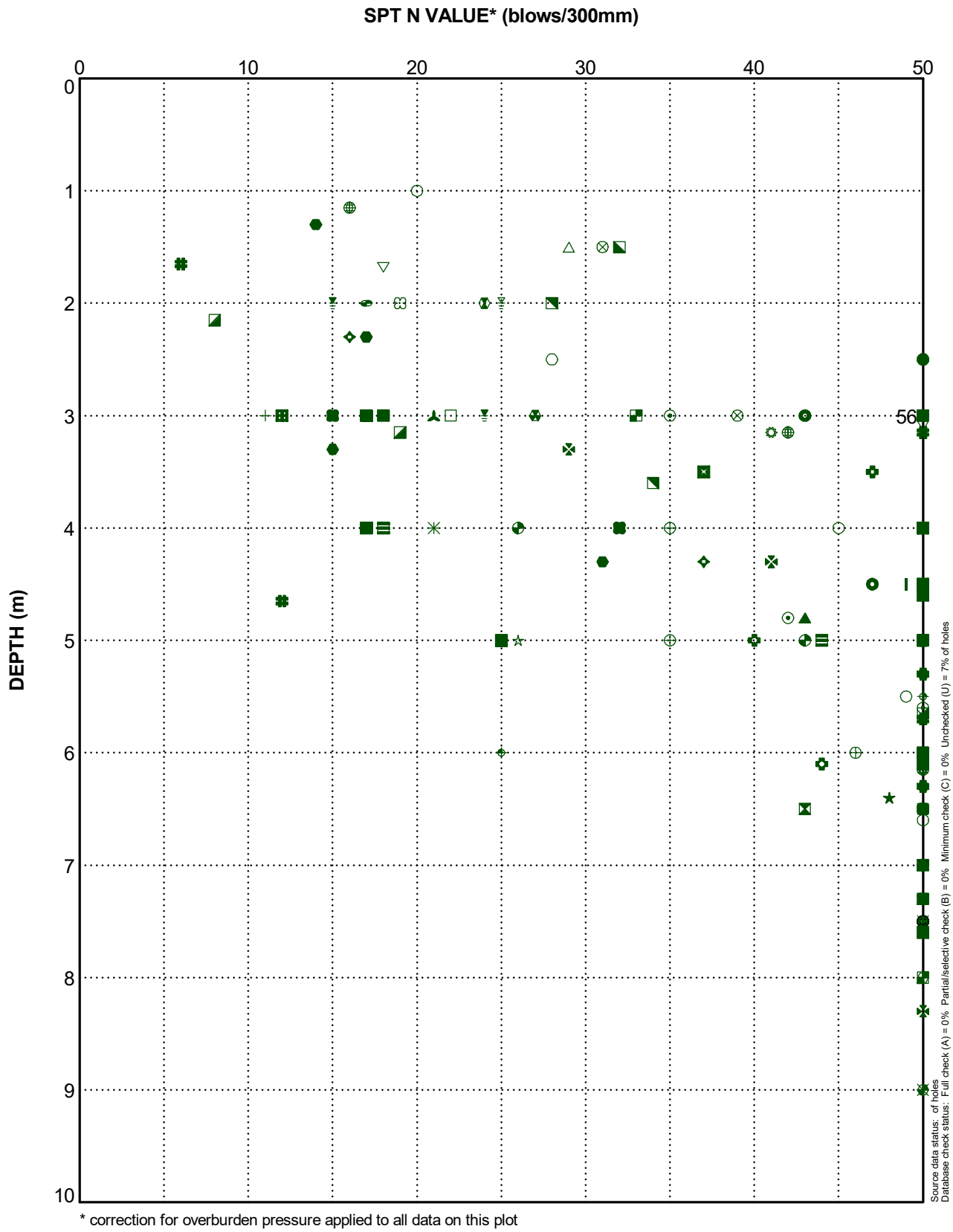
More than 33 boreholes selected. Not all symbols can be shown on legend.

<<DrawingFileSpec>>

Bus Connect
STANDARD PENETRATION TESTS
The Proposed Scheme – Templeogue/ Rathfarnham to City Centre Core Bus Corridor
Made Ground

268401-00

FIGURE B01



* correction for overburden pressure applied to all data on this plot

Topsoil
Made Ground
Rock
Glacial Till Deposits
Granular Deposits

R12-CP03	R167/B51626	R2227/B85210
R1364/B67503	R167/B51627	R2245/B85274
R1364/B67504	R167/B51632	R2245/B85275
R1364/B67505	R167/B51635	R2900/B93114
R1364/B67506	R167/B51636	R2900/B93115
R1364/B67507	R179/B51703	R2900/B93116
R1364/B67508	R179/B51704	R3040/B94930
R137/B51395	R179/B51705	R3040/B94931
R137/B51396	R207/B51955	R3040/B94932
R167/B51620	R207/B51956	R3059/B95098
R167/B51623	R2214/B85117	R3059/B95099

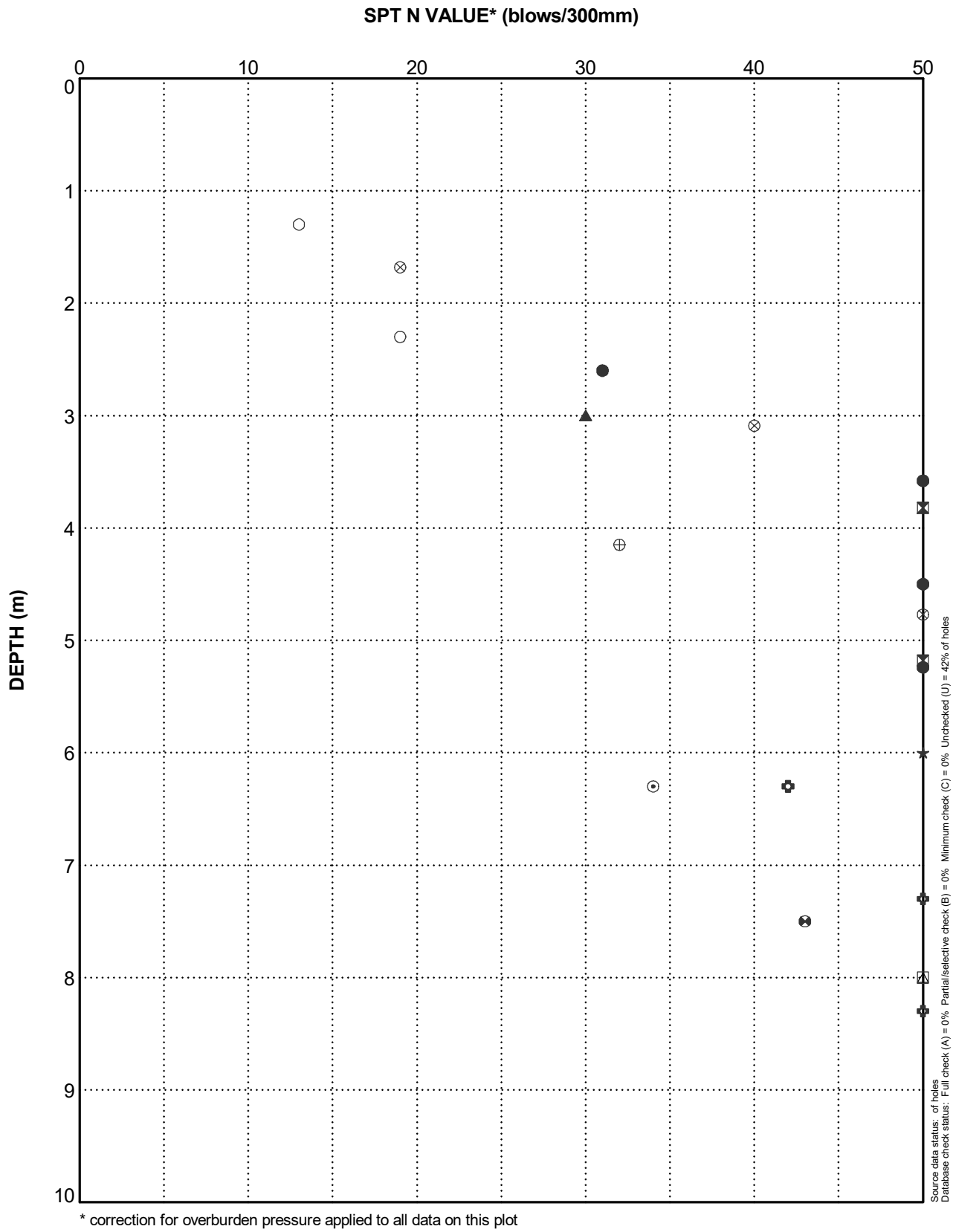
More than 33 boreholes selected. Not all symbols can be shown on legend.

<<DrawingFileSpec>>

Bus Connect
STANDARD PENETRATION TESTS
The Proposed Scheme – Templeogue/ Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits

268401-00

FIGURE B02



* correction for overburden pressure applied to all data on this plot

- Topsoil
- Rock
- Granular Deposits
- Made Ground
- Glacial Till Deposits
- R12-CP02
- R12-CP03
- R167/B51620
- R167/B51632
- R204/B51944
- R3040/B94930
- R3040/B94931
- R4883/B128727
- R669/B60532
- R960/B62753
- R962/B62763
- R983/B62934

<<DrawingFileSpec>>

Bus Connect
STANDARD PENETRATION TESTS
The Proposed Scheme – Templeogue/ Rathfarnham to City Centre Core Bus Corridor
Granular Deposits

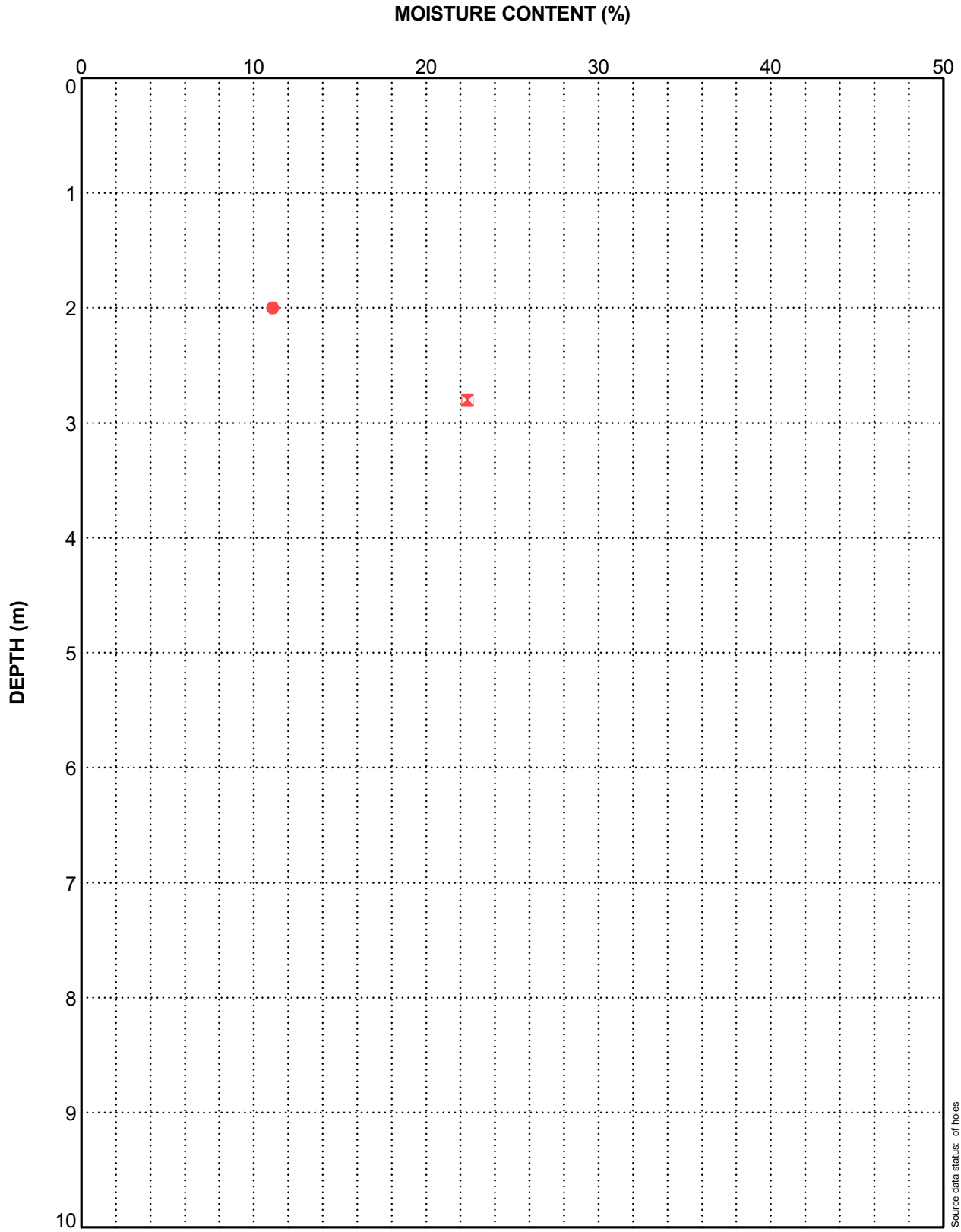
268401-00

FIGURE B03

Appendix C

Laboratory Testing Figures

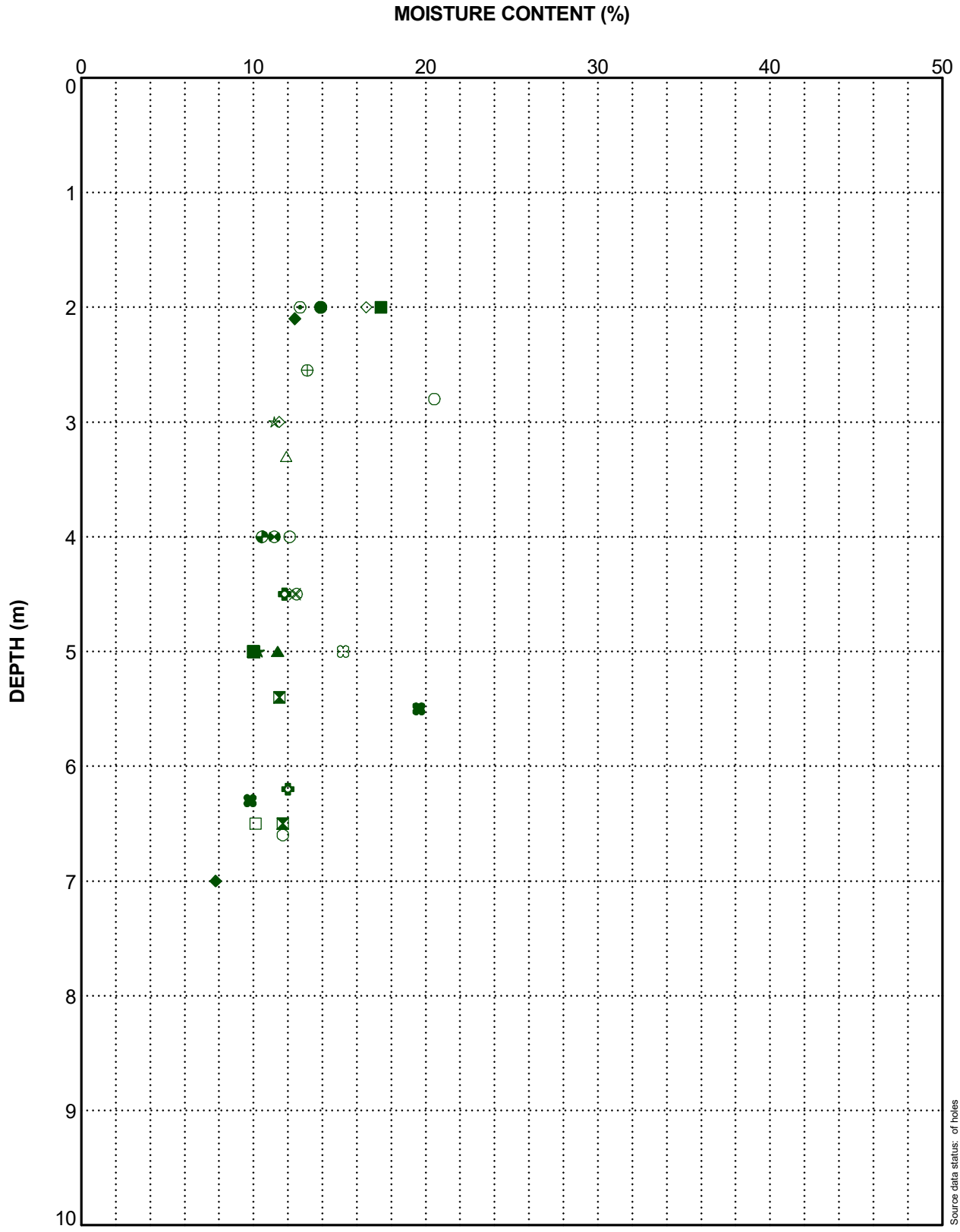
C1



Bus Connect
MOISTURE CONTENT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Made Ground

FIGURE C01

268401-00



Topsoil
Rock
Granularl Deposits
Made Ground
Glacial Till Deposits

R12-CP03
R1364/B67503
R1364/B67504
R1364/B67505
R1364/B67506
R1364/B67507
R1364/B67508
R3059/B95098
R3059/B95099
R367/B58185
R367/B58186
R367/B58188
R4883/B128726
R4883/B128727
R4883/B128728
R4883/B128731
R4883/B128732
R5464/B134039
R841/B62002
R989/B62971

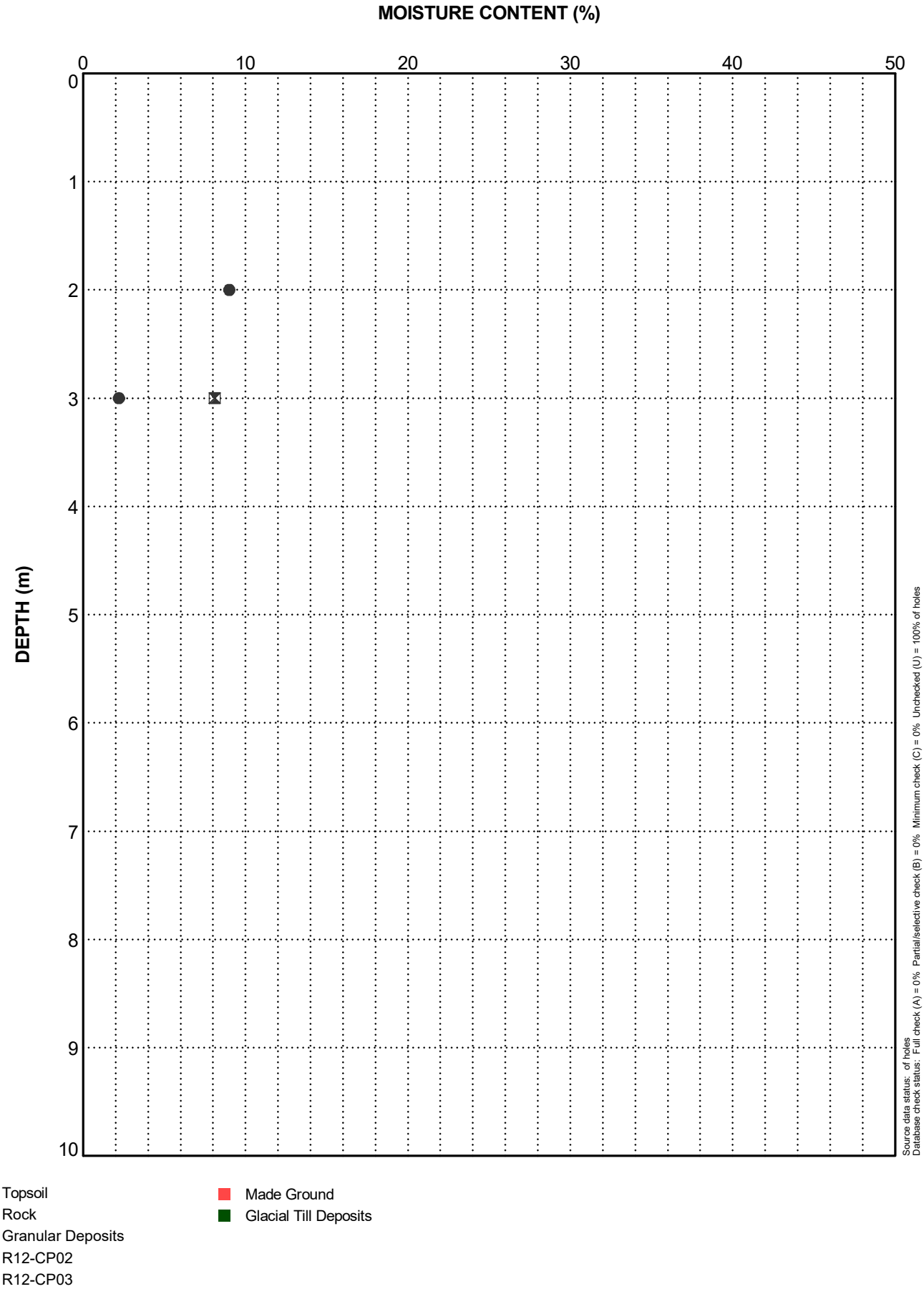
<<DrawingFileSpec>>

gINT v10.00.01.07 Licenced to Arup
Project : c:\users\ozgur.alper\desktop\job shortcuts\arup_job\268401-00_bus connects\gir\r12\02_gint\route10-12.gpj, (Template : 3.0); Library : \\global\europe\dublin\jobs2_civil\ground engineering\1.0 technical\personal folders\ozgur alper\gint\arup_uklib_3-0-002-8.glb
Graph: 3.3.01.D MOISTURE CONTENT (ALL TABLES) (rev 9Feb11)
gINT output page 1 of 1. Made 6Jul'21 14:13

Bus Connect
MOISTURE CONTENT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits

FIGURE **C02**

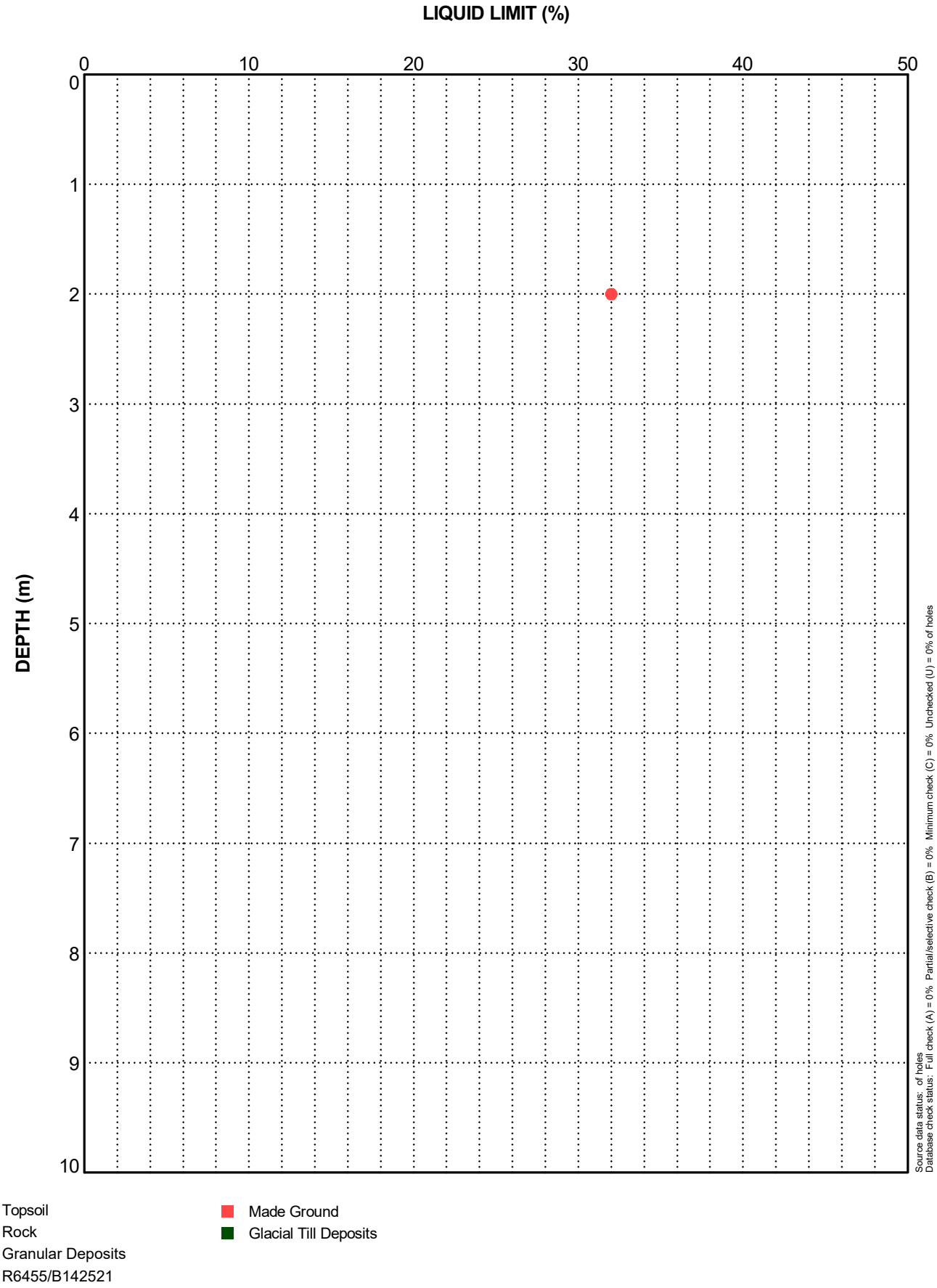
268401-00



Bus Connect
MOISTURE CONTENT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Granular Deposits

FIGURE C03

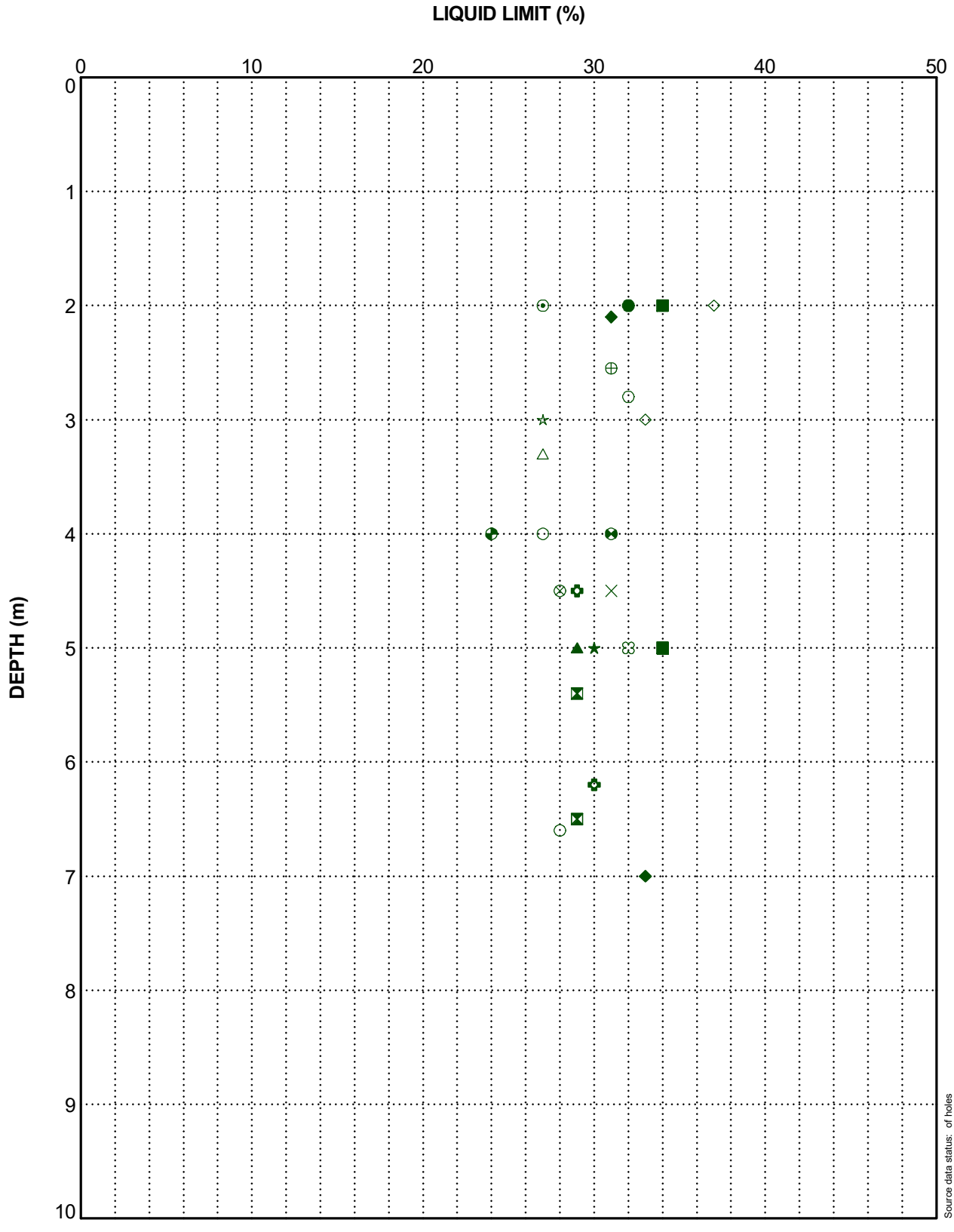
268401-00



Bus Connect
LIQUID LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Made Ground

FIGURE C04

268401-00



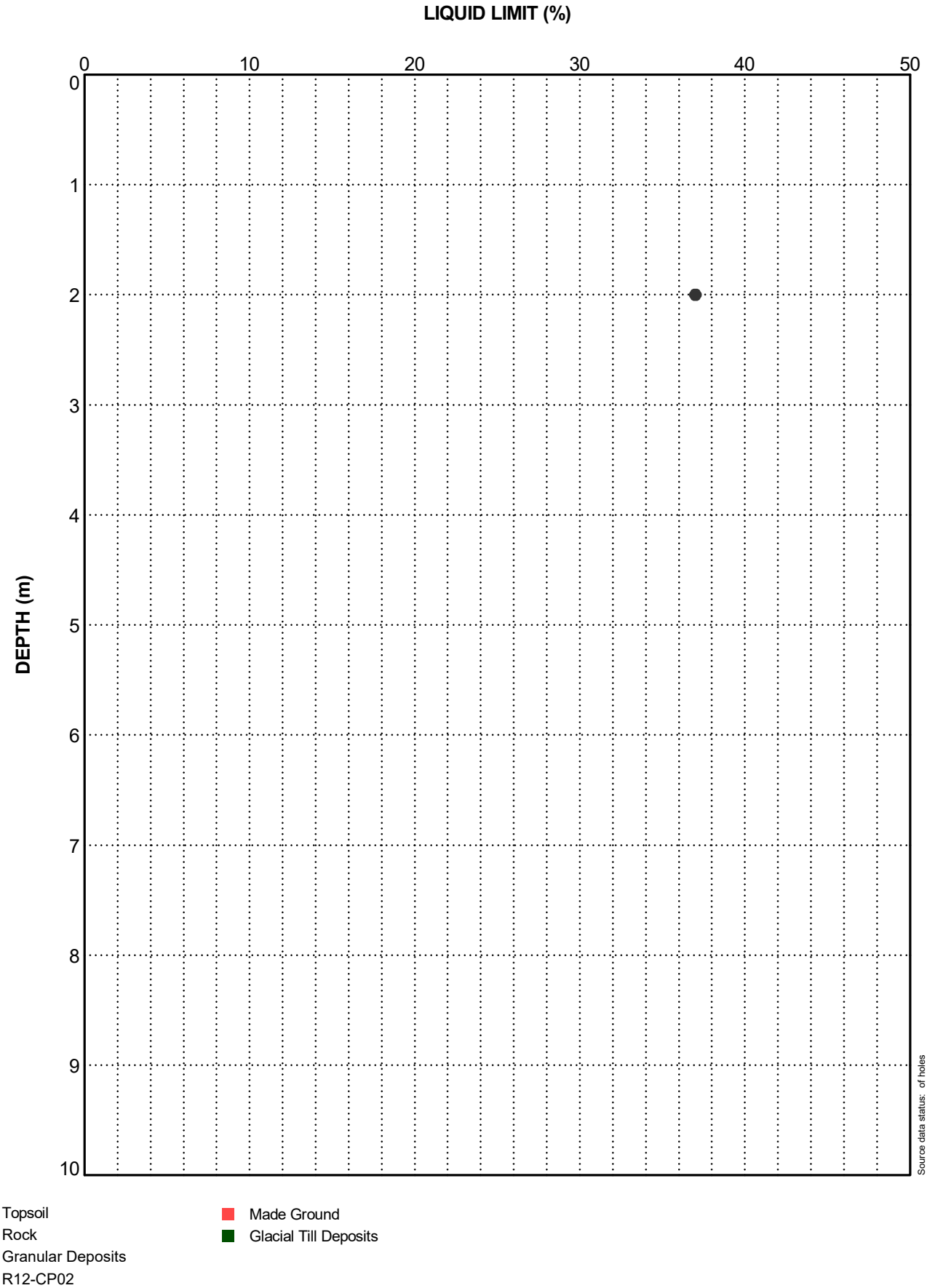
- Topsoil
- Rock
- Granular Deposits
- Made Ground
- Glacial Till Deposits
- R12-CP03
- R1364/B67503
- R1364/B67504
- R1364/B67505
- R1364/B67506
- R1364/B67507
- R1364/B67508
- R3059/B95098
- R3059/B95099
- R367/B58185
- R367/B58186
- R367/B58188
- R4883/B128726
- R4883/B128727
- R4883/B128728
- R4883/B128731
- R4883/B128732
- R5464/B134039
- R841/B62002

<<DrawingFileSpec>>

Bus Connect
LIQUID LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits

FIGURE **C05**

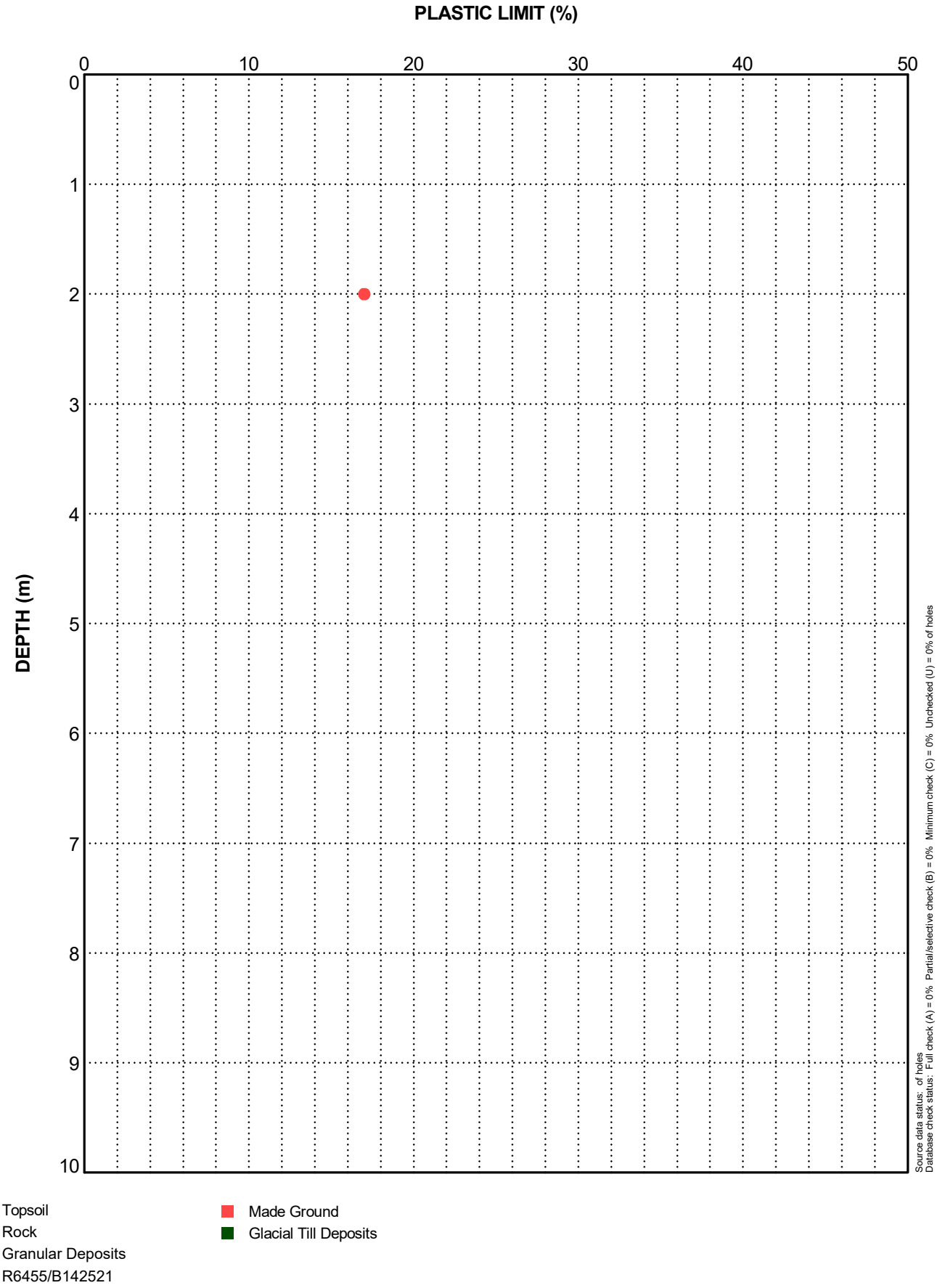
268401-00



Bus Connect
LIQUID LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Granular Deposits

FIGURE C06

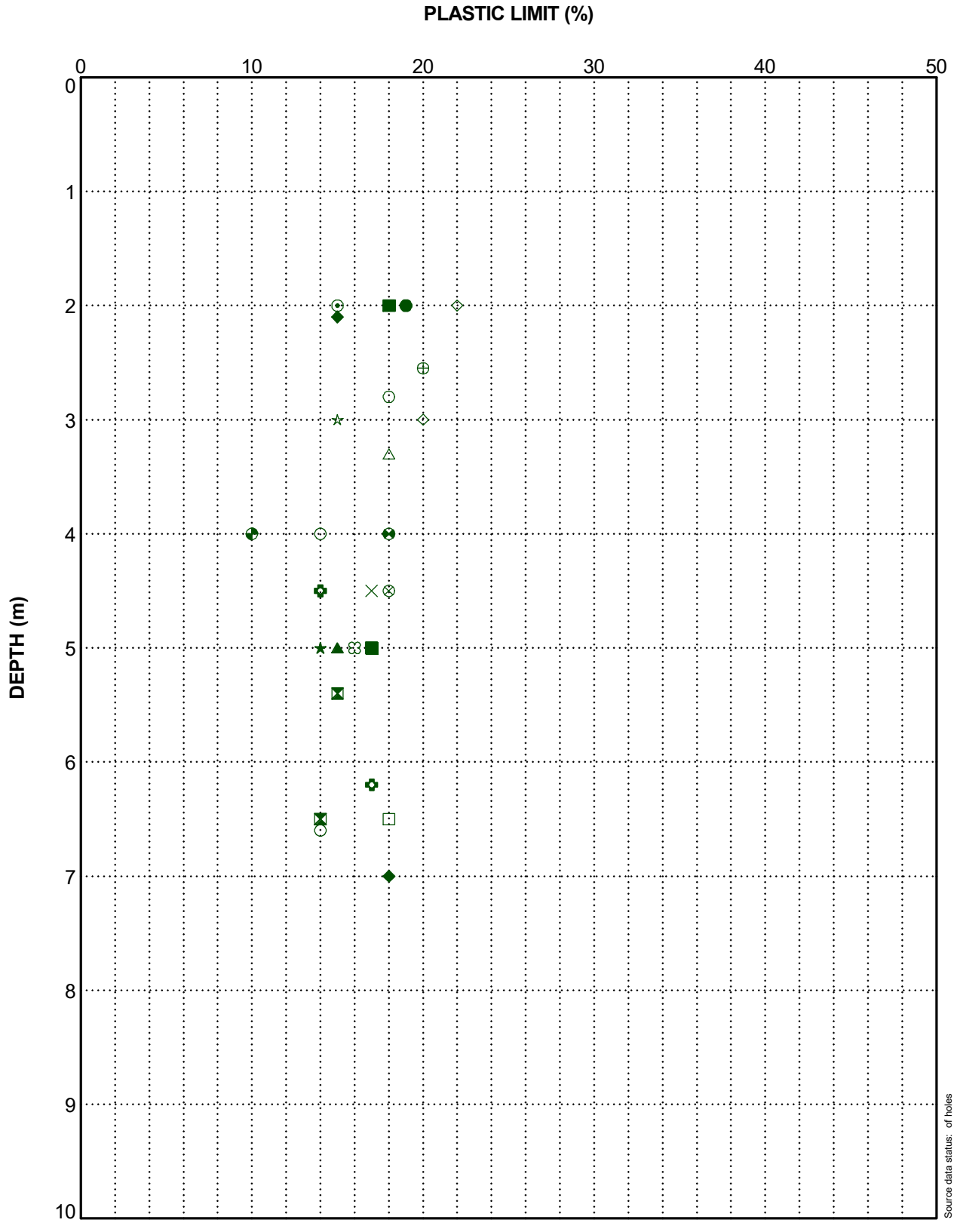
268401-00



Bus Connect
PLASTIC LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Made Ground

FIGURE C07

268401-00



Topsoil
Rock
Granular Deposits
R12-CP03
R1364/B67503
R1364/B67504
R1364/B67505
R1364/B67506
R1364/B67507
R1364/B67508
R3059/B95098
R3059/B95099
R367/B58185
R367/B58186
R367/B58188
R4883/B128726
R4883/B128727
R4883/B128728
R4883/B128731
R4883/B128732
R5464/B134039
R841/B62002
Made Ground
Glacial Till Deposits

<<DrawingFileSpec>>

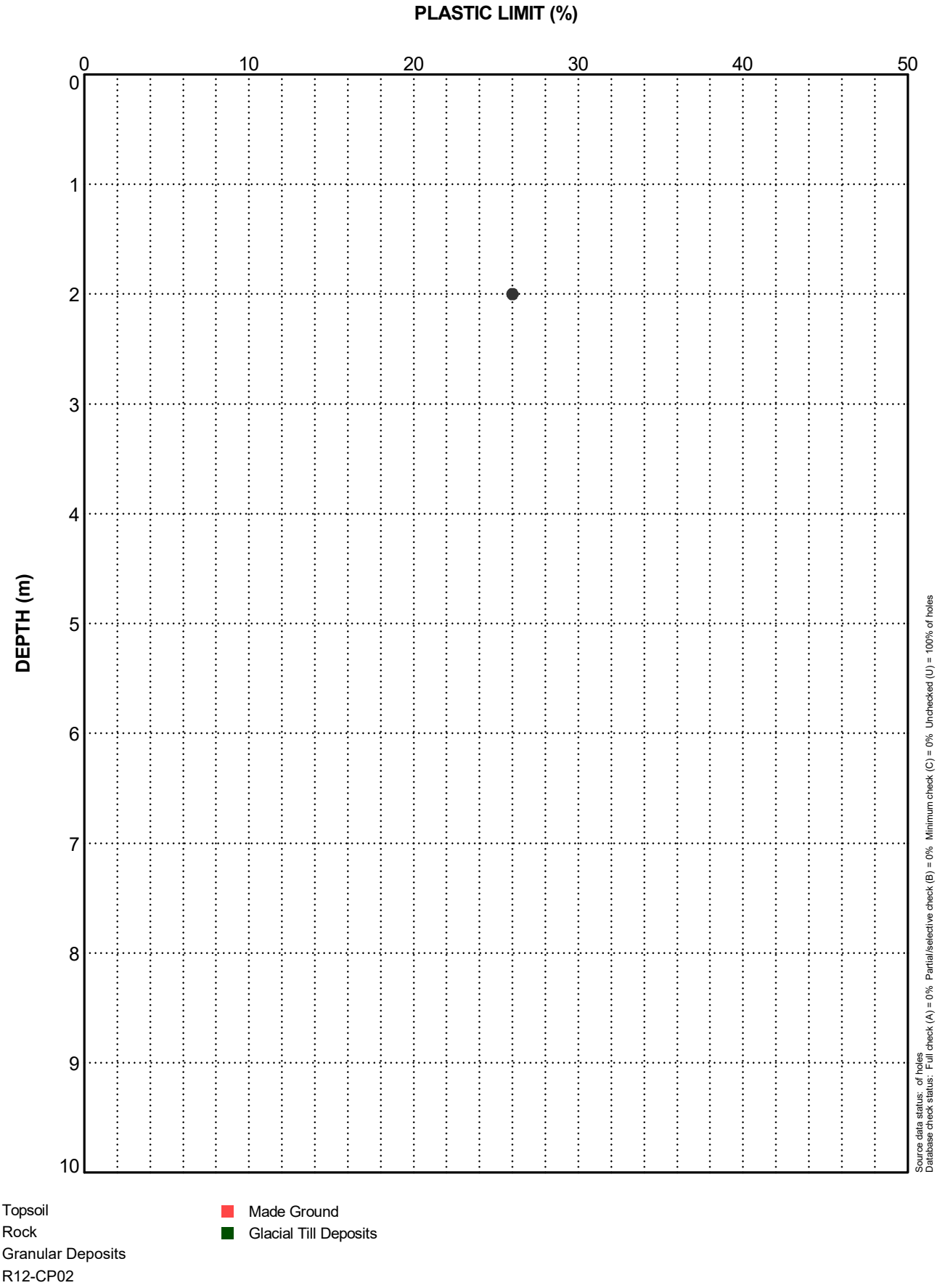
Source data status: of holes
Database check status: Full check (A) = 0% Partial/selective check (B) = 0% Minimum check (C) = 0% Unchecked (U) = 5% of holes

gINT v10.00.01.07 Licenced to Arup
Project : c:\users\ozgur.alper\desktop\job shortcuts\arup job\268401-00_bus connects\gir\r12\02_gint\route10-12.gpj, (Template : 3.0); Library : \\global\europe\dublin\jobs2_civil\ground engineering\1.0 technical\personal folders\ozgur alper\gint\arup_uklib_3-0-002-8.glb
Graph: 3.3.12.D PLASTIC LIMIT (rev 9Feb11)
gINT output page 1 of 1. Made 7Jul21 11:39

Bus Connect
PLASTIC LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits

FIGURE **C08**

268401-00

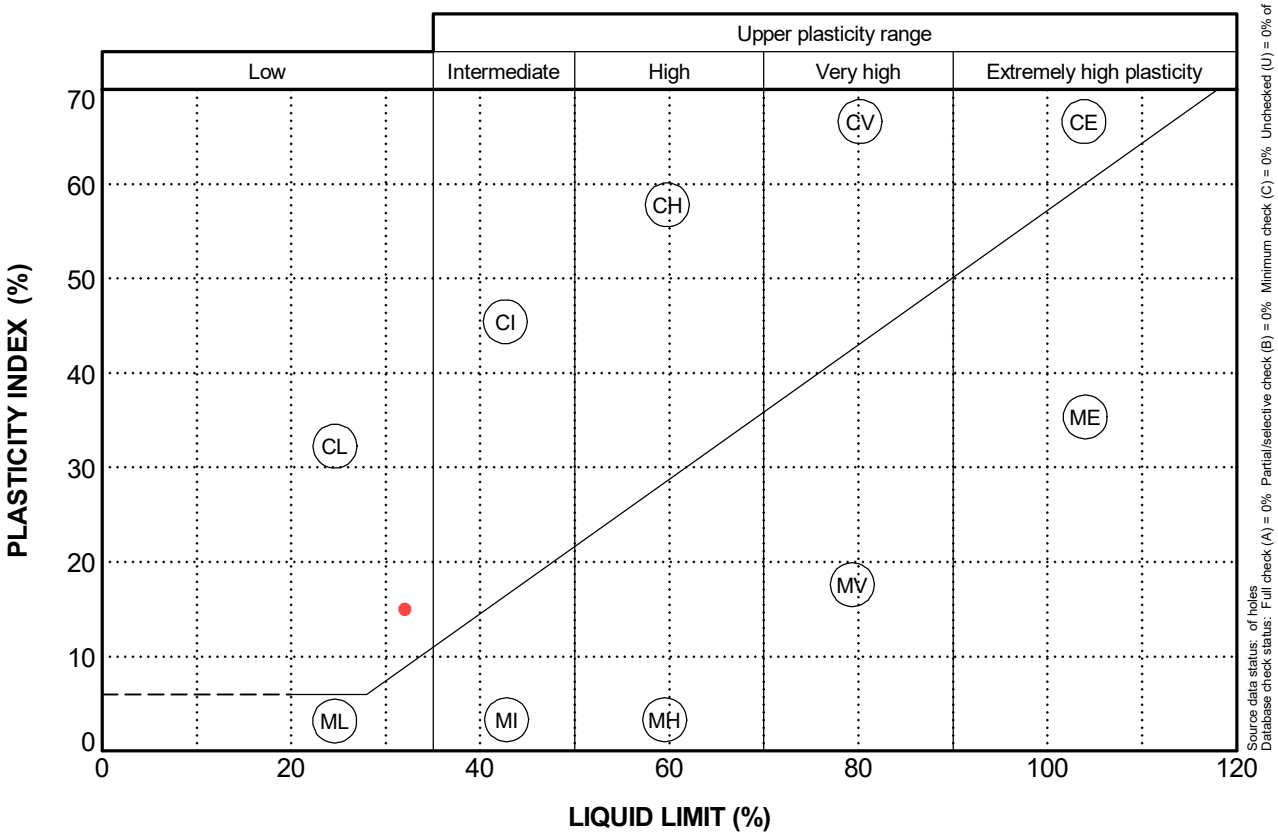


Bus Connect
PLASTIC LIMIT
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Granular Deposits

FIGURE C09

268401-00

<<DrawingFileSpec>>



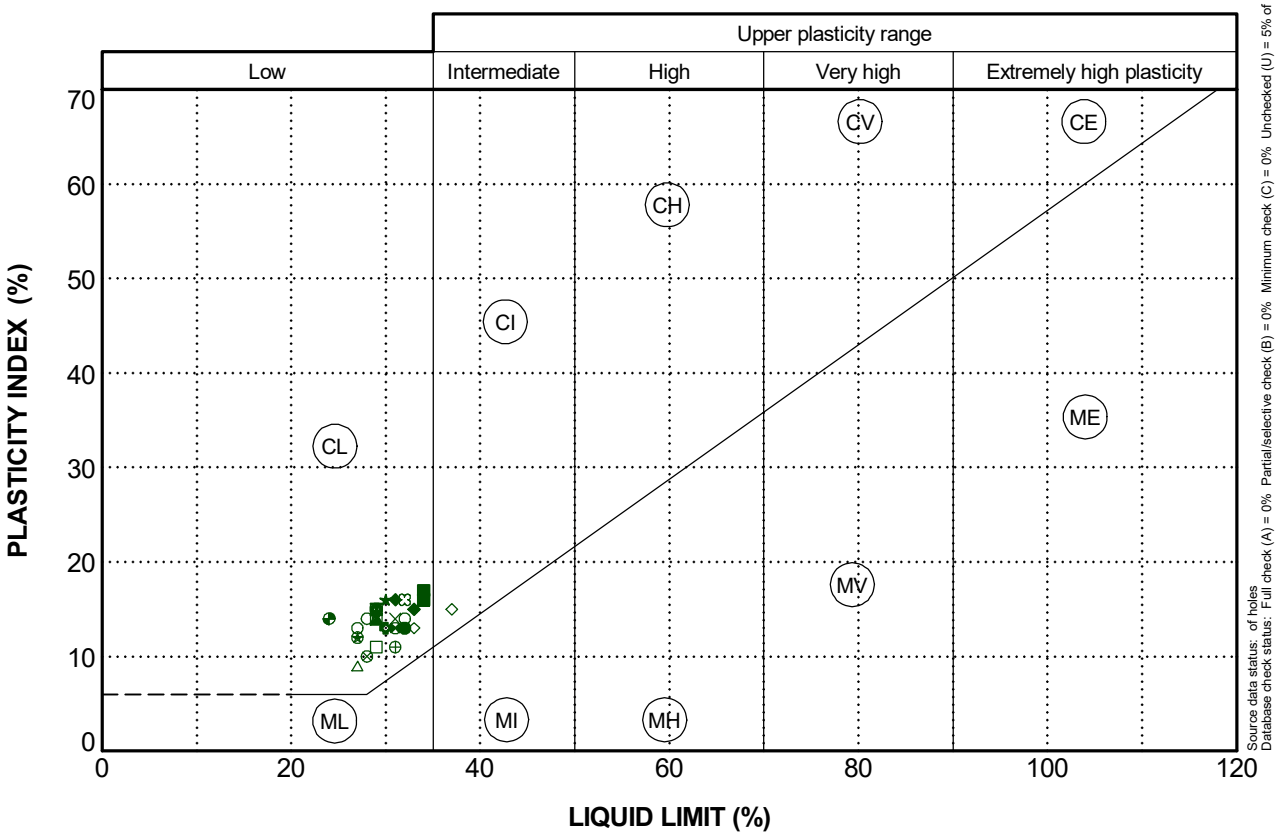
Topsoil
Rock
Granular Deposits
R6455/B142521
Made Ground
Glacial Till Deposits

Bus Connect
PLASTICITY CHART
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Made Ground

FIGURE C10

268401-00

<<DrawingFileSpec>>



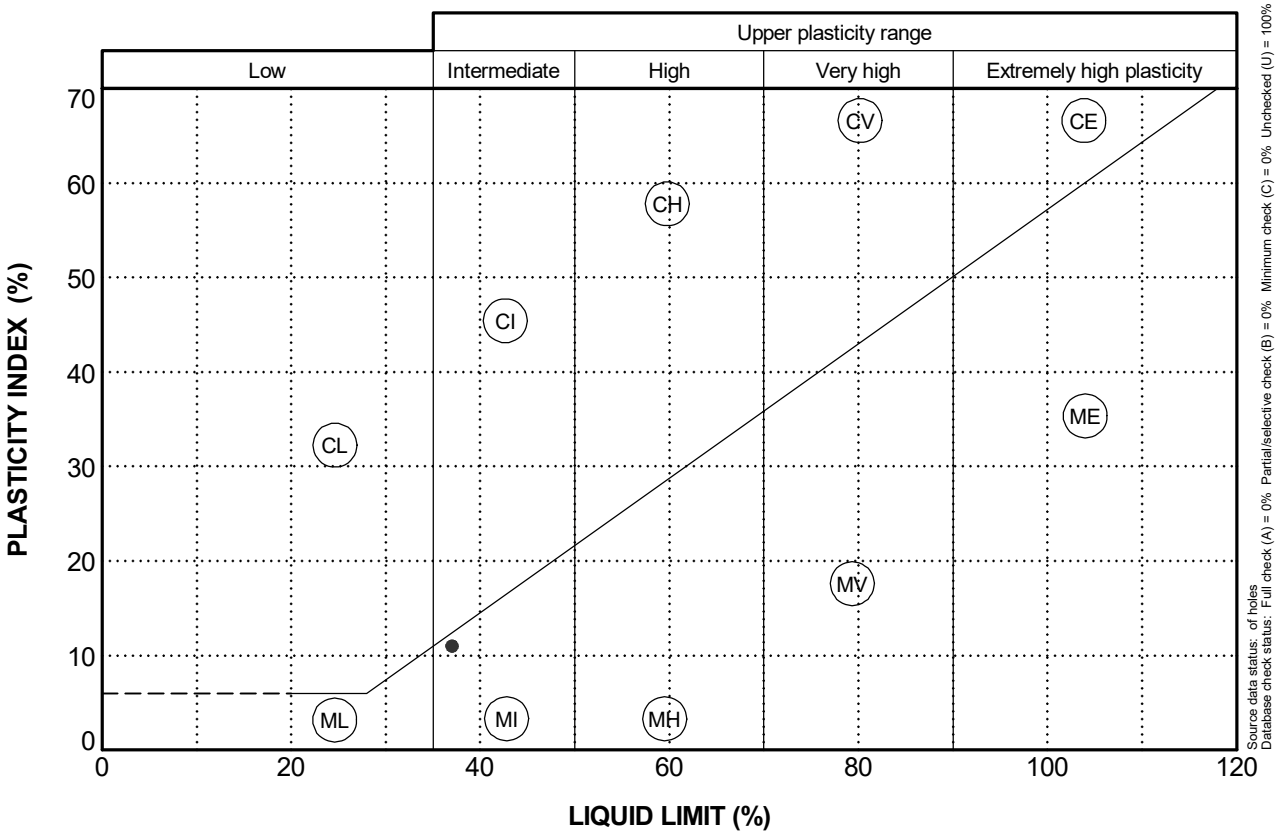
Topsoil
Rock
Granular Deposits
R12-CP03
R1364/B67503
R1364/B67504
R1364/B67505
R1364/B67506
R1364/B67507
R1364/B67508
R3059/B95098
R3059/B95099
R367/B58185
R367/B58186
Made Ground
Glacial Till Deposits
R367/B58188
R4883/B128726
R4883/B128727
R4883/B128728
R4883/B128731
R4883/B128732
R5464/B134039
R841/B62002

<<DrawingFileSpec>>

Bus Connect
PLASTICITY CHART
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits

FIGURE **C11**

268401-00



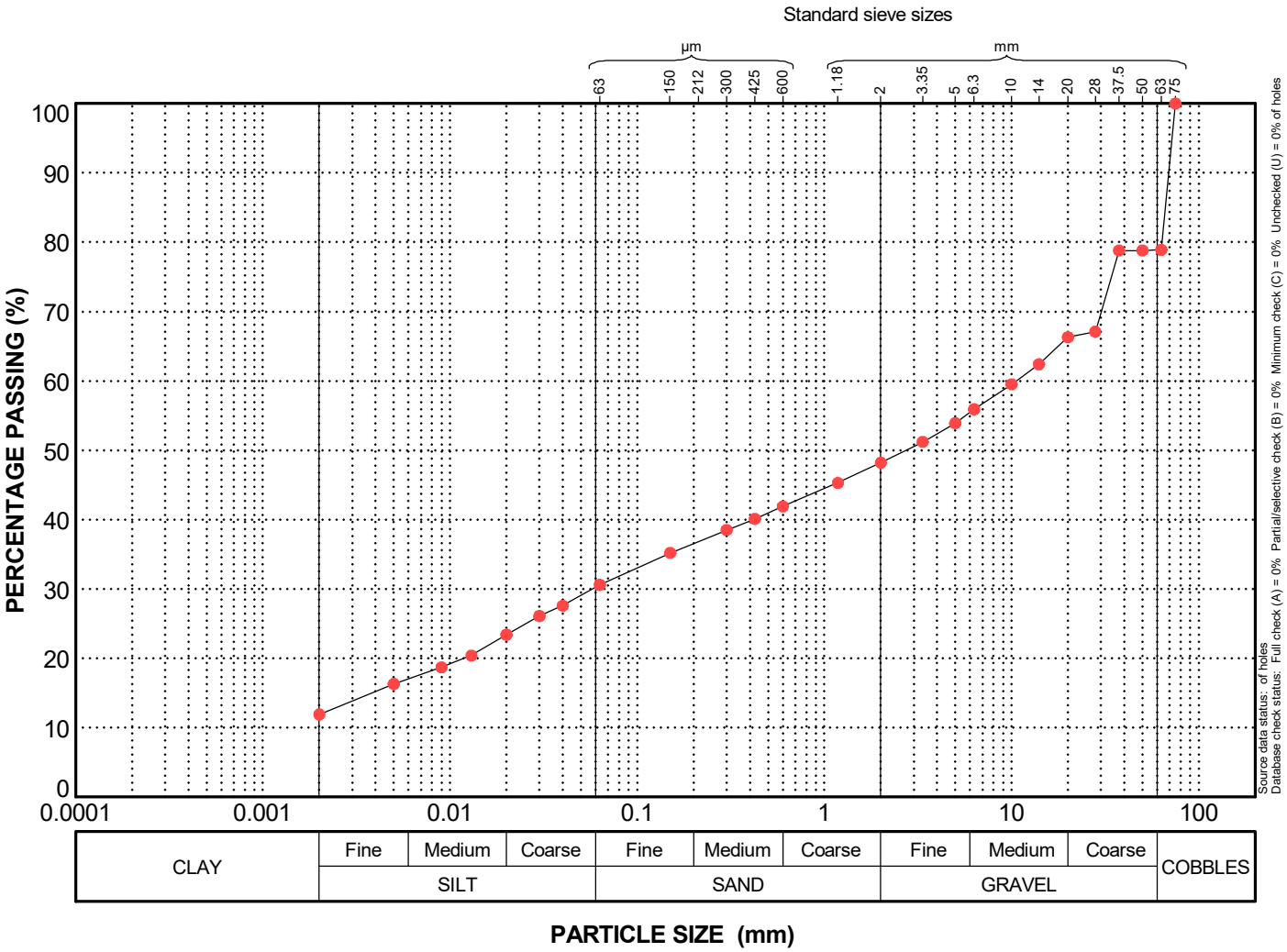
Topsoil
Rock
Granular Deposits
R12-CP02
Made Ground
Glacial Till Deposits

Bus Connect
PLASTICITY CHART
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Granular Deposits

FIGURE C12

268401-00

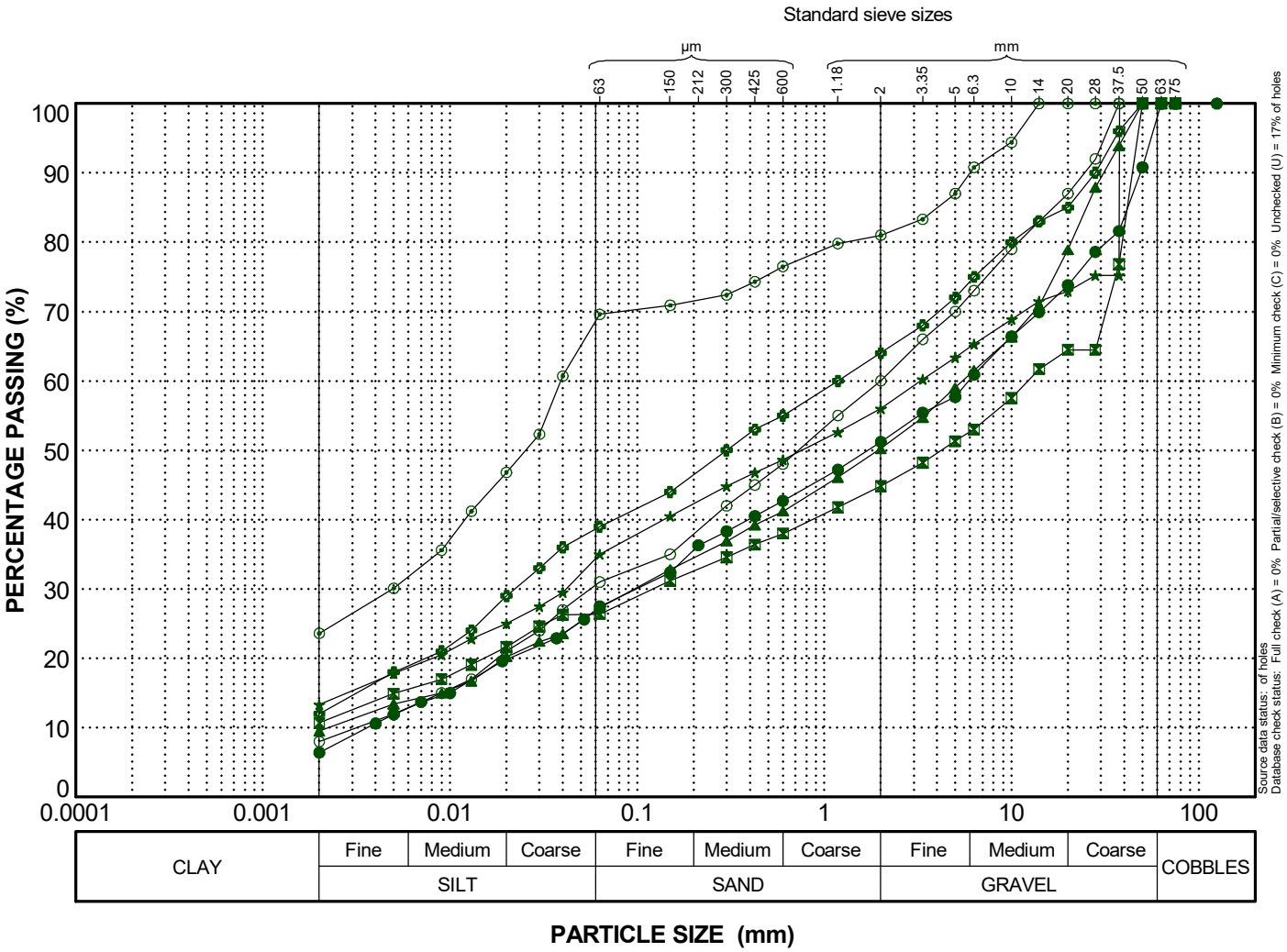
<<DrawingFileSpec>>



- Topsoil
- Made Ground
- Rock
- Glacial Till Deposits
- Granular Deposits

Bus Connect
PARTICLE SIZE DISTRIBUTION
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Made Ground
268401-00

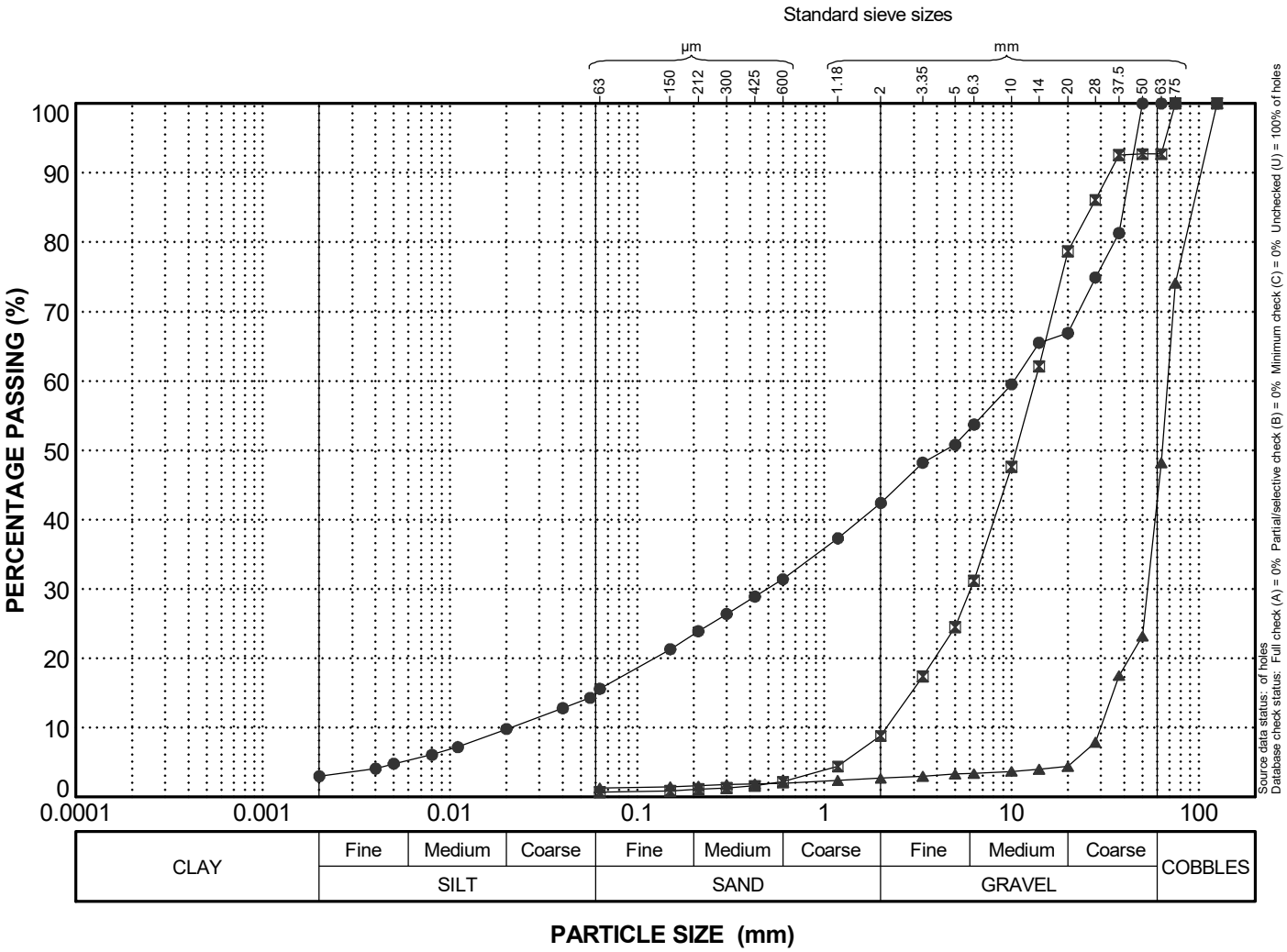
FIGURE C13



- R12-CP03, 2.00m
- R4883/B128728, 3.00m
- R4883/B128731, 7.00m
- R4883/B128732, 4.00m
- R5464/B134039, 2.00m
- R6455/B142521, 3.00m
- R6455/B142521, 4.00m

- Topsoil
- Made Ground
- Rock
- Glacial Till Deposits
- Granular Deposits

Bus Connect
PARTICLE SIZE DISTRIBUTION
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Glacial Till Deposits
268401-00 **FIGURE C14**



● R12-CP02, 2.00m
⊠ R12-CP02, 3.00m
▲ R12-CP03, 3.00m

Topsoil
Made Ground
Rock
Glacial Till Deposits
Granular Deposits

Bus Connect
PARTICLE SIZE DISTRIBUTION
Templeogue/Rathfarnham to City Centre Core Bus Corridor
Granular Deposits
268401-00 **FIGURE C15**

Appendix D

Factual Ground Investigation Report

D1

National Transport Authority

Templeogue/ Rathfarnham to City Centre Core Bus Corridor Scheme

Factual Ground Investigation Report

268401-00

Issue | 6 January 2023

Job number 268401-00

Ove Arup & Partners Ireland Ltd

Arup
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland
www.arup.com

ARUP

Document verification

ARUP

Job title		Templeogue/ Rathfarnham to City Centre Core Bus Corridor Scheme			**Job number** 268401-00
Document title		Factual Ground Investigation Report			**File reference**
Document ref		268401-00			
Revision	**Date**	**Filename**	BCIDC-ARP-ERW_GI-1012_XX_00-RP-CE-0001.docx		
Final Draft	29 Sep 2021	**Description**	Checks and reviews limited to Quality Assurance. Technical content assumed to be correct and responsibility of contractor appointed by NTA		
			Prepared by	Checked by	Approved by
		Name	Ground Investigation Ireland	Ozgur Alper	David Collins
		Signature			
Final Draft	4 Feb 2022	**Filename**	BCIDC-ARP-ERW_GI-1012_XX_00-RP-CE-0001.docx		
		Description	Checks and reviews limited to Quality Assurance. Technical content assumed to be correct and responsibility of contractor appointed by NTA		
			Prepared by	Checked by	Approved by
		Name	Ground Investigation Ireland	Ozgur Alper	David Collins
		Signature			
Issue	6 Jan 2023	**Filename**	BCIDC-ARP-ERW_GI-1012_XX_00-RP-CE-0001.docx		
		Description	Final Issue		
			Prepared by	Checked by	
		Name	Ground Investigation Ireland	Ozgur Alper	David Collins
		Signature			

Issue Document verification with document ✓

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

Ground Investigations Ireland

Bus Connect Detailed Stage 1 Lot 1

Route 12

National Transport Authority

Ground Investigation Report

April 2021

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

DOCUMENT CONTROL SHEET

Project Title	Bus Connect Detailed Stage 1 Lot 1
Engineer	Arup
Client	NTA
Project No	9754-07-20 R12
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Draft	M Sutton	A McDonnell	A McDonnell	Dublin	16 March 2021
B	Final	M Sutton	A McDonnell	A McDonnell	Dublin	01 April 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.

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

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
Geotechnical & Environmental

Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

0 5 10 15 20 25 m

Drawn By:	Date:
PC	15/03/2021

APPENDIX 2 – Borehole Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Bus Connect Detailed Stage 1 Lot 1			**Borehole Number** R12-CP02
Machine : Dando 2000 & Beretta T44 **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

Ground Investigations Ireland Ltd
www.gii.ie

Site Bus Connect Detailed Stage 1 Lot 1			**Borehole Number** R12-CP02
Machine : Dando 2000 & Beretta T44 **Flush :** Water **Core Dia :** 68 mm **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

Ground Investigations Ireland Ltd
www.gii.ie

Site Bus Connect Detailed Stage 1 Lot 1			**Borehole Number** R12-CP03
Machine : Dando 2000 & Beretta T44 **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** 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 1.00 1.00	SPT(C) N=17 B T							4,5/3,3,6,5		(1.20)				
1.50	EN 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 2.00 2.00	SPT(C) 50/190 B 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 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 5.00								25/50 SPT(C) 25*/50 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 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

Ground Investigations Ireland Ltd
www.gii.ie

Site Bus Connect Detailed Stage 1 Lot 1			**Borehole Number** R12-CP03
Machine : Dando 2000 & Beretta T44 **Flush :** Water **Core Dia :** 68 mm **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

Ground Investigations Ireland Ltd
www.gii.ie

Site Bus Connect Detailed Stage 1 Lot 1			**Borehole Number** R12-CP03A
Machine : Dando 2000 **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 3.00	SPT(C) 50*/50 B			50/		3.00	Grey sub-angular COBBLES. 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

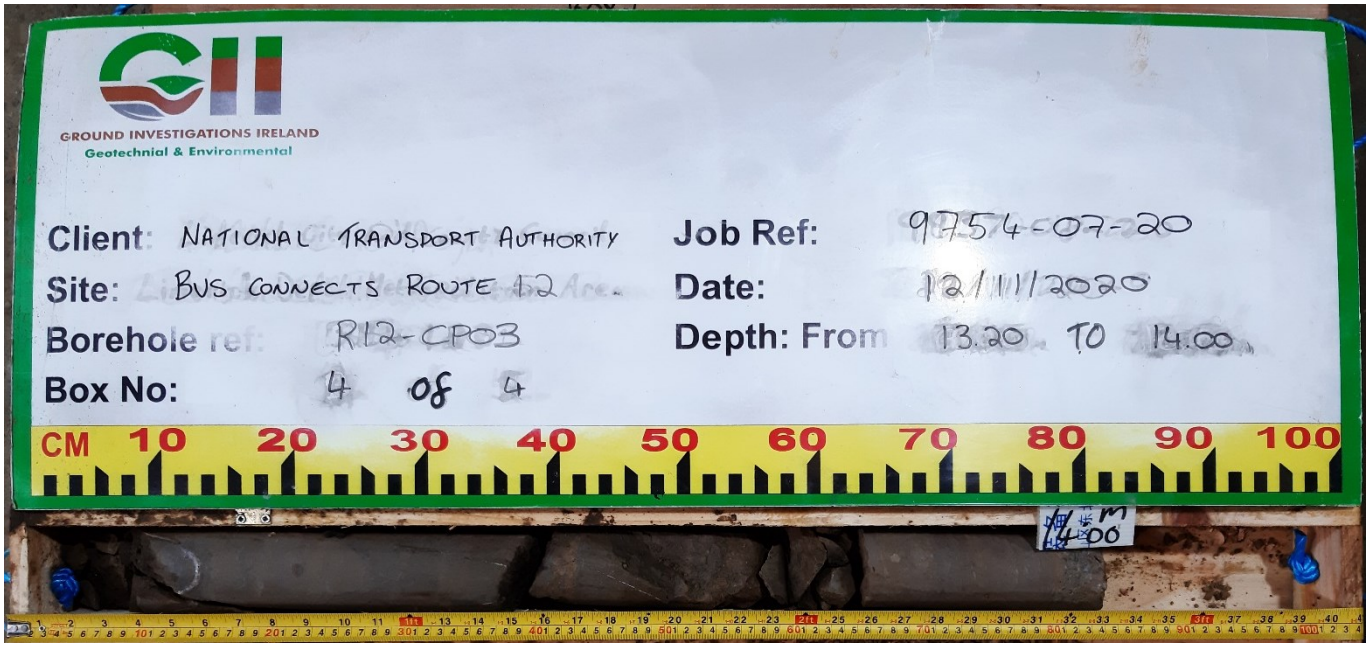
R12 – CP02

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								
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		

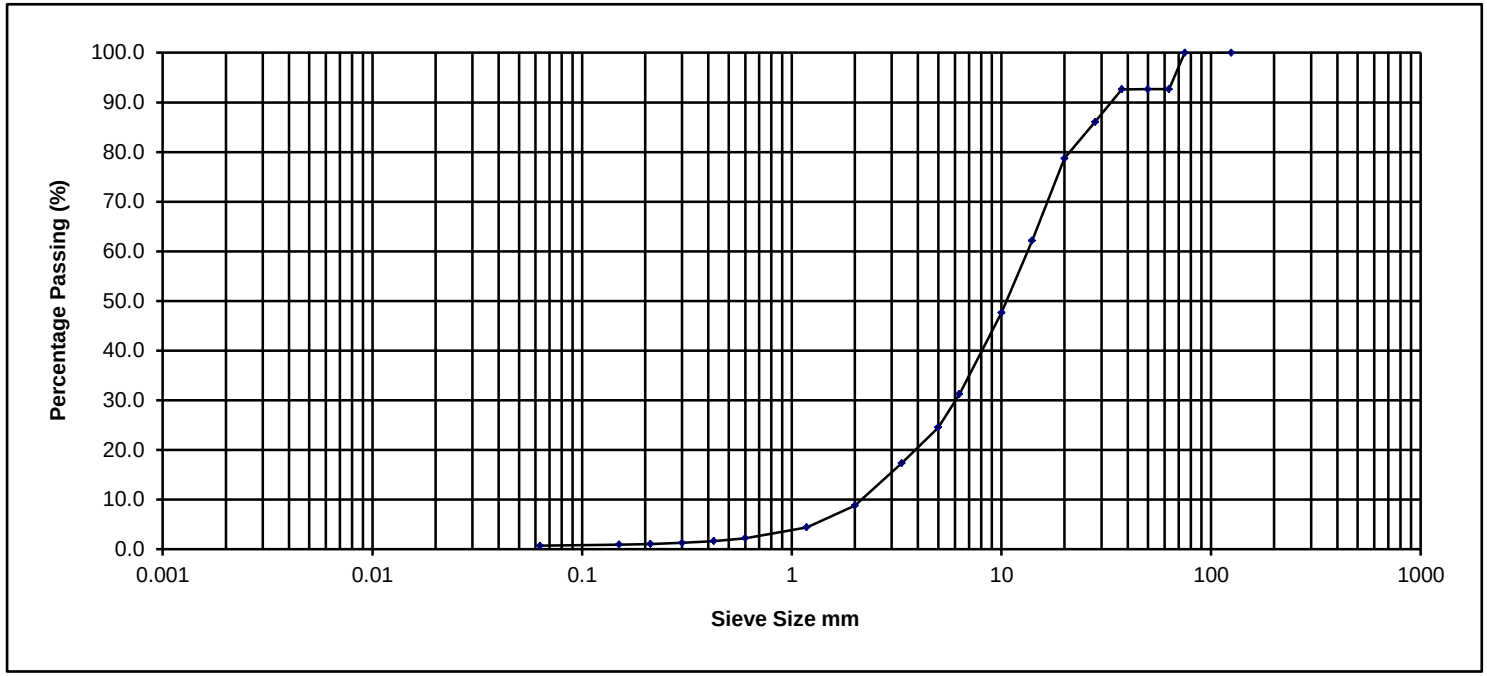
NMTL Ltd

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	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

NMTL Ltd

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	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		

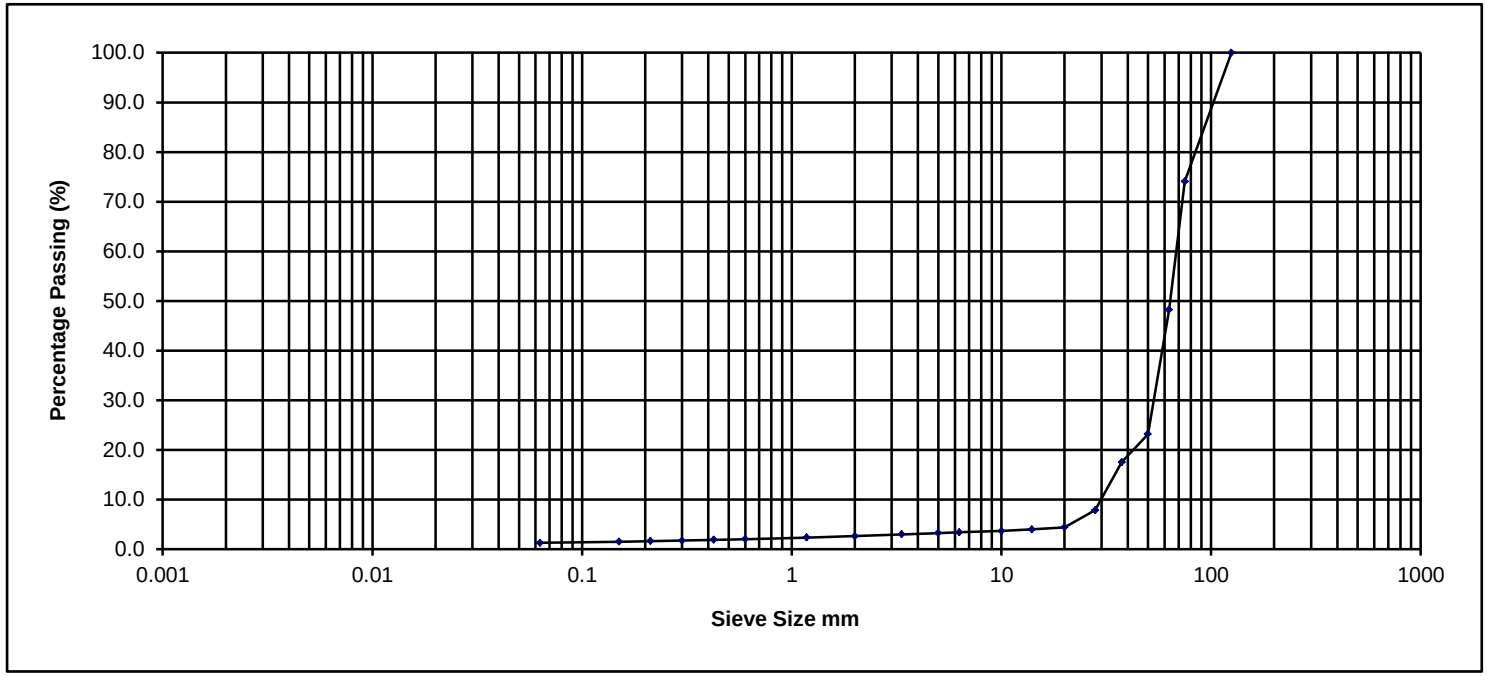
NMTL Ltd

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	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
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781
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,
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 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	

Appendix E

Historical Ground Investigation Data

E1

INV ID 50995

Report No. 2478	BORING RECORD **R73**	IGSL

Contract: **DUBLIN CASTLE**

Borehole No. 1

Sheet

Location: **OLD COACH HOUSE**

Type and Diameter: **Cable Tool 200mm**

Client: **MALACHY WALSH & PARTNERS**

Ground Level

Date: **23.3.94**

Description	Reduced Level	Legend	Depth	Samples Ref No	Samples Type	Samples Depth	Field Records And Tests
CONCRETE (poor quality)			0.30				**Depth N**
MADE GROUND - Loose rubble			1.20				
Soft to firm brown silty CLAY, traces of glass (possibly fill)				0127	U	1.50	2.00 7
				0128	D	2.50	
Hard grey/black silty stony CLAY with fragments of limestone			2.90				3.00 27
				0129	D	3.50	
Fragments of grey LIMESTONE			3.80				4.00 Refusa
* Refusal at 4.10m			4.10				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
23.3.94	2.60	2.60	2.60	Slight seepage
	4.10	3.80	Nil	Borehole Dry

Remarks

1 hr. breaking concrete

2 hrs. chiselling from 2.90-4.1

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

INV 10 Sc 996

Report No. 2478	BORING RECORD **R73**	IGSL

Contract: **DUBLIN CASTLE**

Borehole No. **2**

Sheet

Location: **OLD COACH HOUSE**

Type and Diameter: **Cable Tool 200mm**

Client: **MALACHY WALSH & PARTNERS**

Ground Level

Date: **23.3.94**

Description	Reduced Level	Legend	Depth	Samples Ref No.	Type	Depth	Field Records And Tests Depth	N
CONCRETE			0.30					
Loose variable FILL with cinder, shells, clay, roots				0130	D	1.50	1.50	3
			1.90					
Soft brown silty sandy CLAY, some root fibres				0131	D	2.50	2.50	2
			3.40	0132	D	3.50	3.50	37
Stiff dark grey brown CLAY with some fragments of lime-stone			3.80					
Fragments of grey LIMESTONE			4.00					

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
23.3.94	3.60	3.60	3.60	Very slight
	4.00	3.80	3.70	End of boring

Remarks

Chiselling :

0 - 0.30 for 1 hr

3.40 - 4.00 for 2 hrs.

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R137 51398

BORING RECORD

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Location:
Client: Pat O'Gorman and Associates
Dates: 24/11/94 to 26/11/94

Borehole No 3
Sheet No.
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
Made ground (brown silty CLAY, ash , timber , boulders , rubble)				1053	D	1.50	1.5 N=15
			2.00				
Stiff brown gravelly sandy CLAY with cobbles and boulders				1054	D	2.50	
							3.0 N=40
				1055	D	4.00	
							4.5 N=48
				1056	D	6.00	6.0 N=55

Remarks

Chiselling : 0.5 to 0.7 30 mins.
2.0 to 2.3 40 mins.
4.9 to 5.0 30 mins.
6.5 to 6.6 30 mins.

Driller:

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
				DRY

R137

BORING RECORD- Continuation

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Dates:

Borehole No 3
Sheet No.
Ground Level m.O.D.

Description	Red. Level	Legend	Depth m	samples Ref. No.	samples Type	samples Depth	Field Tests
(cont.)							
			7.50				7.5 N=62
				1057	D	7.60	
Stiff dark brown gravelly sandy CLAY with cobbles and boulders							
				1058	D	9.00	9.0 N=68
Terminated on obstruction (possibly rock)			10.20				

Remarks

Chiselling : 8.1 to 8.3 30 mins.
10.2 to 10.3 2hrs.

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
26-Nov	8.5	8.5	8.1	
	10.2	0.0	7.0	end of boring

R137 S1397

BORING RECORD

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Location:
Client: Pat O'Gorman and Associates
Dates: 22/11/94 to 23/11/94

Borehole No 2
Sheet No.
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
Made Ground (black gravelly silty CLAY with cobbles , boulders and brick fragments)				1044	D	1.00	
			1.50				1.5 N=31
Stiff brown gravelly sandy CLAY with cobbles and boulders				1045	D	1.70	
				1046	D	2.50	
			3.20				3.0 N=53
Stiff brown silty CLAY			3.50	1047	D	3.40	
Stiff brown gravelly sandy CLAY with cobbles and boulders				1048	D	4.50	4.5 N=51
				1049	D	6.00	6.0 N=55
				1050	D	7.00	

Remarks

Chiselling: 0.2 to 0.4 30 mins.
2.5 to 2.7 1 hr.
3.7 to 3.8 30 mins.

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
				DRY

Driller:

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

R137

BORING RECORD- Continuation

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Dates: 23/11/94

Borehole No 2
Sheet No.
Ground Level m.O.D.

Description	Red. Level	Legend	Depth m	samples Ref. No.	samples Type	samples Depth	Field Tests
(cont.)			7.50				
Stiff black gravelly silty CLAY with cobbles and boulders							7.5 N=64
				1051	D	8.50	
							9.0 N=64
				1052	D	9.50	
terminated on obstructiuon at 9.8 metres			9.80				

Remarks

Chiselling : 7.3 to 7.5 1hr.
9.8 to 10.0 2 hrs.

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
				DRY

51396

BORING RECORD

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Location:
Client: Pat O'Gorman and Associates
Dates: 26/11/94 to 28/11/94

Borehole No 1 A
Sheet No.
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
Made Ground (brown and black gravelly CLAY with cobbles , boulders and brick fragments)				1059	D	1.00	
			1.50				1.5 N=31
Stiff brown gravelly sandy CLAY with cobbles and boulders				1060	D	2.00	
							3.0 N=39
				1061	D	3.50	
			4.60				4.5 N=R
Stiff dark brown gravelly sandy CLAY with cobbles and boulders				1062	D	5.00	
							6.0 N=R
				1063	D	6.50	
				1064	D	7.00	
			8.00				7.5 N=68

Remarks

Chiselling : 0.5 to 0.7 1hr.
2.6 to 2.7 30 min
4.2 to 4.5 1hr.
4.6 to 5.0 2hrs. 7.8 to 8.0 2 hrs.

Driller: J. Mc Donald

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
				dry

R137 5:395

BORING RECORD

I.G.S.L.

Contract: Church Lane , Rathfarnham
No.
Location:
Client: Pat O'Gorman and Associates
Dates: 21/11/94

Borehole No 1
Sheet No.
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
Made Ground (brown gravelly CLAY with cobbles and boulders)				1041	D	0.50	
			1.20				
Brown gravelly sandy CLAY with cobbles and boulders							1.5 N=29
				1042	D	2.00	
Obstruction at 2.4 metres (presumed boulders)			2.40				

Remarks
Chiselling : 0.4 to 0.7 1 hr.
2.4 to 2.8 2hrs.

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
				dry

Driller:

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

R167

5162 0

Report No. 606	BORING RECORD	

Contract: V.E.C. BISHOP ST.	Borehole No. 13A Sheet
Location: BISHOP ST./PETER'S ROW, DUBLIN	Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PTNRS.	Ground Level: 12.58 Date: 26/10.83/27.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND, brick, concrete clay, cobbles, etc.				2641	D	1.50	
Firm mottled silty grey brown CLAY, traces of brick fill (Possibly Fill)			2.00	2642	D	2.00	(2.00)N11
Medium dense grey brown GRAVEL with matrix of brown silty clay			2.85	2643	D	3.00	(3.0) N30
Stiff brown silty stony CLAY with boulders			3.50	2644	D	3.50	(4.00)N35
Hard grey black silty stony CLAY with cobbles			4.50	2645	D	4.50	
				2467	D	5.30	(5.00)N35
				2468	D	6.00	(6.00)N46
Fine to coarse GRAVEL, COBBLES and BOULDERS, traces of grey limestone			7.00	2469	D	7.00	
			7.45				
* Rotary percussive drilling to 10.0m. See drilling logs.							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
27.10.83	7.00	7.00	7.00	Strike
	7.00	Nil	3.30	

Remarks: Relocated when BH.3 encountered basement floor. Chiselling in concrete and in boulders for 1½ hrs.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

5161

Report No. 606	BORING RECORD	

Contract	V.E.C. BISHOP ST.	Borehole No. 3 Sheet
Location	BISHOP ST./PETER'S ROW DUBLIN	Type and Diameter Shell & Auger 200 mm Diam.
Client	JOS. McCULLOUGH & PARTNERS	Ground Level 12.51 Date 14.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND, mottled clays, ash, brick, glass, timber, concrete etc.				14303	D	1.30	
				14304	D	2.50	
Total refusal at 3.00 metres			3.00				
** Note : See trial pit log No. 10A.							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
			DRY	

Remarks
Chiselling for 6 hrs at 3.00
100 mm PVC slotted pipe inserted in borehole.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

51623

Report No. 606	BORING RECORD	
Contract: V.E.C. BISHOP ST.		Borehole No. 6 Sheet
Location: BISHOP ST./PETER'S ROW DUBLIN		Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PARTNERS		Ground Level: 12.38 Date: 17.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND, grey and brown clay, brick, timber, ash etc.				17870	D	1.00	(1.5)N14
				17871	D	2.00	
			2.80				
Firm to stiff brown and grey sandy gravelly CLAY				17872	D	3.20	(3.0)N22
			3.90				
Hard grey black silty very stony CLAY, some boulders (Black Boulder Clay)				17873	D	4.00	(4.0)N81
				17874	D	5.00	(5.0)N82
Fragments of LIMESTONE, rock or boulder			5.30	17875	D	5.40	
			5.50				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
17.10.83			Dry	

Remarks

Chiselling from 5.30–5.50 for 1½ hrs.
Placed 100 mm pipe in borehole

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

51626

Report No. 606	BORING RECORD	

Contract: V.E.C. Bishop Street

Borehole No. 9

Sheet

Location: Bishop St./Peters Row,

Client: Jos.McCullough and Partners

Type and Diameter: Shell and Auger, 200mm

Ground Level: 12.10

Date: 18.10.83 - 19.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND, concrete ,brick, rubble ,ash and clay, with a concrete floor at 3.00				16346	D	1.00	1.50 N=14
				16347	D	2.00	
			3.00				3.00 N=Refusa
Soft to firm grgy brown silty clay with stones and traces of fill.				16348	D	3.50	4.00 N=78
			4.30				
Hard grey black silty very stony CLAY with cobbles and boulders. (large boulder at 5.50)				16349	D	4.50	5.00 N=43/150 mm
			5.50				
**Borehole completed on boulders at 5.50							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
18.10.83			3.20	Strike
19.10.83	5.50	5.50	Dry	
	5.50	Nil	3.00	Final

Remarks

Chiselling on concrete in fill 3 hrs, on boulder 1 hr.

PVC pipe placed in B.H.

Sample/Test key	C-Cone Penetration Test
U-Tube Sample	N-Blows/0.3 metres
D-Disturbed Sample	R-Refusal
W-Water Sample	V-Vane
S-Standard Penetration Test	

R167

5162 F

Report No. 606	BORING RECORD	

Contract: V.E.C. BISHOP ST.	Borehole No. 10 Sheet
Location: BISHOP ST./PETER'S ROW, DUBLIN	Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PARTNERS	Ground Level: 12.32
	Date: 20.10.83/21.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND, concrete over rubble, brick, clay, etc.				16350	D	1.50	
Firm mottled brown grey silty sandy CLAY			3.00				
Stiff brown silty stony CLAY (Boulder Clay)			4.30	16351	D	4.50	(4.0)N26
Hard grey black silty very stony CLAY with boulders			5.20	16352	D	5.50	(5.0)N43
Large Boulders at 6.10 m.			6.10	16353	D	6.10	
* Rotary percussive drilling 6.10 to 10.50m. See drilling sheets							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
21.10.83	6.10	6.10	Dry	
	6.10	Nil	3.50	Final level

Remarks: Chiselling on boulders and concrete - 2 hrs.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

S1631

Report No. 606	BORING RECORD	

Contract	Borehole No. 13
V.E.C. BISHOP STREET	Sheet

Location	Type and Diameter
Bishops Street / Peters Row	Shell and Auger
Client	**Ground Level** 12.38
Jos. McCullough and Partners	**Date** 19.10.1983

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
Made Ground, clay, rubble brick glass etc.				17892	D	1.30	
Firm brown silty gravelly CLAY (traces of fill)	1.80			17893	U	2.05	
Stiff brown gravelly CLAY with cobbles and large boulders.	2.45			17894	D	2.90	
Borehole complete at 3.70 on boulders.	3.70						

THIS PAGE LEFT OUT OF REPORT OF 31.1.84

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
19.10.83				Slight seepage in fill.

Remarks

3 Hours chiselling on boulders from 3.00 to 3.70 m

P.V.V. pipe placed in borehole

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

51632

Report No. 606	BORING RECORD	

Contract: V.E.C. BISHOP ST.	Borehole No. v14
	Sheet 1
Location: BISHOP ST./PETER'S ROW, DUBLIN	Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PARTNERS	Ground Level 12.70
	Date 27.10.83/28.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
Reinforced concrete over fill of brick, cobbles, rubble etc.				16360	D	1.50	
Firm brown silty sandy CLAY some stones			3.30	16361	D	3.00	(3.0)N15
Stiff brown silty very stony CLAY (Boulder Clay)			4.00	16362	D	4.50	(5.0) N=26
Coarse gravel with layers of brown stony clay.			5.30	16363	D	5.00	
Large Boulders at			6.50	16364	D	6.00	(6.0) N=32/150 mm

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
28.10.83	4.00	4.00	4.00	Seepage
	6.50	6.50	3.40	
	6.50	Nil	3.00	Final

Remarks

Chiselling concrete - 1 hour

Chiselling Boulders 1½ hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

51644

Report No. 606	TRIAL PIT RECORD	IGSL

Contract: BISHOP ST. V.E.C. DUBLIN	Sheet No.	Trial Pit No. 10A
Location: BISHOP ST./PETER'S ROW, DUBLIN	Excavation Method: Poclain Excavator	
Client: JOS. McCULLOUGH & PARTNERS	Ground Level: 12.56	
	Date: 19.10.83	

Description	Depth	Legend	Samples: Depth	Samples: Type	Samples: Ref. No.
MADE GROUND - Rubble and clay, brick, concrete, glass, polythene sacking, etc. Loose to medium dense condition.					
Concrete floor encountered at 2.75m. Machine unable to penetrate.	2.75				

Ground Water Conditions: Dry

Remarks:

R167

51643

Report No. 606	TRIAL PIT RECORD	IGSL

Contract	BISHOP ST. V.E.C. DUBLIN	Sheet No.	Trial Pit No. 10
Location	BISHOP ST./PETER'S ROW, DUBLIN	Excavation Method	Poclain Excavator
Client	JOS. McCULLOUGH & PARTNERS	Ground Level	12.56
		Date	19.10.83

Description	Depth	Legend	Samples		
			Depth	Type	Ref. No.
MADE GROUND, rubble and concrete, some clay. Blocks of limestone forming an old stone well extending to base of pit. Original ground may have been encountered to one side of pit. Water softening of all soils and ingress of water from about 1.50 metres.					
Pit abandoned at 5.00 m. and backfilled.	5.00				

Ground Water Conditions: Water ingress at about 1.50 metres.

Remarks:

R167

51647

Report No. 606	TRIAL PIT RECORD	IGSL

Contract	BISHOP ST. V.E.C. DUBLIN	Sheet No.	Trial Pit No. 9
Location	BISHOP ST./PETER'S ROW, DUBLIN	Excavation Method	Poclain Excavator
Client	JOS. McCULLOUGH & PARTNERS	Ground Level	12.34
		Date	19.10.83

Description	Depth	Legend	Samples		
			Depth	Type	Ref. No.
MADE GROUND, CLAY and RUBBLE (Medium dense condition)					
Mottled grey and brown silty stony CLAY, quite friable	1.80				
Stiff to hard black silty stony CLAY	2.50				
Fine to coarse GRAVEL and cobbles	3.30				
Stiff black silty stony clay+ Boulders	3.75				
Gravel ,cobbles and boulders	4.15				
Stiff black silty stony CLAY	4.65				
Pit completed at 5.30 m.	5.30				

Ground Water Conditions: Water encountered in gravel at 3.30 m.
After 24 hours level at 2.60 m.

Remarks: Collapsing of pit sides in gravels

R167

51636

Report No. 606	BORING RECORD	

Contract	Borehole No. 18
V.E.C. BISHOP ST.	Sheet
Location: BISHOP ST./PETER'S ROW, DUBLIN	Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PTNRS.	Ground Level: 12.73
	Date: 25.10.83/26.10.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
Reinforced concrete floor over fill of brick, boulders glass, rubble etc.				16354	D	2.00	(2.0)N8
Firm to stiff brown silty very stony CLAY			2.70	16355	D	2.70	(3.0)N17
Compact brown silty CLAY with some gravel			3.30	16356	D	3.50	(4.0)N17
Stiff yellow brown sandy very stony CLAY			4.50	16357	D	4.50	(5.0)N25
Stiff brown very sandy gravelly CLAY			5.40	16358	D	5.50	
Compact fine to coarse GRAVEL, some boulders			6.30	16359	D	6.30	(6.0)N32/150m & Refusa
Borehole completed at 6.60m.			6.60				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
26.10.83	6.60	—	3.50	

Remarks: Breaking out concrete and chiselling into boulders/rock for 3 hrs.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R167

51635

Report No. 606	BORING RECORD	

Contract	Borehole No. 17
V.E.C. BISHOP ST.	Sheet
Location: BISHOP ST/PETER'S ROW, DUBLIN	Type and Diameter: Shell & Auger 200 mm Diam.
Client: JOS. McCULLOUGH & PTNRS.	Ground Level: 12.92
	Date: 28.10.83 - 3.11.83

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
Concrete floor over MADE GROUND of fill, brick etc.				2472	D	1.00	
Firm to stiff brown sandy very stony CLAY (Boulder Clay)			2.00	2473	D	2.30	(2.0)N19
							(3.0)N62
				2474	D	4.00	(4.0)N81
Stiff to hard grey black silty stony CLAY (Boulder Clay)			4.60	2475	D	4.70	
							(5.0)N71
				2476	D	6.00	(6.0)N39/ 150mm & Ref.
Borehole completed at			6.50				
See rotary diamond drill records							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
			Dry	

Remarks: Total of 4½ hrs. chisellin in fill and in black boulder clay

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

Report No.	BORING RECORD	MW ID 51703	IGSL

Contract: **RATHMINES – Richmond Street** R179

Borehole No. 1

Sheet

Location: **DUBLIN**

Client: **K.M.L(Cons.Eng.)**

Type and Diameter: **Cable Tool 200mm**

Ground Level

Date: **22.10.92**

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
FILL-black silty clay,stones bricks etc.							
			0.80	7833	D	0.70	
Medium to stiff brown silty CLAY with some small stones and fragments of brick and rubble(FILL)				7834	D	1.20	1.50 N=18
			2.20				
Stiff brown CLAy with some medium stones				7835	D	2.80	
			2.90				(3.00) N=58/150mm
Very hard black CLAY with medium stones(Boulder Clay) and occ. boulders				7836	D	4.50	(4.50) N=36/75mm
			5.20				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
22.10.42	5.20	3.50	Nil	No free water

Remarks

Chiselling concrete 0 - 0.75m = ½hr

Chiselling boulders=1½hrs

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

Report No.	BORING RECORD Inv ID 51704	IGSL

Contract: **RATHMINES - Richmond Street** R179

Borehole No. 2

Sheet

Location: **DUBLIN**

Client: **K.M.L(Cons.Eng.)**

Type and Diameter: **Cable Tool 200mm**

Ground Level

Date: 23.10.92

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
FILL- black silty clay, bricks,stones etc.							
FILL- brown CLAY with traces of grey silt,medium stones with fragments of glass and brick			0.90	7837	D	1.00	(1.50)N=24
Stiff brown silty CLAY with some medium stones			2.20	7838	D	2.40	
Hard black CLAY with some large stones(Boulder Clay)			2.90	7839	D	4.00	(3.00)N=54/15mm (4.50)N=25/25mm
			5.00				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
23.10.92	5.00	3.00	Nil	No free Water

Remarks

Chiselling concrete 0-0.75=½hr

Chiselling in black boulder clay=2hrs

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

Report No.	BORING RECORD INV 10 51705	IGSL

Contract	Borehole No. 3
RATHMINES - Richmond Street R179	Sheet
Location DUBLIN	Type and Diameter Cable Tool 200mm
Client K.M.L(Cons.Eng.)	Ground Level
	Date 27.10.92

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
FILL-rubble,brick,clay			0.70				
FILL-soft to firm mottled brown clay with traces of brick,glass,pottery etc.							(1.00)N=4
				7840	D	1.70	
							(2.00)N=17
							(3.00)N=50
Stiff to hard grey/black very silty gravelly CLAY with cobbles and boulders			3.40	7841	D	3.50	
							(4.50)40/150mm
				7842	D	5.00	
			6.00				(6.00)30/25mm & refusal

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
27.10.92	6.00	4.00	Nil	No free water

Remarks
Chiselling in Fill=½hr
Chiselling boulders=2hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

INV ID 51956

Report No. 2338	BORING RECORD	IGSL

Contract: AUNGIER STREET R207

Borehole No. 2

Sheet

Location: DUBLIN

Type and Diameter: Cable Tool 200mm

Client: TONY LAWTON CONSULTING ENGINEER

Ground Level

Date: 4.10.93

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND : Brick, timber, ash, rubble, (possibly old basement)				3048	D	1.00	
							(1.5) N30
				3050	D	2.00	
			2.30				
Firm brown silty sandy stony CLAY with cobbles (moist)				3050	D	3.00	(3.0) N18
				3051	D	4.00	
			4.30				
Stiff black silty sandy gravelly CLAY with cobbles and boulders becoming harder with depth				3052	D	4.50	(4.5) N55
				3053	D	6.00	(6.0) N62/150mm
Refused on boulders			6.50				
*150mm slotted pipe installed to monitor water levels							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
4.10.93	6.50	6.50	Nil	No free water

Remarks: Chiselling fill: 1½ hrs
" at 6.50 : 1 hr.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

INV ID 51955

Report No.	BORING RECORD	IGSL

Contract: **AUNGIER STREET** **R207**

Borehole No. **1**

Sheet

Location: **DUBLIN**

Client: **TONY LAWTON**

Type and Diameter: **Cable Tool 200mm**

Ground Level

Date: **2.10.93**

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND :Brick,clay,ash, rubble,timber				2950	D	1.50	(1.50)N=13
			2.30	2951	U	2.20	
Firm brown grey mottled silty CLAY (moist)				2952	U	2.70	(3.00)N=15
			3.80	2953	D	4.00	(4.00)N=32
Firm brown silty sandy gravelly CLAY with boulders (becoming stiffer with depth)			4.70	2954	D	5.00	(5.00)N=66
Stiff grey black silty sandy gravelly CLAY with cobbles and boulders (becoming stiffer with depth)			7.00	2955	D	6.50	(6.50)37/150mm
Compact fine to coarse GRAVEL with traces of black silty stony CLAY and fragments of grey limestone			8.00	2956	D	7.50	(7.50)N=43

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
2.10.93	3.70	3.70	3.70	Slight seepage
	8.00	Nil	3.30	End of boring

Remarks

Chiselling through fill=2hrs

Chiselling 4.70-8.00=1½hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

INVIO: 58185 **R367**

15·600

REPORT NO.	**GEOTECHNICAL BORING RECORD**	**I.G.S.L.**
CONTRACT: Proposed Hotel Development		BOREHOLE NO.: 1
		SHEET: 1 of 1
CLIENT: Hanley Pepper Consulting Engineers	GROUND LEVEL:	DATE STARTED: 24.5.96
	BOREHOLE DIAM.(mm) 200	DATE COMPLETED: 24.5.96
LOCATION: Camden Street, Dublin	BOREHOLE DEPTH 6.50	BORED BY: I.G.S.L.
	CASING DEPTH (m) 6.50	LOGGED BY: I.G.S.L.

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS
0	Tarmac			0.10				
	MADE GROUND (comprised of concrete and some red brick)			1.30	20181	D	1.00	
1					20182	D	1.50	1.50 Ref
	Compact grey brown fine to coarse sandy silty clayey GRAVEL (Possibly claybound gravel) (Possible made ground)			2.40				
2					20183	D	2.50	
	Firm brown silty sandy gravelly CLAY							3.00 11
3								
4				4.00	20184	D	4.10	
	Very stiff to hard black silty gravelly CLAY with cobbles and boulders							4.50 53
5					20185	D	5.50	
6								6.00 65
				6.50				
7	Refusal							
8								
9								

Remarks.

Installed 50mm standpipe with protective cover

Chiselling

From 0 - 1.00 for 1.5hrs

From 6.20 - 6.50 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
24.5	1.40	1.40	1.40	Strike
	1.40	1.40	1.20	30 mins
	6.50	Nil	5.60	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, C-CPT, W-Water Sample, R-Refusal.

INVID : 58186 **R367**

REPORT NO.	**GEOTECHNICAL BORING RECORD**	**I.G.S.L.**

CONTRACT:	Proposed Hotel Development	BOREHOLE NO.:	2
		SHEET:	1 of 1
CLIENT:	Hanley Pepper Consulting Engineers	GROUND LEVEL:	
		BOREHOLE DIAM.(mm)	200
		DATE STARTED:	27.5.96
		DATE COMPLETED:	28.5.96
LOCATION:	Camden Street, Dublin	BOREHOLE DEPTH	9.20
		CASING DEPTH (m)	9.20
		BORED BY:	I.G.S.L.
		LOGGED BY:	I.G.S.L.

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS	
0	Tarmac			0.10					
	MADE GROUND (comprised of concrete, ash, clay and some red brick)				16464	D	1.00	1.00	13
1				1.40					
	Stiff to very stiff brown silty gravelly CLAY with some cobbles				16465	D	2.10	2.00	27
2									
3				3.00				3.00	Ref
	Very stiff to hard black silty gravelly CLAY with cobbles and boulders				16466	D	4.10	4.00	86
4									
5								5.00	41 for 150mm then Ref
6								6.00	77
					16467	D	6.50		
7								7.00	75
8								8.00	Ref
					16468	D	8.50		
9								9.00	Ref
	Refusal			9.20					

Remarks.

Installed 50mm standpipe with protective cover

Chiselling

From 4.70 - 4.90 for 1hr
From7.50 - 8.30 for 1.5hrs
From 9.00 - 9.20 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
28.5	9.20	Nil	Dry	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, C-CPT, W-Water Sample, R-Refusal.

INV ID. = 58188

R367

REPORT NO.	GEOTECHNICAL BORING RECORD	I.G.S.L.

CONTRACT:	Proposed Hotel Development	BOREHOLE NO.:	4
		SHEET:	1 of 1
CLIENT:	Hanley Pepper Consulting Engineers	GROUND LEVEL:	
		BOREHOLE DIAM.(mm)	200
		DATE STARTED:	23.5.96
		DATE COMPLETED:	24.5.96
LOCATION:	Camden Street, Dublin	BOREHOLE DEPTH	7.00
		CASING DEPTH (m)	7.00
		BORED BY:	I.G.S.L.
		LOGGED BY:	I.G.S.L.

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS	
0	Tarmac			0.10					
	MADE GROUND (comprised of concrete, ash, clay and some red brick)				16457	D	1.00	1.00	11
1				1.50					
2	Stiff to very stiff brown silty gravelly CLAY with some cobbles				16458	D	2.10	2.00	24
				2.80					
3					16459	D	3.00	3.00	73
	Very stiff to hard black silty gravelly CLAY with cobbles and boulders								
4					16460	D	4.00	4.00	Ref
5								5.00	79
6					16461	D	6.00	6.00	29 for 75mm then Ref
7				7.00				7.00	Ref
	Refusal								
8									
9									

Remarks.

Chiselling

From 0 - 0.50 for 0.75hrs
From 4.00 - 5.00 for 1hr
From 6.80 - 7.00 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
24.06	7.00	Nil	Dry	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, C-CPT, W-Water Sample, R-Refusal.

R367

INV ID : 58191

Report No.	TRIAL PIT RECORD	I.G.S.L.
CONTRACT: Proposed Hotel Development	Trial Pit No.: 2	
	Sheet : 1 of 1	
CLIENT: Hanley Pepper, Consulting Engineers	Excavation Method: JCB	
	Date Started:	
LOCATION: Camden Street, Dublin	Date Completed:	
	Ground Level (mOD):	

	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	samples Ref. No.	samples Type	samples Depth (m)	Field Tests
-1	MADE GROUND (Comprised of very sandy gravel, clay, red brick, concrete and timber)		1.10		1003	D	0.75	
-2	Stiff grey brown silty gravelly CLAY with cobbles		2.60		1004	D	2	
-3	Very stiff black slightly silty gravelly CLAY with cobbles and boulders		3.00		1005	D	3	
-4								
-5								
-6								

Groundwater Conditions:

Trial Pit Dry

Remarks:

Trial Pit Stable

R367 INV ID - 58194

Report No.	TRIAL PIT RECORD	*I.G.S.L.*

CONTRACT:	Proposed Hotel Development	Trial Pit No.:	5
		Sheet :	1 of 1
CLIENT:	Hanley Pepper, Consulting Engineers	Excavation Method:	JCB
		Date Started:	
LOCATION:	Camden Street, Dublin	Date Completed:	
		Ground Level (mOD):	

Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	samples			Field Tests
				Ref. No.	Type	Depth (m)	
Road sub base naterial		0.25					
MADE GROUND (Comprised of very sandy gravel, clay, red brick, concrete and timber)		2.00		1001	D	1	
Stiff grey brown silty gravelly CLAY with cobbles		3.00		1002	D	2.5	

Groundwater Conditions:

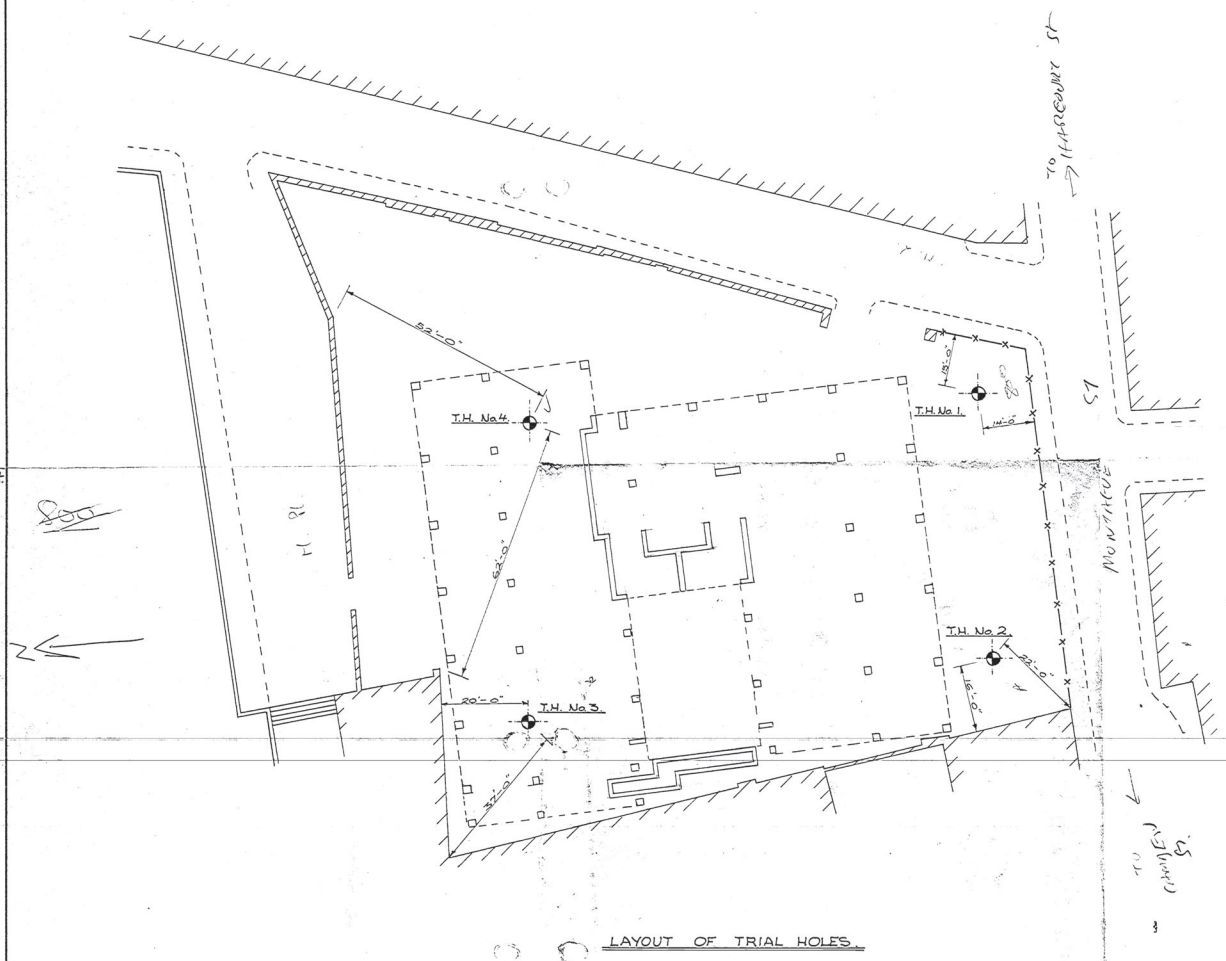
Trial Pit Dry

Remarks:

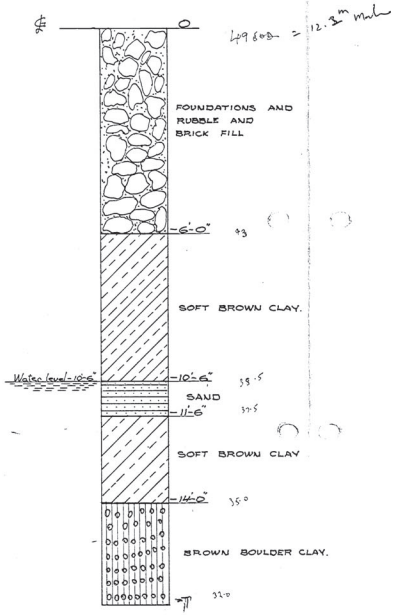
Trial Pit Unstable

800

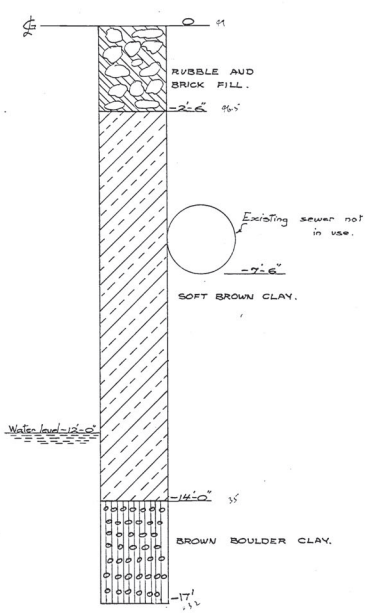
R616



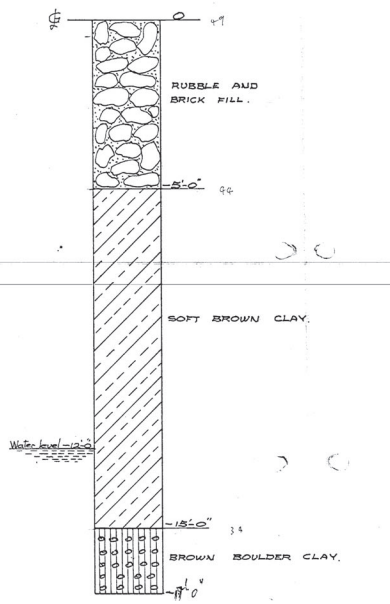
LAYOUT OF TRIAL HOLES.



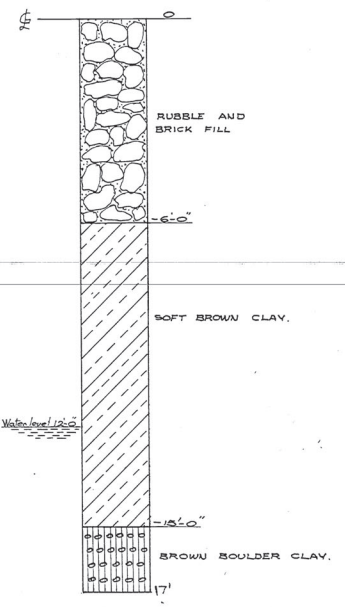
TRIAL HOLE No 1.
Inv ID: 59999



TRIAL HOLE No 2.
Inv ID: 60000



TRIAL HOLE No. 3.
Inv ID: 60001



TRIAL HOLE No. 4.
Inv ID: 60002

29/235E 627

Revision	Mark	Date	Made by
	D		
	C		
	B		
	A		

Concrete to be grade
Maximum aggregate size to be
Unless noted, cover to steel
Location drawing no:
Bending schedule pages

OFFICE DEVELOPMENT AT MONTAGUE STREET FOR HARDWICKE LTD.

DETAILS OF TRIAL HOLES.

Report No. 616
Box No. 30
Investigation ID 59999 – 60002
(4)

Scales	1/8" = 1'-0"
Drawn	W.F.C.
Date	Sept. '71.
Passed	

Ove Arup & Partners, Dublin.
Drawing No. D276/SK.1.

B.C.R & Co. Ltd. Elham 12 E/NE

SITE INVESTIGATIONS LTD.

SOIL INVESTIGATION

BORING RECORD

R669

CONTRACT	Swimming Pool		
Report No.		BOREHOLE No.	2
Bored for	Mallagh Luce & Partners.	Order No.	
Site Address	Rathmines.	INV. ID	60532
Boring Commenced	25.10.1974.	Boring Completed	28.10.1974.
Type of Boring	Percussive.	Diameter of Borehole	15 ins.
Ground level	O.D.		
Water Struck (1)	8' B.G.L.(2)	(3)	
Standing Water Level	4' B.G.L. on completion.		
Remarks	Chiselling 4½ hours. All levels are related to ground level.		

Description of Strata	Depth From	Depth To	Thickness	Samples Ref No.	Samples Type	Samples Depth
Tarmac.	0	0'3"	0'3"			
Filling of sandy gravel with some clay.	0'3"	2'0"	1'9"	5606	D	2'0"
Grey silty stony clay with cobbles.	2'0"	3'0"	1'0"	5607	D	3'0"
Very stony gravelly silty clay with cobbles.	3'0"	5'0"	2'0"	5608	D	5'0"
Very coarse clayey sandy gravel.	5'0"	9'0"	4'0"	5609	D	8'0"
Sandy very gravelly clay with cobbles & boulders. (Chiselling 1 hour).	9'0"	14'6"	5'6"	5610	D	10'0"
Presumed rock. (Chiselling 3½ hours).	14'6"	16'0"	1'6"	5611	D	16'0"

Standard Penetration Tests

At 5'6" 19 blows to 12"
At 10'3" 40 blows to 3" REFUSAL
At 15'0" 50 blows to REFUSAL

Code: U — Undisturbed Sample D — Large Disturbed Sample J — Jar Sample W — Water Sample

SITE INVESTIGATIONS LTD.

SOIL INVESTIGATION

R669

BORING RECORD

CONTRACT Swimming Pool

Report No.

Bored for Mallagh Luce & Partners.

Site Address Rathmines.

Boring Commenced 23.10.1974.

Type of Boring Percussive.

Ground level O.D.

Water Struck (1) 10'6" B.G.(2). (3)

Standing Water Level 5' B.G.L. on completion.

Remarks Chiselling 5½ hours.
All levels are related to ground level.

BOREHOLE No. 1

Order No.

INVESTIGATION ID
60531

Boring Completed 24.10.1974.

Diameter of Borehole 15 ins.

Description of Strata	Depth From	Depth To	Thickness	Samples Ref No.	Samples Type	Samples Depth
Tarmac.	0	0'3"	0'3"			
Filling of sandy gravel with some clay.	0'3"	3'0"	2'9"	5601	D	2'0"
Grey silty stony clay with cobbles & boulders.	3'0"	10'6"	7'6"	5602 5603	D D	4'0" 8'0"
Boulder. (Chiselling 4½ hours).	10'6"	12'6"	2'0"	5604	D	12'0"
Fine sandy gravel.	12'6"	13'6"	1'0"	5605	D	13'0"
Final level. Obstruction. (Chiselling 1 hour).	13'6"					
Standard Penetration Tests						
At 5'6" 18 blows to 12" At 10'3" 54 blows to 3" REFUSAL						

Code: U — Undisturbed Sample D — Large Disturbed Sample J — Jar Sample W — Water Sample

1245

SITE INVESTIGATIONS LTD.

BOREHOLE RECORD

6528

CONTRACT Dame Street Redevelopment BOREHOLE No. 5

R766

Bored for C.I.E.

Site Address Dublin

Boring Commenced 22/12/82 Boring Completed 17/2/83

Type of Boring Shell & Auger and Diamond Drill Diameter of Borehole 200 mm.
NX
BX

Ground Level - O.D.

Water Struck (1) 5.60m B.G.L. (2) (3)

Standing Water Level 5.50m B.G.L. on completion

Remarks All levels are related to ground level. Chiselling 3½ hours. Cored from 5.70 to 20.00m B.G.L.

Depth in Meters From	To	Thickness	Samples Ref. No.	Type	Depth	Description of Strata
0.00	1.00	1.00				Fill of gravel, silty clay, bricks etc.
1.00	2.00	1.00	29575	D	1.50	Firm brown silty stony clay
2.00	5.50	3.50	29576 29577 29578	D D D	3.00 4.50 5.00	Stiff grey silty stony clay with cobbles and boulders (Chiselling 2 hours)
50	5.70	0.20	29580	D	5.70	Presumed rock (Chiselling 1½ hours)
70	5.90	0.20	Core Recovery 85%			Boulders
90	7.50	1.60	Core Recovery 31%			Boulder clay and boulders
50	10.50	3.00	Core Recovery 83%			Limestone rock with thin lenses of residual clay
.50	20.15	9.65	Core Recovery 100%			Limestone rock with thin shaley partings
						Standard Penetration Tests
						At 1.65 6 blows to 12"
						At 3.15 54 blows to 12" At 4.65 12 Blows to 12"
						At 5.70 60 blows to 2" Refusal

1,247.

SITE INVESTIGATIONS LTD.

BOREHOLE RECORD

CONTRACT Dame Street Redevelopment BOREHOLE No. 7

Bored for C.I.E.

R766 6153

Site Address Dublin

Boring Commenced 18/2/83 Boring Completed 24/2/83

Type of Boring Diamond Drill Diameter of Borehole NX mm.

Ground Level - O.D.

Water Struck (1) - (2) (3)

Standing Water Level -

Remarks All levels are related to ground level. Rock rolled from G.L. to 5.00m B.G.L. Cored from 5.00 to 20.00m B.G.L.

Depth in Meters From	To	Thickness	Samples Ref. No.	Type	Depth	Description of Strata
0.00	4.00	4.00				Boulders and clay
4.00	5.00	1.00				Boulders, gravel and clay
5.00	20.30	15.30	Core Recovery 98%			Limestone rockwith thin shaley partings

CLASSIFICATION TEST RESULTS

CONTRACT College of Technology Kevin St. **R841** Report No.

Borehole No.	Sample No.	Depth (metres)	Description	Percentage Passing 425 μm sieve	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %
A	2163	4.50	Brown silty clay with stones		31	17	14	
B	2170	3.00	Brown silty clay with stones		38	16	22	
G	2284	3.00	Brown silty clay with stones		30	16	14	
D	2165	3.00	Brown silty clay with stones		27	17	10	

R876

Report No. 1595	TRIAL PIT RECORD	IGSL

Contract	HARCOURT ST. DUBLIN	Sheet No. 62175	Trial Pit No. 3
Location	HARCOURT ST.	Excavation Method	JCB
Client	JOS. McCULLOUGH & PTNRS.	Ground Level	
		Date	1.11.90

Description	Depth	Legend	Samples		
			Ref. No.	Type	Depth
Compact stone FILL (up to 100mm) (clean and well-graded)	2.20		20550	D	1.80

Ground Water Conditions

Heavy water ingress at 1.80

Remarks

Pit collapsing below 1.80m

R876

Report No. 1595	TRIAL PIT RECORD	IGSL

Contract: HARCOURT ST., DUBLIN	Sheet No. 62176	Trial Pit No. 3A
	Excavation Method: JCB	
Location: HARCOURT ST.		
Client: JOS. McCULLOUGH & PARTNERS	Ground Level	
	Date: 1.11.90	

Description	Depth	Legend	Samples		
			Ref. No.	Type	Depth
HARDCORE FILL : Slightly silty or sandy GRAVEL with some brick etc.					
	1.60				
Firm brown silty stony CLAY			20551	D	1.80
	2.20				

Ground Water Conditions: Dry

Remarks: Pit collapsing in granular fill 0 - 1.60m

62206

SITE INVESTIGATIONS LTD.

SOIL INVESTIGATION R877

BORING RECORD

CONTRACT Developement in Harcourt Street Area **BOREHOLE No.** 13

Report No. **Order No.**

Bored for J. McCullough & Partners

Site Address Dublin

Boring Commenced 23/4/80 **Boring Completed** 24/4/80

Type of Boring Shell & Auger **Diameter of Borehole** 200 mm.

Ground level - 15.5 ± 1 O.D.

Water Struck (1) Nil (2) (3)

Standing Water Level Nil

Remarks All levels are related to ground level.

Description of Strata	Depth From	Depth To	Thickness	Samples Ref No.	Samples Type	Samples Depth
Topsoil and fill	0.00	0.90	0.90			
Firm/stiff brown silty stony clay	0.90	2.00	1.10	11555 11556 ~~11557~~	D U ~~D~~	1.00 1.50-1.95 ~~2.00~~
Final level	2.00					

62805

SITE INVESTIGATIONS LTD.

SOIL INVESTIGATION R877

BORING RECORD

CONTRACT Developement in Harcourt Street Area **BOREHOLE No.** 12

Report No. **Order No.**

Bored for J. McCullough & Partners

Site Address Dublin

Boring Commenced 25/4/80 **Boring Completed** 28/4/80

Type of Boring Shell & Auger **Diameter of Borehole** 200 mm.

Ground level - 15.5 ±1 O.D.

Water Struck (1) - (2) (3)

Standing Water Level 1.60m B.G.L.

Remarks All levels are related to ground level. Chiselling 8 hours.

Description of Strata	Depth From	Depth To	Thickness	Samples Ref No.	Samples Type	Samples Depth
Topsoil and fill	0.00	0.45	0.45			
Loose fill of clay, bricks etc.,	0.45	1.40	0.95	11558	D	1.20
Firm/stiff brown silty stony clay	1.40	2.50	1.10	11559 11560	U D	2.00-2.45 2.50
Stiff/hard Blue/grey silty stony clay with cobbles and ~~boulders (chiselling 6hrs)~~	2.50	7.60	5.20	11561 11562 11563	D U D	4.00 4.50-4.95 5.00
Presumed Rock (Chiselling 2 hours)	7.60	7.75		11564 11565 11566	D D D	6.00 7.00 7.75
Standard Penetration Tests						
At 1.15 8 Blows to 12" At 3.15 41 Blows to 12"						
At 6.15 80 Blows to 12" At 7.75 Refusal						

62804

SITE INVESTIGATIONS LTD.

SOIL INVESTIGATION R877

BORING RECORD

CONTRACT Development in Harcourt Street Area **BOREHOLE No.** 11

Report No. **Order No.**

Bored for J. McCullough & Partners

Site Address Dublin

Boring Commenced 16/4/80 **Boring Completed** 2/5/80

Type of Boring Shell & Auger **Diameter of Borehole** 200 mm.

Ground level - 15.5 ±1 O.D.

Water Struck (1) Nil (2) (3)

Standing Water Level 1.20 B.G.L.

Remarks All levels are related to ground level. Chiselling 14¼ hrs. 1 hr. breaking out cobbles yard. Wagon Drilled from 8.20m to 11.20m B.G.L.

Description of Strata	Depth From	Depth To	Thickness	Samples Ref No.	Samples Type	Samples Depth
Cobble Yard (1 Hr. breaking out)	0.00	0.15	0.15			
Boulders (Chiselling 2 hrs)	0.15	1.00	0.85			
Firm/stiff mottled brown silty stony clay with cobbles	1.00	2.50	1.50	11543 11544 11545	D U D	1.00 2.00-2.45 2.45
Firm/stiff dark brown silty stony clay with cobbles and boulders (Chiselling 1½hrs.)	2.50	3.00	0.50	20491 11546	W D	1.70 2.50
Firm/stiff blue/grey silty stony clay with cobbles and boulders (chiselling 8 hrs)	3.00	8.00	5.00	11547 11548 11551	D D U	3.00 4.00 4.50-4.95
Presumed rock (Chiselling 2¾ hrs.)	8.00	8.20	0.20	11549 11550 11552	D D D	5.00 6.00 7.00
Rock	8.20	11.20	3.00	11553 11554	D D	7.90 8.20
Standard Penetration Tests						
At 1.15 16 Blows to 12" At 3.15 42 " " 3"						
At 6.15 56 " " 4½" At 8.30 Refusal						

R960

Report No.	BORING RECORD	IGSL

Contract: PORTOBELLO

Borehole No. 2

Sheet 62753

Location: RATHMINES,CO.DUBLIN

Type and Diameter: Cable Tool 200mm

Client: LOHAN & DONNELLY

Ground Level:

Date: 14.2.92

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND - clay,brick,ash, pottery,slate ,glass etc.				25890	D	1.00	(1.15)N=15
			1.70				
Firm grey silty CLAY with lenses of fine gravel				25891	D	2.00	(2.15)N=8
			2.60				
Stiff grey silty CLAY , slightly laminated				25892	D	3.00	(3.15)N=19
			3.30				
Compact fine to coarse sandy GRAVEL with cobbles				25893	D	4.00	(4.15)N=32
			5.10				
Stiff to hard black very silty very stony CLAY with cobbles (Boulder Clay)				25894	D	5.50	(5.65)N=55
			6.50				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
14.2.92	3.00	3.00	3.00	Water noted
	5.00	5.00	Nil	Water sealed
	6.50	5.50	Nil	
	6.50	Nil	1.40	End of boring

Remarks

Chiselling 5.00-6.50=1½hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R960

Report No.	BORING RECORD	IGSL

Contract: PORTOBELLO

Borehole No. 1

Sheet 62752

Location: RATHMINES, CO. DUBLIN

Type and Diameter: Cable Tool 200mm

Client: LOHAN & DONNELLY

Ground Level:

Date: 13.2.92

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND - rubble			0.50				
MADE GROUND - silt, glass, clay, pottery etc.				25882	D	1.00	(1.15)N=9
				25883	D	1.70	
firm grey silty CLAY with traces of fine gravel (Some damp pockets)			2.00				(2.15)N]=10
				25884	D	2.60	
Stiff grey silty CLAY with some laminations			2.80	25885	D	3.00	(3.15)N=21
				25886	D	4.00	
Compact fine to coarse sandy GRAVEL with cobbles			4.30				(4.60)N=46
				25887	D	5.00	
Stiff to hard black very silty very stony CLAY (Boulder clay)			5.60				(6.00)N=54
				25888	D	6.50	
			7.50	25889	W	WATER	(7.50)27/75mm
*6 hrs moving equipment to site & levelling area for rig							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
13.2.92	4.30	4.30	4.30	Water noted
	5.60	5.60	Nil	Water sealed
	7.50	6.00	Nil	
	7.50	Nil	1.70	End of boring

Remarks

Chiselling at 5.00=1½hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R962 62763

IRISH SOIL LABORATORIES LTD. | BOREHOLE No. 1

CONTRACT: Rathmines Development	REPORT No. 353
Bored for: Ove Arup and Partners	Ground Level
Site Address: Homeville	Boring Commenced 20.8.80 / Boring Completed 21.8.80
Type and Dia. of Boring: Shell and Auger, 200mm	

Water Strikes	Water Levels Recorded During Boring			
1. 8.00	Hole Depth	8.00	8.00	
2.	Casing Depth	8.00	Nil	
3.	Water Level	7.50	4.00	(after 24 hrs)

Remarks: Chiselling in large boulders 2 hrs
Chiselling in Limestone 4 hrs.

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth		N
TOP SOIL , sandy, root fibres.	0.60						
Stiff grey brown mottled silty stony clay with root fibres to about 1.50m (friable)			25894	D	1.50	1.5	32
Stiff grey black silty clay containing numerous small stones and some cobbles and boulders.	3.00		25895	D	3.00	3.0	56
			25896	D	4.60	4.6	63
			25897	D	6.10	6.1	71
			25898	D	7.60	7.6	37/10C + mm Ref
Compact fine to coarse gravel Fragments of limestone	8.00 8.15 .45		27899	D	8.00	8.0	37/15C + Ref

Code: U—Undisturbed Sample ... Sample J—Jar Sample W—Water Sample

R962

62764

IRISH SOIL LABORATORIES LTD.	BOREHOLE No. 2

CONTRACT	Rathmines Development	REPORT No.	353
Bored for	Ove Arup and Partners	Ground Level	
Site Address	Front No 214 Rathmines Road.	Boring Commenced Boring Completed	15.8.80 16.8.80
Type and Dia. of Boring	Shell and Auger, 200mm		

Water Strikes	Water Levels Recorded During Boring										
1. 8.00	Hole Depth	8.00	8.00								
2.	Casing Depth	8.00									
3.	Water Level	5.00									

Remarks: Chiselling boulders in clay 1½ hours, chiselling rock 4 hrs
High stone content precluded taking of undisturbed samples.

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth		N
Top soil, sandy.							
	0.60						
Firm/stiff brown yellow mottled silty clay with stones and cobbles..			25888	D	1.50		
						2.0	28
			25889	D	3.00		
	3.60						
Stiff grey black silty clay high stone content with cobbles and boulders, some more granular lenses of clay and silt bound gravel, some softening noted from 7.50 to 8.00.			25890	D	3.60	3.6	34
						4.6	70
			25891	D	5.00		
			25892	D	6.1	6.1	46/100 mm
			25893	D	7.60	7.6	40/150 + 21/25mm
	8.00						
Fragments of grey limestone with traces of stiff grey silt.						8.0	20/75mm + Ref.

Code: U—Undisturbed Sample D—Large J—Jar Sample W—Water Sample

R962

62767

IRISH SOIL LABORATORIES LTD.

BOREHOLE No. 5 and 5 Rebore

CONTRACT	Rathmines Development	REPORT No.	353
Bored for	Ove Arup and Partners	Ground Level	
Site Address	Rere 236 Rathmines Road	Boring Commenced / Boring Completed	13.8.80 / 22.9.80
Type and Dia. of Boring	Shell and Auger 200mm, Rotary 50mm drill		

Water Strikes	Water Levels Recorded During Boring			
1. 6.75	Hole Depth	6.80	6.80	
2.	Casing Depth	6.80	Nil	
3.	Water Level	6.75	4.00	Slight seepage at 4.00 observed.

Remarks: Hole rebored after encountering large boulders at 4.00. Thickness of boulders proved by rotary drill. Total time spent in chiselling boulders and limestone 15½ hours.

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth		N
Top soil, loamy clay, roots.							
	0.60						
Stiff yellow brown mottled silty clay, some stones and root fibres.			25884	D	1.50	1.5	55
	3.00		25885	D	3.00	3.0	43/150mm + Ref.
Stiff to hard grey black very silty very stony clay large boulders particularly at 4.00 m level.			25886	D	4.00		22/75mm + Ref
						5.0	37/100mm + Ref
			3600	D	5.50		
	6.75		3601	D	7.00		
Fragments of grey limestone layers of hard grey silt.	7.00		3602	W	Water		

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample

R962

62775

IRISH SOIL LABORATORIES LTD.

TRIAL PIT . 6

CONTRACT	Rathmines Development	REPORT No.	353
Bored for	Ove Arup and Partners	Ground Level	
Site Address	Rere 236 Rathmines Road	Boring Commenced / Boring Completed	26.8.80
Type and Dia. of Boring	Excavator		

Water Strikes	Water Levels Recorded During Boring										
1.	Hole Depth										
2.	Casing Depth										
3.	Water Level										

Remarks: No free water, Pit very stable, very hard digging from 2.50 Water pipe encountered, pit relocated to avoid this.

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth	N
Top soil over loose loamy clay with many root fibres						
	1.00					
Stiff mottled grey brown silty very stony clay, a slight water softening at 2.70			A	D	1.50	
	2.70					
Fragments of hard black silty stony clay with brown grey mottled clay.	3.00		B	D	2.75	

Code : U—Undisturbed Sample ... J—Jar Sample W—Water Sample

R962 62769

IRISH SOIL LABORATORIES LTD.	BOREHOLE No. 7 and 7 Rebore

CONTRACT	Rathmines Development	REPORT No.	353
Bored for	Ove Arup and Partners	Ground Level	
Site Address	Castlewood Avenue	Boring Commenced Boring Completed	11.8.80 18.9.80
Type and Dia. of Boring	Shell and auger 200mm and Rotary 50mm		

Water Strikes	Water Levels Recorded During Boring									
1. 6.50	Hole Depth	6.80	6.80							
2.	Casing Depth	6.10	Nil							
3.	Water Level	5.90	5.00							

Remarks: Hole rebored after encountering boulders at 3.30 m. Rotary drill used to prove boulder thickness. Total time chiselling boulders and rock 13 hours.

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth		N
Made ground, clay, stones.	0.60						
Stiff mottled yellow brown silty clay, some root fibres small stones.			25882	D	1. 0	1.60	50
	2.45						
Stiff grey black very silty clay containing numerous stones, cobbles and large boulders.			25883	D	3.00	3.0	33/150 + Ref
			3603	D	4.00		35/100 + Ref
			3604	D	5.50	5.5	31/100m + Ref
Grey limestone fragments	6.50 6.80		3605	D	6.50		Ref

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

R962

62776

IRISH SOIL LABORATORIES LTD.	TRIAL PIT NO.7

CONTRACT	Rathmines Development	REPORT No.	353
Bored for	Ove Arup and Partners.	Ground Level	
Site Address	Castlewood Avenue	Boring Commenced / Boring Completed	26.8.80
Type and Dia. of Boring	Excavator		

Water Strikes	Water Levels Recorded During Boring										
1.	Hole Depth										
2.	Casing Depth										
3.	Water Level										

Remarks: Very slight seepage at 2.00. Otherwise pit extremely stable. Difficult digging from 2.60

Description	Scale Depth	Legend	Samples & S.P.T. Ref. No.	Type	Depth	N
Made ground, clayey in composition, traces of old top soil, root fibres, brick etc.						
	1.00					
Stiff grey brown mottled silty clay, containing stones and fine root fibres.						
	2.60					
Hard black silty very stony clay, only small fragments excavated due to hardness of material.	2.90					

Code: U—Undisturbed Sample D—Large [illegible] ar Sample W—Water Sample

Report No.	BORING RECORD	IGSL

Contract: **AUNGIER STREET** **R983**

Borehole No. 1

Sheet mw ID:62934

Location: **DUBLIN**

Client: **TONY LAWTON**

Type and Diameter: Cable Tool 200mm

Ground Level: 11.3m Malin ±1m

Date: 2.10.93

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND :Brick,clay,ash, rubble,timber				2950	D	1.50	(1.50)N=13
			2.30	2951	U	2.20	
Firm brown grey mottled silty CLAY (moist)				2952	U	2.70	(3.00)N=15
			3.80				
Firm brown silty sandy gravelly CLAY with boulders (becoming stiffer with depth)				2953	D	4.00	(4.00)N=32
			4.70				
				2954	D	5.00	(5.00)N=66
Stiff grey black silty sandy gravelly CLAY with cobbles and boulders (becoming stiffer with depth)				2955	D	6.50	(6.50)37/150mm
			7.00				
Compact fine to coarse GRAVEL with traces of black silty stony CLAY and fragments of grey limestone				2956	D	7.50	(7.50)N=43
			8.00				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
2.10.93	3.70	3.70	3.70	Slight seepage
	8.00	Nil	3.30	End of boring

Remarks

Chiselling through fill=2hrs

Chiselling 4.70-8.00=1½hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

Report No. 2338	BORING RECORD	IGSL

Contract: AUNGIER STREET — R983

Borehole No. 2

Sheet — Imw ID: 62935

Location: DUBLIN

Client: TONY LAWTON CONSULTING ENGINEER

Type and Diameter: Cable Tool 200mm

Ground Level: 11.3m Malin ± 1m

Date: 4.10.93

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND : Brick, timber, ash, rubble, (possibly old basement)				3048	D	1.00	
							(1.5) N30
				3050	D	2.00	
			2.30				
Firm brown silty sandy stony CLAY with cobbles (moist)				3050	D	3.00	(3.0) N18
				3051	D	4.00	
			4.30				
Stiff black silty sandy gravelly CLAY with cobbles and boulders becoming harder with depth				3052	D	4.50	(4.5) N55
				3053	D	6.00	(6.0) N62/150mm
Refused on boulders			6.50				
*150mm slotted pipe installed to monitor water levels							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
4.10.93	6.50	6.50	Nil	No free water

Remarks: Chiselling fill: 1½ hrs
" at 6.50 : 1 hr.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R989

62971

Report No. 1342	BORING RECORD	IGSL

Contract: PORTOBELLO HARBOUR	Borehole No. 4 Sheet
Location: 17, PORTOBELLO HARBOUR	Type and Diameter: Cable Tool 200mm Diam.
Client: KML CONSULTING ENGINEERS	Ground Level Date: 28.7.89

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
CONCRETE			0.10				
HARDCORE			1.10				
Firm grey silty sandy CLAY with gravel (damp)				019	D	1.30	(1.5)N11
				020	D	2.80	(3.0)N18
				021	D	4.30	(4.5)N22
Grey silty sandy gravelly CLAY			5.00	022	D	5.50	
Stiff dark grey silty CLAY			5.85	023	D	6.30	(6.0)N25
* 2 hours breaking out concrete.			7.00				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
28.7.89			5.2	First Strike
"	6.0	6.0	None	
"	7.0	7.0	None	
"	7.0	0.0	4.7	

Remarks

Requested to stop at 7.0 metres because of vibratio and noise in adjacent premises Waiting 8 hours for instructions

Sample/Test key	
U-Tube Sample	C-Cone Penetration Test
D-Disturbed Sample	N-Blows/0.3 metres
W-Water Sample	R-Refusal
S-Standard Penetration Test	V-Vane

R1364 67503

Report No. 954	BORING RECORD	IGSL

Contract	Borehole No. / Sheet
BUTTERFIELD AVENUE	1

Location	Type and Diameter
RATHFARNHAM	

Client	Ground Level
DUBLIN CORPORATION	

		Date 17.12.86

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND (clay, bricks, concrete, slates, stones)				15345	D	1.5	(1.5)N28
				15346	D	2.9	(3.0)N32
			4.90	15347	D	4.7	(5.0)N33
Stiff brown gravelly silty CLAY with cobbles and boulders				15348	D	5.4	
				15349	D	6.5	(6.5)N43
			7.40				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
17.12.86			4.9	Seepage
"	7.4	6.0	7.3	
"	7.4	0.0	5.0	

Remarks

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

8

R1364 67504

Report No. 954	BORING RECORD	IGSL

Contract	BUTTERFIELD AVENUE	Borehole No. 2
		Sheet
Location	RATHFARNHAM	Type and Diameter Cable Tool
Client	DUBLIN CORPORATION	Ground Level
		Date 17.12.86

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND (clay, bricks, concrete, timber, cobbles)				15350	D	1.0	(1.5)N23
				15351	D	2.0	
				15352	D	3.0	(2.9)N31
Stiff greyish brown gravelly silty CLAY with cobbles and boulders			4.00	15353	D	4.0	
				15354	D	5.0	(4.8)N43
				15355	D	6.0	(6.0)N55
			7.50	15356	D	7.0	(7.0)N51

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
				Dry

Remarks

Chiselling :

0.0 - 4.0 .... 1½ hrs.
4.0 - 7.5 .... 1 hr.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

9

R1364

67505

Report No. 954	BORING RECORD	IGSL

Contract: BUTTERFIELD AVENUE	Borehole No. 3 Sheet
Location: RATHFARNHAM	Type and Diameter: Cable Tool
Client: DUBLIN CORPORATION	Ground Level Date: 18.12.86

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND (clay, concrete, bricks, slates, cobbles)				15357	D	1.0	(1.5)N19
				15358	D	2.6	(3.0)N25
			4.30	15359	D	4.0	(4.5)N53
Stiff greyish brown gravelly silty CLAY with cobbles and boulders				15360	D	5.0	
			7.00	15361	D	6.5	(6.4)N48

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
18.12.86			4.3	Seepage

Remarks: Chiselling :

0.0 - 4.3 ... 1 hr.
5.0 - 7.0 ... 1 hr.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R1364

67506

Report No. 954	BORING RECORD	IGSL

Contract: BUTTERFIELD AVENUE	Borehole No. 4 Sheet
Location: RATHFARNHAM	Type and Diameter: Cable Tool
Client: DUBLIN CORPORATION	Ground Level
	Date: 16.12.86

Description	Reduced Level	Legend	Depth	Samples: Ref. No.	Type	Depth	Field Records And Tests
MADE GROUND (clay, slates, bricks, concrete, cobbles)				15339	D	1.0	(1.5)N32
			1.80	15340	D	2.0	
Stiff greyish brown gravelly silty CLAY with cobbles and boulders				15341	D	3.0	(3.0)N35
				15342	D	4.0	
				15343	D	5.0	(4.8)N42
							(5.6)N51
			6.10	15344	D	6.0	

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
				Dry

Remarks: Chiselling :

0.5 - 1.8 ... 1½ hrs.
2.0 - 6.1 ... 1 hr.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R1364

67507

Report No. 954	BORING RECORD	IGSL

Contract	BUTTERFIELD AVENUE	Borehole No. 5
		Sheet
Location	RATHFARNHAM	Type and Diameter
Client	DUBLIN CORPORATION	Ground Level
		Date 18.12.86

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND (clay, bricks, concrete, cobbles, timber)				15362	D	1.5	(1.6)N22
				15363	D	3.0	(2.9)N30
			3.6				
Stiff greyish brown gravelly silty CLAY with cobbles and boulders				15364	D	4.5	(5.0)N40
				15365	D	6.2	(6.1)N44
			7.0				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
18.12.86			3.6	Seepage
"	7.0	6.0	7.9	
"	7.0	0.0	5.0	

Remarks

Chiselling :

0.0 - 7.0 ... 1½ hrs.

Sample/Test key	C-Cone Penetration Test
U-Tube Sample	N-Blows/0.3 metres
D-Disturbed Sample	R-Refusal
W-Water Sample	V-Vane
S-Standard Penetration Test	

12

67508

Report No. 954	BORING RECORD	IGSL

Contract: BUTTERFIELD AVENUE	Borehole No. 6 Sheet
Location: RATHFARNHAM	Type and Diameter: Cable Tool
Client: DUBLIN CORPORATION	Ground Level Date: 19.12.86

Description	Reduced Level	Legend	Depth	Samples: Ref. No.	Type	Depth	Field Records And Tests
HARDCORE			0.30				
MADE GROUND (bricks, concrete, pottery, clay)				15367	D	1.5	(1.0)N20
			2.70	15368	D	2.8	(2.5)N28
Stiff mottled grey and brown gravelly CLAY			3.00				
Stiff brown gravelly silty CLAY with cobbles and boulders				15369	D	4.0	(4.0)N45
				15370	D	5.5	(5.5)N49
				15371	D	6.6	(6.6)N51
			7.00				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
			2.7	Seepage

Remarks

Chiselling :

0.0 - 7.0 ... 1¾ hrs.

Sample/Test key

U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R2214

Report No. 1470	BORING RECORD	IGSL

Contract: **AUNGIER STREET**

Borehole No. 1

Sheet

Location: **AUNGIER ST.DUBLIN**

Type and Diameter: **Cable tool 200mm**

Client: **O'CONNOR SUTTON CRONIN, CONSULTING ENGINEERS**

Ground Level

Date: **1.3.90**

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Type	Depth	Field Records And Tests	N
FILL : Brick , ash , gravel, clay and stones				3798	D	1.50	(1.5)	8
			2.20				(2.5)	14
Firm brown silty sandy gravelly CLAY some roots and fragments of fill (Quite damp)				3799	D	3.00		
			3.90	3800	D	4.00	(4.0)	21
Stiff brown silty stony CLAY (BOULDER CLAY)			4.30					
Stiff grey black silty v.stony CLAY (BOULDER CLAY)				3704	D	5.00	(5.0)	62
				3705	D	6.00	(6.5)	34/150mm
			6.60	3706	D	6.80		
Coarse sandy GRAVEL & boulders			7.00				(7.5)	84
Stiff grey black very silty, very stony CLAY with numerous boulders				3707	D	8.50		
				3708	W	Water	(9.0)	45/150mm
			10.00					

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
1.3.90	6.80	6.80	6.80	Water noted
	10.00	10.00	Dry	End of boring
	10.00	Nil	3.80	Final level

Remarks

Chiselling through fill = 1½hrs
Chiselling in boulders & boulder clay = 2½hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R2227 85210

Report No.	BORING RECORD	IGSL

Contract: **58 DAME STREET**

Borehole No. **1**

Sheet

Location: **DUBLIN**

Type and Diameter: **Cable Tool 150mm**

Client: **O'CONNOR SUTTON CRONIN**

Ground Level

Date: **13.11.93**

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
MADE GROUND:Brick,rubble, timber				3532	D	1.30	
			1.60	3533	D	1.60	(1.50)N=17
MADE GROUND:Black and brown CLAY with grey silt and occ.gravel fragments				3534	D	2.70	
							(3.00)N=21
			3.30	3535	D	3.30	
Stiff grey black very silty very stony CLAY with boulders			3.70	3536	D	3.80	
Fragments of grey Limestone with some grey clay and silt			4.20				(4.00)55/75mm & refusal
NOTE:Refusal at 4.20m is presumed to be the Limestone bedrock							
Slotted 25mm steel pipe placed in borehole to monitor landfill gases,backfilled with gravel							

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
13.11.93	3.50	3.50	3.50	Water noted
	4.20	4.00	3.70	End of boring
	4.20	Nil	0.50	After 2hrs

Remarks
Chiselling in fill=1hr
Chiselling 3.70-4.20=2hrs

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R2245 S274

Report No. 1289	BORING RECORD	IGSL

Contract: PORTOBELLO

Borehole No. 1

Sheet

Location: RATHMINES, DUBLIN

Type and Diameter: Shell & Auger 200mm

Client: ZOE DEVELOPMENTS

Ground Level

Date: 19.5.89 - 22.5.89

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
FILL : Brick, ash, clay, etc.			1.30				
Firm brown silty stony CLAY slight traces of fill, flecks of organic matter (Fill)			2.50	7170	D	1.50	
				7171	U	2.00	
Stiff grey brown silty sandy very stony CLAY (Boulder Clay)			3.50	7172	D	3.00	(3.0)N=33
Stiff to hard grey black very silty very stony CLAY (Boulder Clay)							(4.0)N=54
				7173	D	4.50	
							(5.0)N=39/150mm
				7174	D	6.00	(6.0)N=40/150mm
							(7.0)N=45/150mm
				7175	D	7.50	
							(8.0)N=42/150mm
Borehole complete at 8.30			8.30				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
19.5.89	2.00	2.00	2.00	Seepage
22.5.89	8.00	Nil	1.60	End of Boring

Remarks: Chiselling on boulders 7 - 8 metres : 2 hrs.

Chiselling through boulder clays 3 hrs.

Sample/Test key
- U-Tube Sample
- D-Disturbed Sample
- W-Water Sample
- S-Standard Penetration Test
- C-Cone Penetration Test
- N-Blows/0.3 metres
- R-Refusal
- V-Vane

R2245

Report No. 1289	BORING RECORD	IGSL

Contract: PORTOBELLO	Borehole No. 2 / Sheet
Location: RATHMINES, DUBLIN	Type and Diameter: Shell & Auger 200mm
Client: ZOE DEVELOPMENTS	Ground Level
	Date: 23.5.89

Description	Reduced Level	Legend	Depth	Samples Ref. No.	Samples Type	Samples Depth	Field Records And Tests
FILL ; Ash, brick, stones and clay							(1.0)N=3
				7176	D	1.50	
			1.70				
Soft to firm grey brown silty sandy CLAY, traces of brick and glass (Fill)							(2.0)N=5
				7177	U	2.50	
			3.00				(3.0)N=12
Firm to stiff grey silty sandy CLAY (Boulder Clay)							(4.0)N=18
				7178	U	4.50	
			5.00				(5.0)N=44
Stiff black clayey SILT some stones (Boulder Clay)							
				7179	D	6.00	(6.0)N=35/150mm
			6.70				
Stiff to hard grey black silty stony CLAY with boulders (Boulder Clay)							
				7180	D	7.50	(7.6)N=37/150mm
Borehole complete at....			8.40				

Water Level Observations during Boring

Date	Hole Depth	Casing Depth	Depth to Water	Remarks
22.5.89	6.80	6.80	6.80	Seepage
	8.40	8.40	Nil	
	8.40	Nil	4.30	Final Level

Remarks: Chiselling on cobbles and boulders in boulder clay for 3½ hrs.

Sample/Test key
U-Tube Sample
D-Disturbed Sample
W-Water Sample
S-Standard Penetration Test
C-Cone Penetration Test
N-Blows/0.3 metres
R-Refusal
V-Vane

R2371 86507

Boring method: Rotary Open Hole Drilling (ODEX)	Boring diameter (mm): 150 to 18.50m; 120 to 30.00m		Record of BOREHOLE 40A
Boring equipment: Hands England 36/80(Lorry Mounted); Down-Hole Hammer; Air Flush	Casing diameter (mm): ODEX to 18.50m		(Sheet 1 of 3)
Location: E 315563.0 N 233746.0	Orientation: Vertical	Ground level (mOD): 9.80	Date commenced: 22/01/00

Samples and in situ tests Depth (m)	Type	Casing depth (m)	Backfill Depth (m)	Symbol	Water depth (m)	TCR SCR (RQD)	If	Depth (m)	Description of Strata	OD Level (mOD)	Legend
								0.04	#TARMAC	9.76	
								0.17	#MADE GROUND (cobblestones)	9.63	
									#CONCRETE		
			0.50					0.50		9.30	
									#MADE GROUND (brown gravelly clay with some broken brick and mortar)		
					DRY						
					DRY						
			1.50					1.70		8.10	
									#Brown gravelly CLAY with some cobbles		
								2.10		7.70	
									#Brown gravelly CLAY with many limestone cobbles		
								3.80		6.00	
									#Dark brown gravelly CLAY with many limestone cobbles		
								5.70		4.10	
									#Brown clayey GRAVEL with many cobbles and some boulders		

REMARKS:
Description based on Driller's log.
An inspection pit was excavated by hand to a depth of 1.20m to clear services.
The borehole was lined with plastic casing to a depth of 18.70m, but was open thereafter.
A rising head permeability test was carried out in the borehole on 26/01/00. The results are given in Table 4.

Drilling Progress		Ground-water				Water Added	
Date	Depth(m)	Struck(m)	Rose To(m)	Time(min)	Cut Off(m)	From(m)	To(m)
22/01/00	1.20	7.20					
23/01/00	30.00	9.10					

Chiselling			Flush		
From(m)	To(m)	Time(hr)	Depth(m)	Type	Returns
			30.00	Air	Full

Driller	Originator	BOREHOLE RECORD Scale 1:50 For explanation of symbols and abbreviations see Key Sheet	
PC	AMcL 11/02/2000		WIMTEC ENVIRONMENTAL
Checked & Approved: WTG	Log Status: FINAL	DUBLIN LIGHT RAIL PROJECT TUNNEL LINK	Fig 37

Lab Ref No S/32589 Template: STANDARD.GDT Style: BOREHOLE1 File: S:\PROJECTS\GINTW32589.GPJ Printed: 15/02/2000 15:44:11 Wimtec Environmental Limited, Loaningpark House, Uphall, West Lothian. EH52 5NW

R2371

Boring method: Rotary Open Hole Drilling (ODEX)	Boring diameter (mm): 150 to 18.50m; 120 to 30.00m		Record of BOREHOLE 40A
Boring equipment: Hands England 36/80(Lorry Mounted); Down-Hole Hammer; Air Flush	Casing diameter (mm): ODEX to 18.50m		(Sheet 2 of 3)
Location: E 315563.0 N 233746.0	Orientation: Vertical	Ground level (mOD): 9.80	Date commenced: 22/01/00

Samples and in situ tests Depth (m)	Type	Casing depth (m)	Backfill Depth (m)	Symbol	Water depth (m)	TCR SCR (RQD)	If	Depth (m)	Description of Strata	OD Level (mOD)	Legend
					▼			10.20	See previous sheet #Brown coarse SAND and GRAVEL	-0.40	
								17.60	#Dark grey LIMESTONE	-7.80	
								18.30	#Black LIMESTONE	-8.50	
			18.70								

REMARKS:

Drilling Progress	
Date	Depth(m)
22/01/00	1.20
23/01/00	30.00

Ground-water				Water Added	
Struck(m)	Rose To(m)	Time(min)	Cut Off(m)	From(m)	To(m)
10.20					

Chiselling			Flush		
From(m)	To(m)	Time(hr)	Depth(m)	Type	Returns

Driller	Originator	BOREHOLE RECORD	
PC	AMcL 11/02/2000	Scale 1:50 For explanation of symbols and abbreviations see Key Sheet	
Checked & Approved: WTG	Log Status: FINAL	DUBLIN LIGHT RAIL PROJECT TUNNEL LINK	WIMTEC ENVIRONMENTAL Fig 37 Cont'd

Lab Ref No S/32589 Template: STANDARD.GDT Style: BOREHOLE1 File: S:\PROJECTS\GINTW32589.GPJ Printed: 15/02/2000 12:50:22 Wimtec Environmental Limited, Loaningpark House, Uphall, West Lothian, EH52 5NW

R2371

Boring method	Rotary Open Hole Drilling (ODEX)	Boring diameter (mm)	150 to 18.50m; 120 to 30.00m
Boring equipment	Hands England 36/80(Lorry Mounted); Down-Hole Hammer; Air Flush	Casing diameter (mm)	ODEX to 18.50m
Location	E 315563.0 N 233746.0	Orientation Vertical	Ground level (mOD) 9.80 / Date commenced 22/01/00

Record of **BOREHOLE 40A** (Sheet 3 of 3)

Samples and in situ tests Depth (m)	Type	Casing depth (m)	Backfill Depth (m)	Symbol	Water depth (m)	TCR SCR (RQD)	If	Depth (m)	Description of Strata	OD Level (mOD)	Legend
								20.30	See previous sheet	-10.50	
									#Dark grey LIMESTONE with occasional calcite veins and some black weaker bands (possibly siltstone)		
			30.00					30.00	END OF BOREHOLE	-20.20	

REMARKS:

Drilling Progress Date	Depth(m)
22/01/00	1.20
23/01/00	30.00

Ground-water Struck(m)	Rose To(m)	Time(min)	Cut Off(m)	Water Added From(m)	To(m)

Chiselling From(m)	To(m)	Time(hr)	Flush Depth(m)	Type	Returns

Driller	Originator
PC	AMcL 11/02/2000
Checked & Approved	Log Status
WTG	FINAL

BOREHOLE RECORD
Scale 1:50
For explanation of symbols and abbreviations see Key Sheet

DUBLIN LIGHT RAIL PROJECT
TUNNEL LINK

WIMTEC ENVIRONMENTAL

Fig 37 Cont'd

R2900

9314

REPORT NO.	GEOTECHNICAL BORING RECORD	I.G.S.L.

CONTRACT:	Proposed Social & Services Community Centre	BOREHOLE NO.:	3
		SHEET:	1 of 1
CLIENT:	Molony & Millar, Consulting Engineers	DATE STARTED:	8.6.96
	BOREHOLE DIAM.(mm) 200	DATE COMPLETED:	8.6.96
LOCATION:	Aungier Street, Dublin 2	BORED BY:	I.G.S.L.
	BOREHOLE DEPTH 6.50	LOGGED BY:	I.G.S.L.
	CASING DEPTH (m) 6.50		

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS
0								Depth N
	MADE GROUND (Comprised of red brick gravel, clay etc)							
-1					20197	D	1.50	1.50 6
-2				2.50				
	Firm to stiff brown silty gravelly CLAY with cobbles							
-3					20198	D	3.00	3.00 12
-4				4.20	20199	D	4.20	
	Very stiff to hard black slightly silty gravelly CLAY with cobbles and boulders							4.50 50
-5								
-6					20101	D	6.00	6.00 65
				6.50				
-7	Refusal							
-8								
9								

Remarks.

Chiselling

From 6.00 - 6.50 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
8.6	4.20	4.20	4.20	Seepage
	6.50	Nil	Dry	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, S-SPT, W-Water Sample, R-Refusal.

R2900

93115

GEOTECHNICAL BORING RECORD

I.G.S.L.

REPORT NO.			
CONTRACT:	Proposed Social & Services Community Centre	BOREHOLE NO.:	4
		SHEET:	1 of 1
CLIENT:	Molony & Millar, Consulting Engineers	DATE STARTED:	9.6.96
		DATE COMPLETED:	9.6.96
LOCATION:	Aungier Street, Dublin 2	BORED BY:	I.G.S.L.
BOREHOLE DIAM.(mm)	200	LOGGED BY:	I.G.S.L.
BOREHOLE DEPTH	8.00		
CASING DEPTH (m)	8.00		

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS
0	Concrete			0.10				Depth N
	MADE GROUND (Comprised of red brick gravel, clay etc)				18149	D	1.50	1.50 11
3				3.00	18150	D	3.00	3.00 43
	Stiff to very stiff brown silty gravelly CLAY with cobbles				18151	D	4.30	4.50 47
6				6.00	18152	D	6.00	6.00 134
	Very stiff to hard black slightly silty gravelly CLAY with cobbles and boulders				18153	D	7.50	7.50 25 for 75mm then Ref
8				8.00				
	Refusal							
9								

Remarks.

Chiselling From 0 - 0.10 for 1hr
From 1.50 - 3.00 for 1hr
From 7.50 - 8.00 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
9.6	8.00	Nil	Dry	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, S-SPT, W-Water Sample, R-Refusal.

R2900

93116

GEOTECHNICAL BORING RECORD

I.G.S.L.

REPORT NO.			
CONTRACT:	Proposed Social & Services Community Centre	BOREHOLE NO.:	5
		SHEET:	1 of 1
CLIENT:	Molony & Millar, Consulting Engineers	DATE STARTED:	16.6.96
		DATE COMPLETED:	16.6.96
LOCATION:	Aungier Street, Dublin 2	BORED BY:	I.G.S.L.
	BOREHOLE DIAM.(mm) 200	LOGGED BY:	I.G.S.L.
	BOREHOLE DEPTH 7.00		
	CASING DEPTH (m) 7.00		

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS
0								Depth N
	MADE GROUND (Comprised of red brick gravel, clay etc)							
-1					18101	D	1.00	1.00 11
-2					18102	D	2.20	2.20 21
				2.30				
	Stiff to very stiff brown silty gravelly CLAY with cobbles							
-3					18103	D	3.00	
								3.50 47
-4					18104	D	4.00	
				4.50				
					18105	D	4.60	
	Hard black slightly silty gravelly CLAY with cobbles and boulders							
-5								5.00 63
-6					18106	D	6.00	
								6.50 94
-7				7.00				
	Refusal							
-8								
9								

Remarks.

Chiselling

From 4.60 - 4.90 for 1hr
From 6.80 - 7.00 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
16.6	7.00	Nil	Dry	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, S-SPT, W-Water Sample, R-Refusal.

R3059

95098

BORING RECORD

I.G.S.L.

Contract:	KELLY'S CORNER	Borehole No.	1
No.	2825	Sheet No.	
Location:	SOUTH CIRCULAR RD. DUBLIN	Method	Cable Tool
Client:	TONY LAWTON, CONSULTING ENGINEER	Dia.	200mm
Dates:	9.1.95 - 10.1.95	Ground Level	m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	samples Type	samples Depth	Field Tests
MADE GROUND : brick, mortar, clay, ash, etc.				100	D	1.50	(1.50)N=17
			2.00				
Firm brown silty sandy gravelly CLAY (damp)				101	D	2.50	
			2.90				
Stiff to very stiff grey black very silty gravelly				102	D	3.30	(3.00)N=52
				103	D	4.50	(4.50)N=57
							(6.00)41/150m
				104	D	6.50	
Borehole complete at 7.00m			7.00				

Remarks

Chiselling in fill = 1hr30mins

Chiselling boulders 2.90-7.00=3hrs

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
9.1.95	3.00	3.00	3.00	Seepage
	3.50	3.50	Nil	Dry
	7.00	Nil	Nil	End of borin

Driller:

Sample/Test Key : U - tube sample D - disturbed sample

W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

R3059 95100

BORING RECORD

I.G.S.L.

Contract: KELLY'S CORNER
No. 2825
Location: SOUTH CIRCULAR RD. DUBLIN
Client: TONY LAWTON, CONSULTING ENGINEER
Dates: 11.1.95 - 12.1.95

Borehole No. 3
Sheet No.
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
MADE GROUND - Ash , brick,rubble,clay,timber , glass							(1.00)N=14
				109	D	1.50	
			2.10				
Firm brown silty sandy gravelly CLAY (DAMP)				110	D	2.30	(3.00)N=13
			3.20				
Stiff to very stiff grey black very silty gravelly CLAY with cobbles and boulders (Boulder Clay)				111	D	3.50	(4.00)N=64
				112	D	4.30	
				113	D	5.50	(6.00)N= 43/150mm
				114	D	7.00	
				115	W	Water	(7.30)N= 36/75mm
complete at 7.30 on cobbles and boulders			7.5				

Remarks
Chiselling in fill = 1hr30mins
Chiselling boulders 3.20-7.30=2hrs

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
11.1.95	3.00	3.00	3.00	Dampish
	7.30	7,00	Nil	Dry
12.1.95	7.30	Nil	4.50	End of borin

Driller:

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

R3059 95099

BORING RECORD

I.G.S.L.

Contract:	KELLY'S CORNER	Borehole No.	2
No.	2825	Sheet No.	
Location:	SOUTH CIRCULAR RD. DUBLIN	Method	Cable Tool
Client:	TONY LAWTON, CONSULTING ENGINEER	Dia.	200mm
Dates:	10..1.95 - 11.1.95	Ground Level	m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
MADE GROUND - brick , ash,timber etc.				105	D	1.00	(1.50)N=16
			2.10				
Firm brown silty sandy gravelly CLAY (Damp)				106	D	2.50	
			3.20				(3.00)N=10
Very stiff grey black very silty very gravelly CLAY with cobbles and boulders (Black boulder Clay)				107	D	3.50	(4.00)N=61
				108	D	4.50	(5.00)N= 45/150mm
			5.50				
Refusal on boulders at 5.50m							

Remarks
Chiselling in fill = 1hr
Chiselling at 5.50=2hrs30mins

Driller:

Sample/Test Key : U - tube sample D - disturbed sample
W - water sample S - S.P.T. C - C.P.T. R - REFUSAL V- vane

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
10.1.95	3.20	3.20	3.20	Seepage
	5.50	5.00	Nil	Dry
	5.50	Nil	3.60	End of borin

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL

CONTRACT: Aungier Street

BOREHOLE NO: BH1
Sheet 1 of 1

CLIENT:	YMCA Dublin	GROUND LEVEL (mOD)	0.00
ENGINEER:	White Young Green	BOREHOLE DIAMETER (mm)	200
CO-ORDINATES:	E 0.00 N 0.00	BOREHOLE DEPTH (m)	7.50
		CASING DEPTH (m)	7.50

DATE STARTED: 22/01/2002
DATE COMPLETED: 22/01/2002
BORED BY: IGSL

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.30					
1	MADE GROUND (Containing silt/clay , gravel, wood, red brick)				2582	DB	1.00	9/300mm	
2					2583	DB	2.00	21/300mm	
	Very stiff brown sandy gravelly CLAY			2.50					
3					2584	DB	3.00	73/225mm	
4					2585	DB	4.00	29/75mm	
	Hard black gravelly CLAY with occasional cobbles and boulders			4.80					
5					2586	DB	5.00	74/225mm	
6					2587	DB	6.00	74/225mm	
	Hard brown gravelly CLAY with occasional cobbles and boulders			6.80					
7					2588	DB	7.00	46/150mm	
	End of Borehole at 7.50 m			7.50					
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.30	1.00	
4.30	4.50	1.00	
7.30	7.50	2.00	

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments
22/01/2002	7.50	7.50	0.00	No groundwater encountered

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL
CONTRACT: Aungier Street		BOREHOLE NO: BH2 Sheet 1 of 1
CLIENT: YMCA Dublin	GROUND LEVEL (mOD) 0.00	DATE STARTED: 21/01/2002
ENGINEER: White Young Green	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED: 21/01/2002
CO-ORDINATES: E 0.00 N 0.00	BOREHOLE DEPTH (m) 8.20	BORED BY: IGSL
	CASING DEPTH (m) 8.20	

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.20					
	MADE GROUND (Contalning silt/clay , red brick, ash, tin)				2573	DB	1.00	10/300mm	
					2574	DB	2.00	11/300mm	
	Stiff brown sandy gravelly CLAY with occasional cobbles and boulders			2.50	2575	DB	3.00	30/75mm	
					2576	DB	4.00	65/300mm	
	Very stiff brown slightly sandy gravelly CLAY with cobbles and boulders			4.50	2577	DB	5.00	41/0mm	
	Hard black gravelly CLAY with occasional cobbles and boulders			5.20	2578	DB	6.00	29/75mm	
					2579	DB	7.00	52/150mm	
	Fine to coarse GRAVEL with cobbles and boulders			7.70	2580	DB	7.80		
	End of Borehole at 8.20 m			8.00				28/0mm	

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.20	1.00	
3.20	3.40	1.00	
5.10	5.50	1.00	
8.00	8.20	2.00	

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments
7.70	7.70	0.00	6.70	5	

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments
21/01/2002	8.20	8.20	5.00	

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL

CONTRACT: Aungier Street

BOREHOLE NO: BH3
Sheet 1 of 1

CLIENT:	YMCA Dublin	GROUND LEVEL (mOD)	0.00
ENGINEER:	White Young Green	BOREHOLE DIAMETER (mm)	200
CO-ORDINATES:	E 0.00 N 0.00	BOREHOLE DEPTH (m)	7.30
		CASING DEPTH (m)	7.30

DATE STARTED: 23/01/2002
DATE COMPLETED: 23/01/2002
BORED BY: IGSL

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.30					
1	MADE GROUND (Containing silt/clay , red brick, ash, cobbles and boulders)				~~2589~~	DB	1.00	16/300mm	
2					2590	DB	2.00	15/300mm	
3	Very stiff brown sandy gravelly CLAY with occasional cobbles and boulders			2.80	2591	DB	3.00	88/300mm	
4					2592	DB	4.00	69/225mm	
5	Hard black gravelly CLAY with cobbles and boulders			4.40	2593	DB	5.00	39/0mm	
6					2594	DB	6.00	24/75mm	
7	Hard brown gravelly CLAY with cobbles and boulders			6.90	2595	DB	7.00	31/0mm	
	End of Borehole at 7.30 m			7.30					
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.30	1.00	.
4.40	4.50	0.50	.
5.20	5.40	1.00	.
7.10	7.30	2.00	.

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type
23/01/2002	7.00	1.00	7.00	50mm

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL

CONTRACT: Aungier Street

BOREHOLE NO: BH4
Sheet 1 of 1

CLIENT: YMCA Dublin
ENGINEER: White Young Green

CO-ORDINATES: E 0.00
N 0.00

GROUND LEVEL (mOD) 0.00
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 1.70
CASING DEPTH (m) 1.70

DATE STARTED: 26/01/2002
DATE COMPLETED: 26/01/2002

BORED BY: IGSL

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.10					
1	MADE GROUND (Containing soft/firm silt/clay , wood, red brick, ash)				2505	DB	1.00	9/300mm	
				1.70					
2	End of Borehole at 1.70 m								
3									
4									
5									
6									
7									
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.10	0.50	
1.70	1.72	2.00	

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL

CONTRACT: Aungier Street

BOREHOLE NO: BH5
Sheet 1 of 1

CLIENT:	YMCA Dublin	GROUND LEVEL (mOD)	0.00	DATE STARTED:	24/01/2002
ENGINEER:	White Young Green	BOREHOLE DIAMETER (mm)	200	DATE COMPLETED:	24/01/2002
CO-ORDINATES:	E 0.00 N 0.00	BOREHOLE DEPTH (m)	1.70	BORED BY:	IGSL
		CASING DEPTH (m)	1.70		

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REF. NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
0	TARMAC			0.10					
1	*MADE GROUND (Containing silt/clay , red brick, ash, plastic)*				2596	DB	1.00	8/300mm	
				1.70					
2	End of Borehole at 1.70 m								
3									
4									
5									
6									
7									
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.10	0.50	.
1.70	1.72	2.00	.

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL
CONTRACT: Aungier Street		BOREHOLE NO: BH6 Sheet 1 of 1
CLIENT: YMCA Dublin	GROUND LEVEL (mOD) 0.00	DATE STARTED: 25/01/2002
ENGINEER: White Young Green	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED: 25/01/2002
CO-ORDINATES: E 0.00 N 0.00	BOREHOLE DEPTH (m) 7.50	BORED BY: IGSL
	CASING DEPTH (m) 7.50	

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.30					
1	MADE GROUND (Containing silt/clay , red brick, ash, cloth)				2597	DB	1.00	12/300mm	
2	Stiff brown slightly sandy gravelly CLAY with occasional cobbles and boulders.			2.00	2598	DB	2.00	25/300mm	
3					2599	DB	3.00	96/300mm	
4					2600	DB	4.00	29/75mm	
	Hard black gravelly CLAY with cobbles and boulders			4.50					
5					2502	DB	5.00	31/75mm	
6					2503	DB	6.00	43/0mm	
7					2504	DB	7.00	43/0mm	
	End of Borehole at 7.50 m			7.50					
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.30	1.00	.
4.60	4.80	1.00	.
5.20	5.30	0.50	.
7.20	7.50	2.00	.

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type
25/01/2002	7.50	0.50	7.00	50mm

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments

Remarks:

R4483

REPORT NO. 7688	GEOTECHNICAL BORING RECORD	IGSL
CONTRACT: Aungier Street		BOREHOLE NO: BH7 Sheet 1 of 1
CLIENT: YMCA Dublin	GROUND LEVEL (mOD) 0.00	DATE STARTED: 27/01/2002
ENGINEER: White Young Green	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED: 27/01/2002
CO-ORDINATES: E 0.00 N 0.00	BOREHOLE DEPTH (m) 7.40	BORED BY: IGSL
	CASING DEPTH (m) 7.40	

DEPTH (M)	DESCRIPTION	LEGEND	ELEVATION (mOD)	DEPTH (m)	SAMPLES REF. NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH (m)	FIELD TEST RESULTS	STAND PIPE DETAILS
	TARMAC			0.10					
1	MAOE GROUND (Containing silt/clay , red brick, ash, plastic)				2506	DB	1.00	10/300mm	
2	Firm brown sandy gravelly CLAY with occasional cobbles and boulders			2.00	2507	DB	2.10	15/300mm	
3	Stiff brown sandy gravelly CLAY with occasional cobbles and boulders			2.60	2508	DB	3.00	24/300mm	
4	Hard black gravelly CLAY with cobbles and boulders			4.00	2509	DB	4.10	41/0mm	
5					2510	DB	5.00	29/75mm	
6					2511	DB	6.00	55/150mm	
7					2512	DB	7.00	24/75mm	
	End of Borehole at 7.40 m			7.40					
8									
9									

Hard Strata Boring / Chiselling

From (m)	To (m)	Hours	Comments
0.00	0.10	0.50	.
4.10	4.30	1.00	.
5.20	5.30	0.50	.
7.10	7.40	2.00	.

Water Strike Details

Water Strike	Casing Depth	Sealed at	Rise to	Time	Comments

Standpipe Installation Details

Date	Tip Depth	RZ Top	RZ Base	Type

Groundwater Observations

Date	Hole Depth	Casing Depth	Depth to Water	Comments

Remarks:

R5464

REPORT NO.

GEOTECHNICAL BORING RECORD

I.G.S.L.

CONTRACT:	Space Projects Development - Rathgar Dublin	BOREHOLE NO.:	1
		SHEET:	1 of 1
CLIENT:	Space Projects Limited	GROUND LEVEL:	DATE STARTED: 20.6.03
ENGINEER:	PKT Consulting	BOREHOLE DIAM.(mm) 200	DATE COMPLETED: 23.6.03
LOCATION:	Rathgar, Dublin	BOREHOLE DEPTH 3.30	BORED BY: I.G.S.L.
		CASING DEPTH (m) 3.30	LOGGED BY: I.G.S.L.

DOWNHOLE DEPTH (m)	DESCRIPTION	SYMBOLIC LOG	ELEVATION (mOD)	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	FIELD TEST RESULTS
0	Topsoil			0.20				Depth N
-1	Soft grey slightly sandy CLAY with organics (poss. made ground)			1.40	6930	D	1.00	1.00 3
-2	Firm to stiff brown slightly sandy gravelly CLAY			2.80	6931	D	2.00	2.00 17
-3	Very stiff grey black gravelly CLAY with small cobbles			3.30	6932	D	3.00	3.00 50 for75mm then Ref
-4	Refusal							
-5								
-6								
-7								
-8								
9								

Remarks.

Provide IGSL Crane to site to lift rig over wall

Chiselling

From 0 - 0 for 2hrs craning rig into site
From 3.20 - 3.30 for 2hrs

Water level observations during boring

DATE	HOLE DEPTH	CASING DEPTH	DEPTH TO WATER	REMARKS
23.6.	3.20	3.20	3.20	strike
	3.20	3.20	2.90	20 mins
	3.30	nil	2.50	Bh End

FIELD TEST KEY: U-U100, Db-Disturbed Sample, S-SPT, W-Water Sample, R-Refusal.

GEOTECHNICAL BORING RECORD R6455

REPORT NUMBER 11746

CONTRACT	Bishops, Kevin street
CO-ORDINATES(_)	
CLIENT	
ENGINEER	The O'Reilly Partnership
GROUND LEVEL (m)	
BOREHOLE DIAMETER (mm)	200
BOREHOLE DEPTH (m)	5.40
CASING DEPTH (m)	5.40
BOREHOLE NO.	BH1
SHEET	Sheet 1 of 1
DATE STARTED	12/05/2006
DATE COMPLETED	12/05/2006
BORED BY	IGSL
PROCESSED BY	C.Killaly

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Field Test Results	Standpipe Details
0	MADE GROUND comprised of TARMAC								
	MADE GROUND comprised of hardcore fill material			0.20					
	MADE GROUND comprised of grey brown sandy gravelly CLAY with brick, cobble and wood fill			0.40	V2301	B	1.00-1.00	N = 9 (2, 2, 1, 3, 3, 2)	
1					V2302	B	2.00-2.00	N = 9 (2, 2, 1, 1, 3, 4)	
2	Stiff grey brown sandy gravelly CLAY with some cobbles and occasional boulders			2.40	V2303	B	3.00-3.00	N = 21 (2, 3, 4, 4, 6, 7)	
3	Very stiff black sandy gravelly CLAY with some cobbles and boulders			3.70	V2304	B	4.00-4.00	N = 53 (7, 7, 9, 12, 14, 18)	
4					V2305	B	5.00-5.00	N = 41/150 mm (10, 12, 16, 25)	
5	Obstruction			5.20					
	End of Borehole at 5.40 m			5.40					
6									
7									
8									
9									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
0.4	1	1	
3.5	3.6	0.75	
5.2	5.4	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.80	4.00	3.90	3.60		Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
12-05-06	5.40	0.00	5.00	

REMARKS

IGSL BH LOG 11746.GPJ IGSL.GDT 1/6/06

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

R3040

CONTRACT Harolds Cross
CLIENT The McKenna Pearse Practice
Site Address Harolds Cross, Dublin
Boring Commenced 30/11/98
Type of Boring Shell & Auger

Borehole No. 1 94930
Sheet 1 of 1
E N
Boring Completed 1/12/98
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
FILL of clayey sandy gravelly SILT		0.05 0.90							
FILL of grey clayey sandy SILT		1.70		B S(11)	1.00 1.15	52593			
Firm to stiff black clayey very sandy very gravelly SILT		4.00		B C(16) B C(15)	2.00 2.15 3.00 3.15	52594 52595		30/11/98 01/12/98	Nil Nil
Stiff black clayey very sandy very gravelly SILT with cobbles		5.80		B C(37) B C(67)	4.00 4.15 5.00 5.15	52596 52597		01/12/98	4.6
Dense grey sandy fine to coarse GRAVEL with cobbles		7.00		B C(42) W	6.00 6.15 6.30	52598 52599			
Very dense grey sandy fine to coarse GRAVEL with cobbles		8.30		B C(*) B C(*)	7.00 7.15 8.00 8.15	52600 52521			
Final Level									

Remarks:
At 7.15m from 7.15mBGL 4, 16, 19, 28.
At 8.15m from 8.15mBGL 7, 25, 36.
Installed 40mm diameter standpipe with pea gravel surround bentonite seal and protective cover.

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
↓C(N) - Cone Penetration Test
↓S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

R3040

CONTRACT Harolds Cross
CLIENT The McKenna Pearse Practice
Site Address Harolds Cross, Dublin
Boring Commenced 2/12/98
Type of Boring Shell & Auger

Borehole No. 2 94931
Sheet 1 of 1
E N
Boring Completed 2/12/98
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
FILL of gravel		0.05 0.50							
Firm to stiff brown grey clayey sandy GRAVEL		1.70		B C(13)	1.00 1.15	49525			
Firm to stiff grey clayey sandy GRAVEL		2.40		B C(19)	2.00 2.15	49253			
Stiff grading to very stiff black clayey very sandy very gravelly SILT with cobbles		5.00		B C(29)	3.00 3.15	49254			
				B C(41)	4.00 4.15	49255			
Very stiff black clayey very sandy very gravelly SILT with cobbles		8.30		B C(*)	5.00 5.15	49256		02/12/98	5.50
				B C(*)	6.00 6.15	49257			
				W B C(*)	6.99 7.00 7.15	49260 49258			
				B C(*)	8.00 8.15	49259			
Final Level									

Remarks:

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
↓C(N) - Cone Penetration Test
↓S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

SITE INVESTIGATION LIMITED
BOREHOLE RECORD

R3040

CONTRACT Harolds Cross
CLIENT The McKenna Pearse Practice
Site Address Harolds Cross, Dublin
Boring Commenced 3/12/98
Type of Boring Shell & Auger

Borehole No. 3 94932
Sheet 1 of 1
E N
Boring Completed 3/12/98
Diameter of Borehole 200 mm

Description of Strata	Reduced Level	Depth	Legend	Sample/Tests Type	Depth m	Ref. No.	Casing Depth	Date	Water Depth m
Ground Level	m	m							
TARMAC.		0.20							
FILL of grey clayey coarse gravelly SILT		0.95							
Firm to stiff brown clayey very sandy very gravelly SILT with cobbles		2.90		B C(14)	1.00 1.15	49261			
				B C(17)	2.00 2.15	49262			
Do. except black		4.20		B C(15)	3.00 3.15	49263			
				B C(31)	4.00 4.15	49264		03/12/98	4.10
Stiff to very stiff black clayey very sandy very gravelly SILT with cobbles		5.00							
Very stiff black clayey very sandy very gravelly SILT with cobbles		6.50		B C(52)	5.00 5.15	49265			
				B C(58)	6.00 6.15	49266			
Final Level									

Remarks:
Installed 40mm diameter standpipe with pea gravel surround, bentonite seal and protective cover.

KEY - EXPLANATION
↓ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
↓C(N) - Cone Penetration Test
↓S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

R204 51942

TRIAL PIT RECORD

I.G.S.L.

Contract: Brighton Square
No.
Location: Terenure Road North
Client: Carew and Associates/ Project Management Ltd.
Date: 29/6/95

PIT No 1
Sheet
Excavation method:

Ground Level

Description	Red. Level	Leg end	Depth	samples Ref. No.	samples Type	samples Depth	Remarks
Made Ground (Rubble, timber , glass and pottery intermixed with black organic silt) Layers of black peaty SILT noted between 2.0 metres and 3.5 metres			3.50				

Observations	Groundwater Conditions
Severe collapsing of trial pit below 2 metres in association with water ingress.	Rapid water ingress between 2.0 and 2.5 metres.

R204

51943

TRIAL PIT RECORD

I.G.S.L.

Contract: Brighton Square	PIT No 2
No.	Sheet
Location: Terenure Road North	Excavation method:
Client: Carew and Associates/ Project Management Ltd.	
Date: 29/6/95	Ground Level

Description	Red. Level	Legend	Depth	samples Ref. No.	samples Type	samples Depth	Remarks
Made Ground (Rubble, timber , glass and pottery intermixed with black organic silt)			1.50				
Soft dark grey organic SILT			3.00				

Observations	Groundwater Conditions
Severe collapsing of trial pit below 1.5 metres in association with water ingress.	Rapid water ingress from 1.5 metres.

R204

51946

BORING RECORD

I.G.S.L.

Contract: BRIGHTON SQUARE
No. 3063
Location: DUBLIN
Client: CAREW & ASSOCIATES / PROJECT MANAGEMENT LTD.
Dates: 21.7.95

Borehole No. 3
Sheet No. 1 of 1
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
Concrete and steel (MADE GROUND)			0.25				
Made Ground (Brown black silty gravelly CLAY with boulders , red brick, and ash)							
				3882	D	1.50	(1.50)N=16
				3883	D	3.00	(3.00)N=17
				3884	W	3.00	
			4.50	3885	D	4.50	(4.50)N=4
Made Ground (Soft brown and black silty CLAY with boulders)							
				3886	D	6.00	(6.00)N=12
				3887	W	7.00	
				3888	D	7.50	(7.50)N=15
			9.00				(9.00)N=29
Made Ground (Soft silty CLAY and GRAVEL)				3889	D	9.20	
			9.70				
Grey GRAVEL and BOULDERS				3890	D	9.80	
			10.00				(10.00)N=R

Remarks
Breaking out floor and roof of shed 4 hours
Chiselling 0.20 - 0.80 = 2hrs (Boulders

Chiselling 10.00 - 10.10 = 2hrs (Presumed rock)

Driller: J. Mc Donald

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
21/7/95			2.5	strike
				Rose to 1.6 m
	4.3	4.3	Dry	end of day
24/7/95	4.30	4.30	DRY	start of day
	7.00	7.00	1.60	strike
	10.00	0.00	1.30	casing pulled

Sample/Test Key : U - tube sample. D - disturbed sample. W - water sample. S - SPT. C - CPT. R - Refusal. V- vane.

R204

5194 S

BORING RECORD

I.G.S.L.

Contract: BRIGHTON SQUARE
No. 3063
Location: DUBLIN
Client: CAREW & ASSOCIATES / PROJECT MANAGEMENT LTD.
Dates: 20.7.95

Borehole No. 2
Sheet No. 1 of 1
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

	Description	Red. Level	Legend	Depth m	samples Ref. No	Type	Depth	Field Tests
	Concrete and steel (MADE GROUND)			0 25				
1	Made Ground (Red brick , ash , mortar)							
				1.20	3873	D	1.00	
	Made Ground (Brick rubble intermixed with brown and black silty CLAY)							(1.50)N=8
2					3874	D	2.00	
3					3875	W	3.00	(3.00)N=4
				3.70				
4	Made Ground (Gravel , silty clay , red brick)				3876	D	3.80	
					3877	D	4.50	(4.50)N=13
5				5.20				
	Soft brown and black organic silty CLAY - presumed fill				3878	D	5.50	
6								(6.00)N=12
7					3879	D	7.00	
								(7.50)N=R
				7.80				
8					3880	W	8.00	
	Presumed ROCK (angular Limestone fragments recovered)			8.10	3881	D	8.00	
9								

Remarks
Breaking out concrete floor and roof of shed 4 hours
Chiselling 0.40 - 0.60 = 1hr
Chiselling 7.80 - 8.10 = 2hrs (Presumed ROCK)

Installed Gas detection standpipe

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
20.7.95			3.0	Strike
				Rose to 2.0m
	7.5	7.5	None	Sealed off
	8.10	8.10	1.6	Rose to 1.6 m
				in 3 mins.
	8.10	0.00	1.4	End of boring

Driller: J. Mc Donald

Sample/Test Key : U - tube sample. D - disturbed sample. W - water sample. S - SPT. C - CPT. R - Refusal. V - vane.

R204

51944

BORING RECORD

I.G.S.L.

Contract: BRIGHTON SQUARE
No. 3063
Location: DUBLIN
Client: CAREW & ASSOCIATES / PROJECT MANAGEMENT LTD.
Dates: 18.7.95

Borehole No. 1
Sheet No. 1 of 1
Method Cable Tool
Dia. 200mm
Ground Level m.O.D

	Description	Red. Level	Legend	Depth m	samples Ref. No.	Type	Depth	Field Tests
	Tarmac over black gravelly CLAY (FILL)				3865	D	0.30	
				0.50				
1	Made Ground (Soft brown and black organic clayey SILT with red brick , pottery and ash.)							
					3866	D	1.50	(1.50)N=9
2								
3					3867	D	3.00	(3.00)N=8
4								
				4.50	3868	D	4.50	(4.50)N=11
	Made Ground (Brown and black organic SILT with red brick,pottery,ash)							
5					3869	W	5.00	
6				6.00				(6.00)N=34
	Grey sandy GRAVEL with cobbles , boulders and bands o f stff black gravelly CLAY				3870	D	6.10	
					3871	D	6.80	
7				7.00				(7.00)N=R
	Presumed ROCK (angular Limestone fragments recovered)				3872	D	7.10	
				7.20				
8								
9								

Remarks

Chiselling 6.50 - 6.70 = 1hr
Chiselling 7.00 - 7.20 = 2hrs (Presumed rock)

Installed Gas Detection Standpipe

Water level observations

Date	Hole Depth	Cased Depth	Water Depth	Remarks
18.7.95	2.40	2.40	2.40	Water Strike
	2.40	2.40	1.70	After 30mins
	4.50	4.50	3.20	End of day
19.7.95	4.50	4.50	1.40	Start of day

Driller:

Sample/Test Key : U - tube sample. D - disturbed sample. W - water sample. S - SPT. C - CPT. R - Refusal. V- vane.

R367

Report No.	CLASSIFICATION TEST RESULTS	I.G.S.L.

Contract: Site Investigation At Camden Street

Borehole No.	Sample No.	Depth (m)	Sample Description	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %
1	20183	2.50	Brown slightly silty gravelly CLAY	31	20	11	13.12
2	16467	6.50	Black slightly silty gravelly CLAY with cobbles	29	18	11	10.12
4	16460	4.00	Black slightly silty gravelly CLAY with cobbles	31	18	13	11.22
5	20189	4.50	Black slightly silty gravelly CLAY with cobbles	31	20	11	10.84

R989

Report No. 1342	CLASSIFICATION TEST RESULTS	IGSL

Contract

PORTOBELLO HARBOUR

Borehole No.	Sample No.	Depth (Metres)	Sample Description	Percentage Passing 425 μm Sieve	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %
3	016	4.30	Grey mottled gravelly CLAY					20.3
	017	5.30	Brown and grey mottled gravelly silty CLAY					19.3
	018	6.50	Dark grey gravelly silty CLAY					9.1
4	020	2.80	Grey sandy CLAY with gravel					22.4
	022	5.50	Grey sandy gravelly CLAY					19.6
	023	6.30	Dark grey gravelly silty CLAY					9.8

Report No. 954

CLASSIFICATION TEST RESULTS

IGSL

Contract

BUTTERFIELD AVENUE

Borehole No.	Sample No.	Depth (Metres)	Sample Description	Percentage Passing 425 µm Sieve	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %
1	15348	5.4	Brown gravelly silty CLAY		29	15	14	11.5
	15349	6.5	Greyish brown silty CLAY with gravel		29	14	15	11.7
2	15354	5.0	Greyish brown gravelly silty CLAY		29	15	14	11.4
3	15360	5.0	Greyish brown gravelly silty CLAY		30	14	16	10.3
4	15340	2.0	Greyish brown silty CLAY with gravel		27	15	12	12.7
5	15364	4.5	Greyish brown gravelly silty CLAY		29	14	15	11.8
	15365	6.2	Greyish brown silty CLAY with gravel		30	17	13	12.0
6	15368	2.8	Dark grey and brown mottled gravelly silty CLAY		32	18	14	20.5
	15369	4.0	Brown gravelly silty CLAY		27	14	13	12.1
	15371	6.6	Brown silty CLAY with gravel		28	14	14	11.7

R3059

Report No.	CLASSIFICATION TEST RESULTS	I.G.S.L.

Contract: KELLY'S CORNER - DUBLIN

Borehole No.	Sample No.	Depth (m)	Sample Description	% passing 425um	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %
1	102	3.3	Grey black silty gravelly CLAY		27	18	9	11.9
2	108	4.5	Grey black silty gravelly CLAY		28	18	10	12.5

R4483

Summary of Classification Tests

BS1377:Part 2:1990, clauses 3.2, 4.3, 5.3 & 5.4

BH/TP No.	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425 µm %	Preparation	Description	Classification
BH1	2585	4.00	D	10.5	24	10	14	43.8	WS	Brown slightly sandy gravelly CLAY	C L
BH2	2575	3.00	D	11.2	27	15	12	47.5	WS	Brown slightly sandy gravelly CLAY	C L
BH3	2593	5.00	D	15.2	32	16	16	42.1	WS	Dark grey slightly sandy gravelly CLAY	C L
BH6	2598	2.00	D	17.4	34	18	16	50.1	WS	Brown slightly sandy gravelly CLAY	C L
BH6	2502	5.00	D	10	34	17	17	46.8	WS	Dark grey slightly sandy gravelly CLAY	C L
BH7	2507	2.10	D	12.4	31	15	16	45.8	WS	Brown slightly sandy gravelly CLAY	C L
BH7	2512	7.00	D	7.8	33	18	15	39.2	WS	Dark grey slightly sandy gravelly CLAY	C L

Notes: NAT - tested as received WS - Wet sieved (425 µm) NP - Non Plastic

IGSL	Contract				Contract No.
	YMCA DEV. AUNGIER STREET				7688
	Compiled By	Date	Checked By	Date	Page
	D CONNOLLY	13/02/02			of

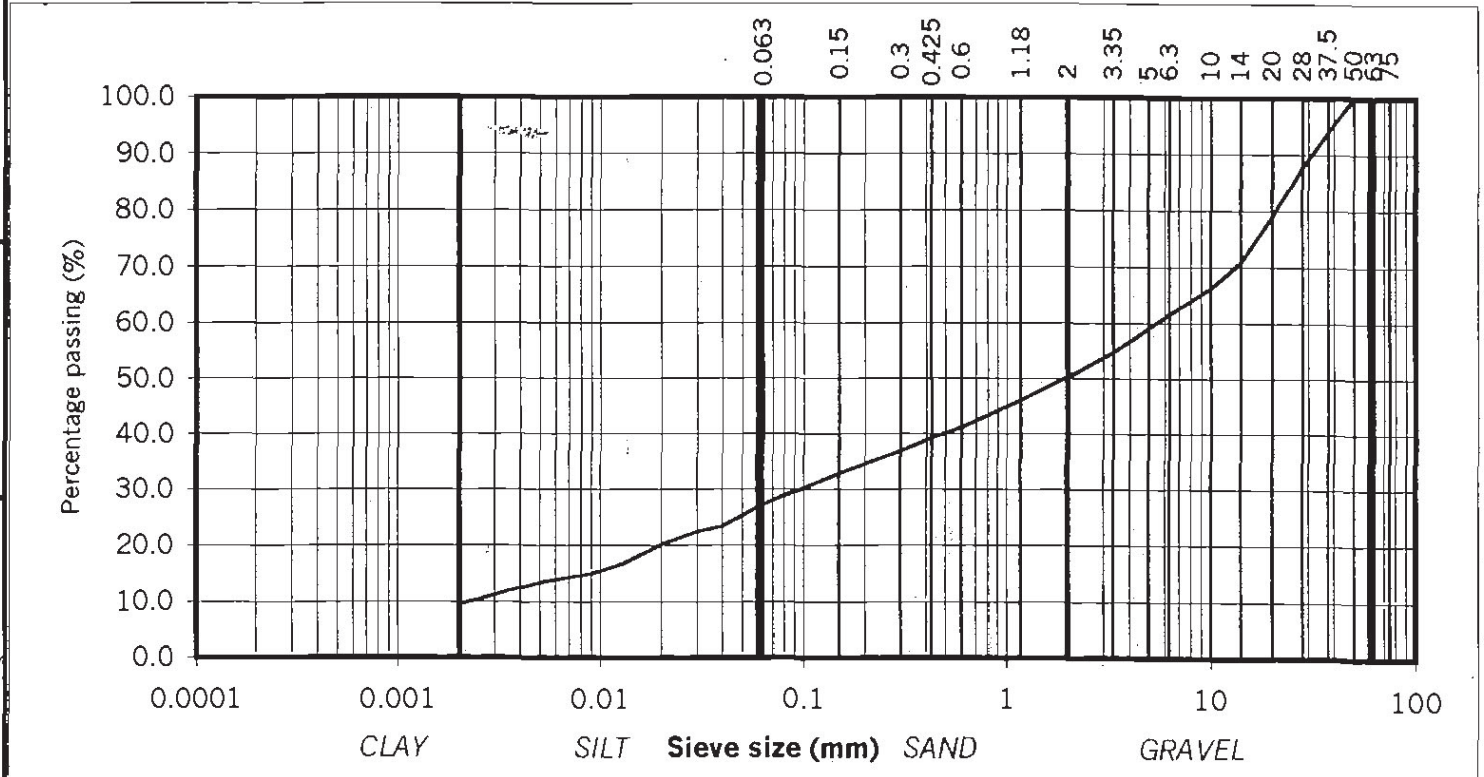
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

R4483

particle size	% passing	
75	100.0	COBBLES
63	100.0	GRAVEL
50	100.0	
37.5	93.9	
28	87.9	
20	78.9	
14	70.8	
10	66.3	
6.3	61.5	
5	59.0	
3.35	54.7	
2	50.2	SAND
1.18	46.1	
0.6	41.2	
0.425	39.2	
0.3	36.9	
0.15	32.8	
0.063	27.3	SILT/CLAY
0.04	23.5	
0.03	22.4	
0.02	20.2	
0.013	16.7	
0.009	15.0	
0.005	13.4	
0.002	9.5	

Contract No: 7688
Contract: YMCA DEV. AUNGIER STREET
BH/TP No: BH6
SAMPLE No.: 2504
DEPTH (m): 7.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Dark grey slightly sandy, gravelly, CLAY



IGSL	Compiled by:	Date:	Checked by:	Date:	Page no:
	D CONNOLLY	12/02/02			

Irish Geotechnical Services Ltd., Industrial Estate, Newbridge, Co kildare

PSD V3.1 12.01

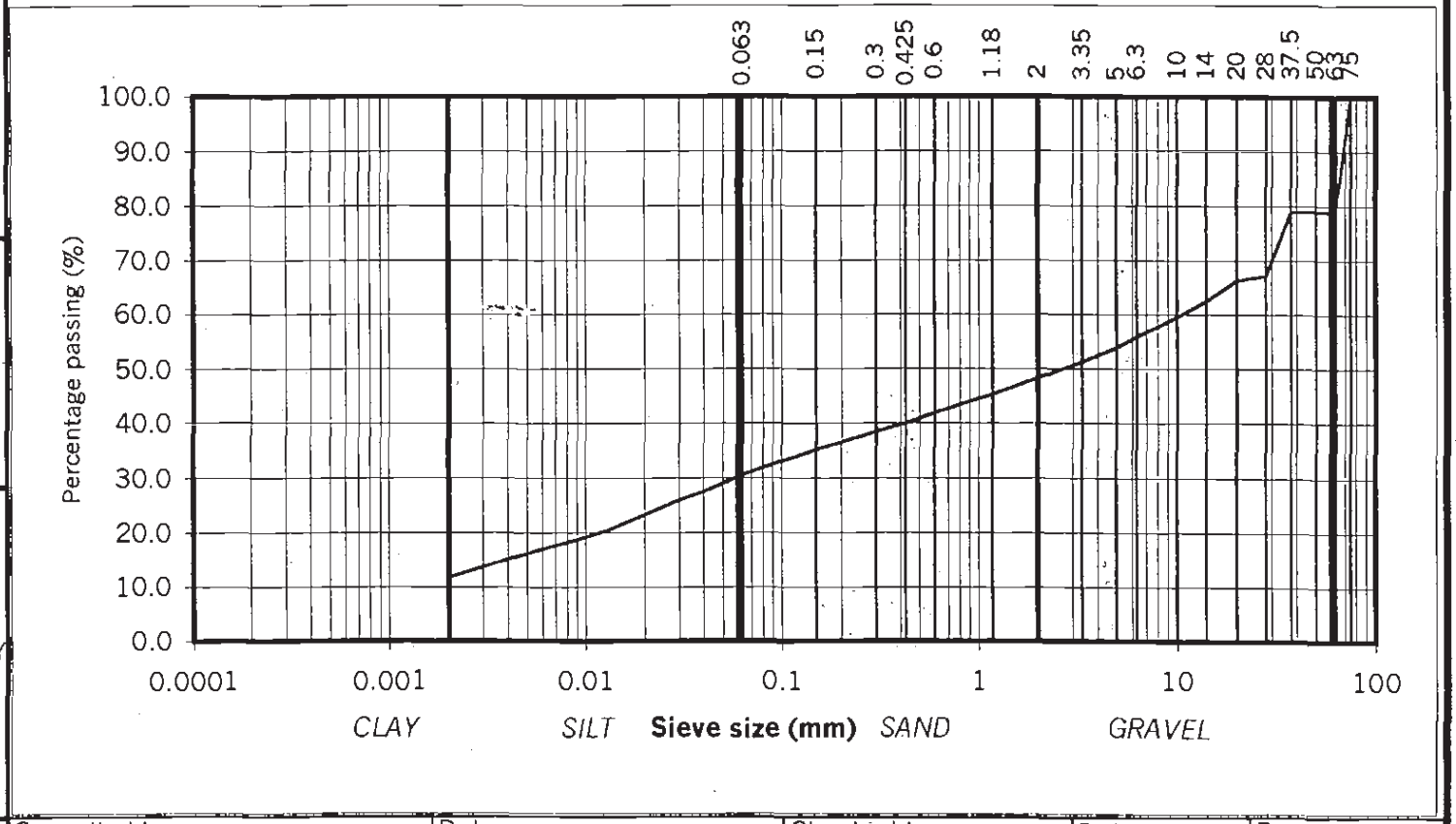
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

R4483

particle size	% passing	
75	100.0	COBBLES
63	78.9	
50	78.8	
37.5	78.8	
28	67.1	
20	66.3	GRAVEL
14	62.4	
10	59.5	
6.3	55.9	
5	53.9	
3.35	51.2	
2	48.2	
1.18	45.3	
0.6	41.9	SAND
0.425	40.1	
0.3	38.5	
0.15	35.2	
0.063	30.6	
0.04	27.6	
0.03	26.1	
0.02	23.4	SILT/CLAY
0.013	20.4	
0.009	18.7	
0.005	16.3	
0.002	11.9	

Contract No: 7688
Contract: YMCA DEV. AUNGIER STREET
BH/TP No: BH2
SAMPLE No.: 2578
DEPTH (m): 6.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Dark grey slightly sandy, gravelly, CLAY



IGSL

Compiled by:	Date:	Checked by:	Date:	Page no:
D CONNOLLY	12/02/02			

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

R4483

particle size	% passing	
75	100.0	COBBLES
63	100.0	
50	100.0	
37.5	76.8	
28	64.5	
20	64.5	GRAVEL
14	61.7	
10	57.5	
6.3	53.6	
5	51.3	
3.35	48.2	
2	44.8	
1.18	41.8	
0.6	38.0	SAND
0.425	36.4	
0.3	34.6	
0.15	31.2	
0.063	26.4	
0.04	26.3	
0.03	24.6	
0.02	21.6	SILT/CLAY
0.013	19.1	
0.009	17.0	
0.005	14.9	
0.002	10.7	

Contract No: 7688

Contract: YMCA DEV. AUNGIER STREET

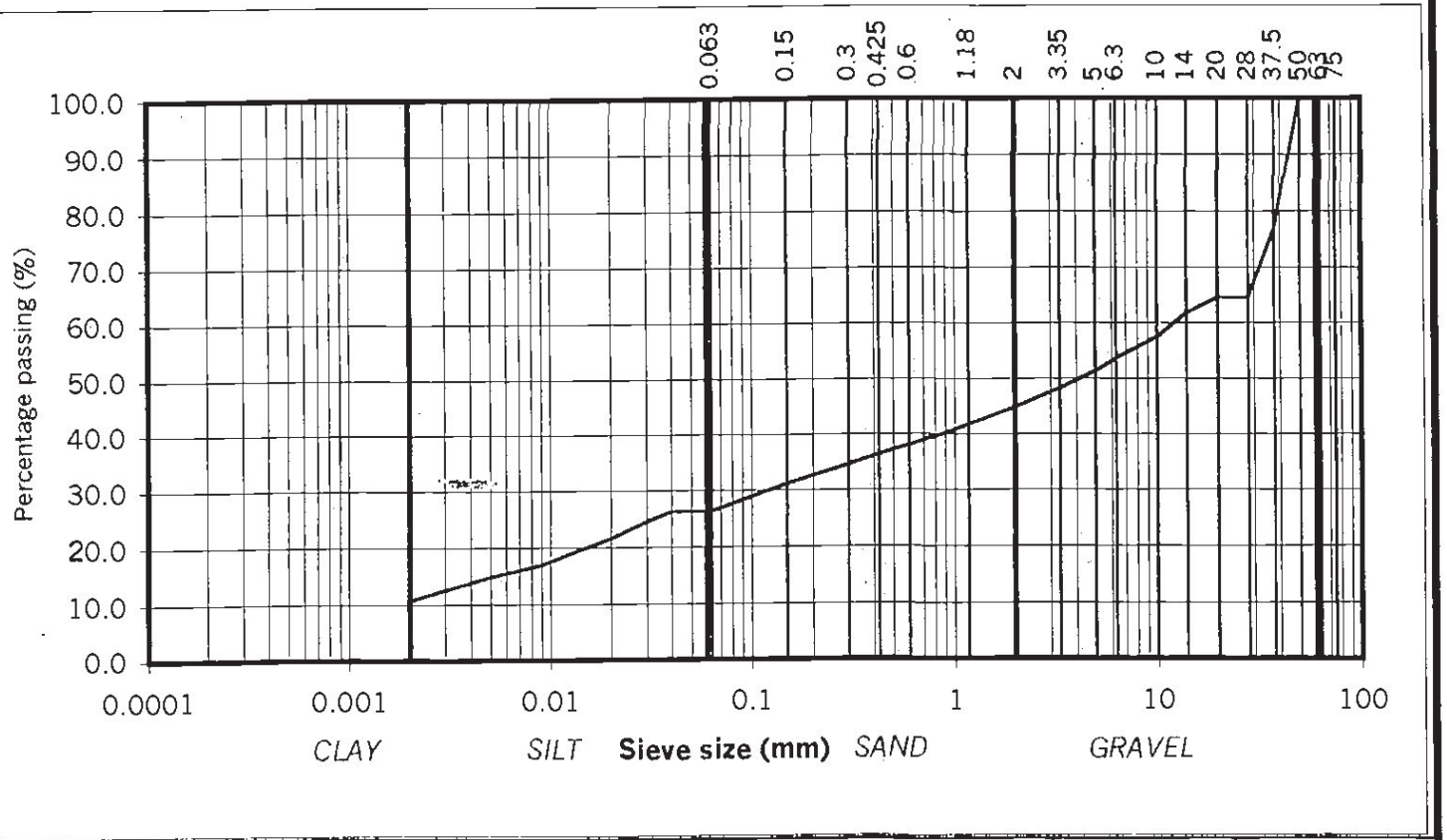
BH/TP No: BH3

SAMPLE No.: 2591

DEPTH (m): 3.00

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Dark grey slightly sandy, gravelly, CLAY



IGSL

Compiled by:	Date:	Checked by:	Date:	Page no:
D CONNOLLY	12/02/02			

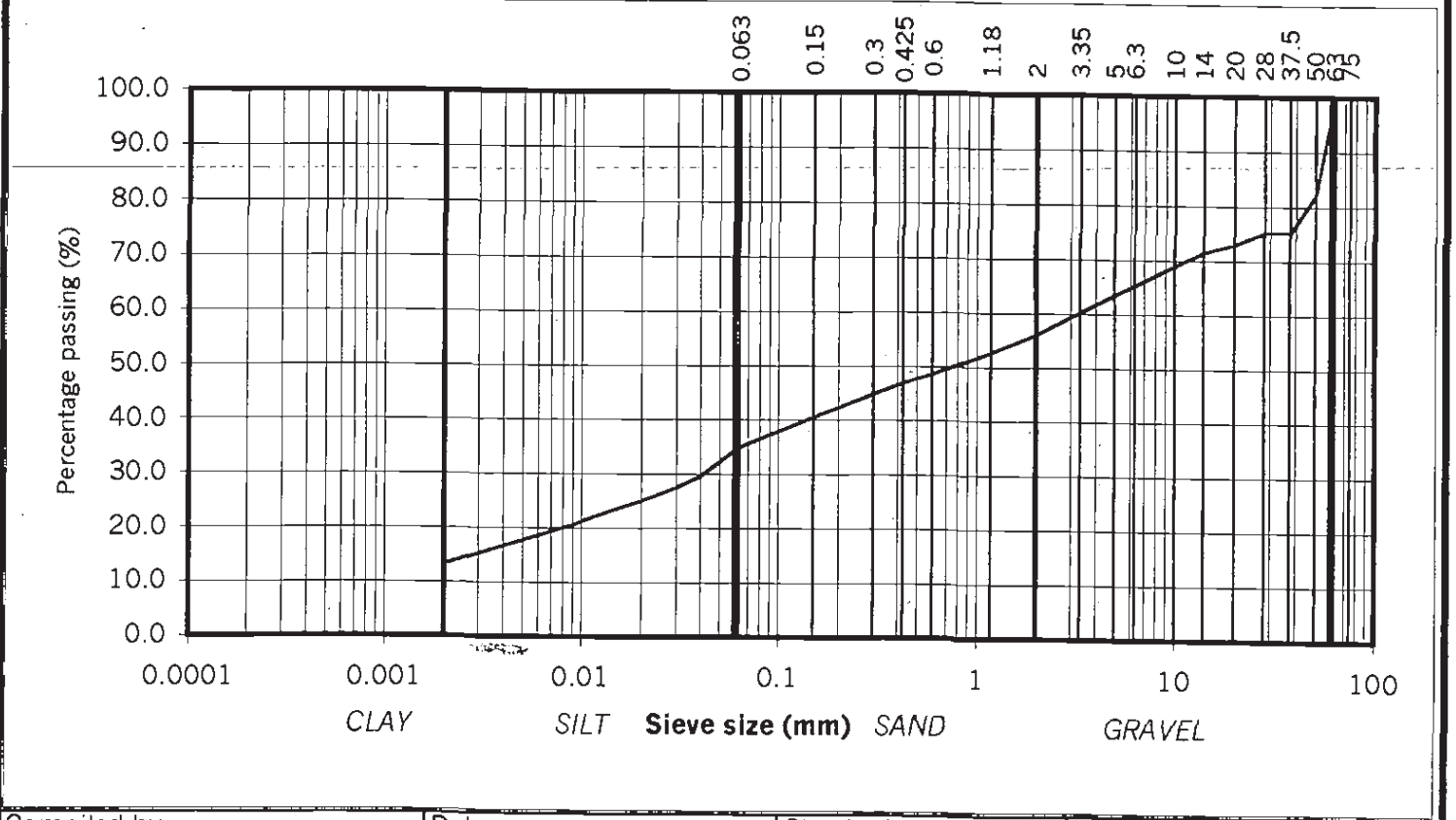
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

R4483

particle size	% passing	
75	100.0	COBBLES
63	100.0	
50	82.1	
37.5	75.2	
28	75.2	
20	72.9	GRAVEL
14	71.5	
10	68.9	
6.3	65.3	
5	63.4	
3.35	60.2	
2	56.0	
1.18	52.6	
0.6	48.6	SAND
0.425	46.8	
0.3	44.8	
0.15	40.5	
0.063	34.9	
0.04	29.5	
0.03	27.5	
0.02	25.0	SILT/CLAY
0.013	22.8	
0.009	20.5	
0.005	17.8	
0.002	13.3	

Contract No: 7688
Contract: YMCA DEV. AUNGIER STREET
BH/TP No: BH7
SAMPLE No.: 2510
DEPTH (m): 5.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION: Dark grey slightly sandy, gravelly, CLAY



IGSL

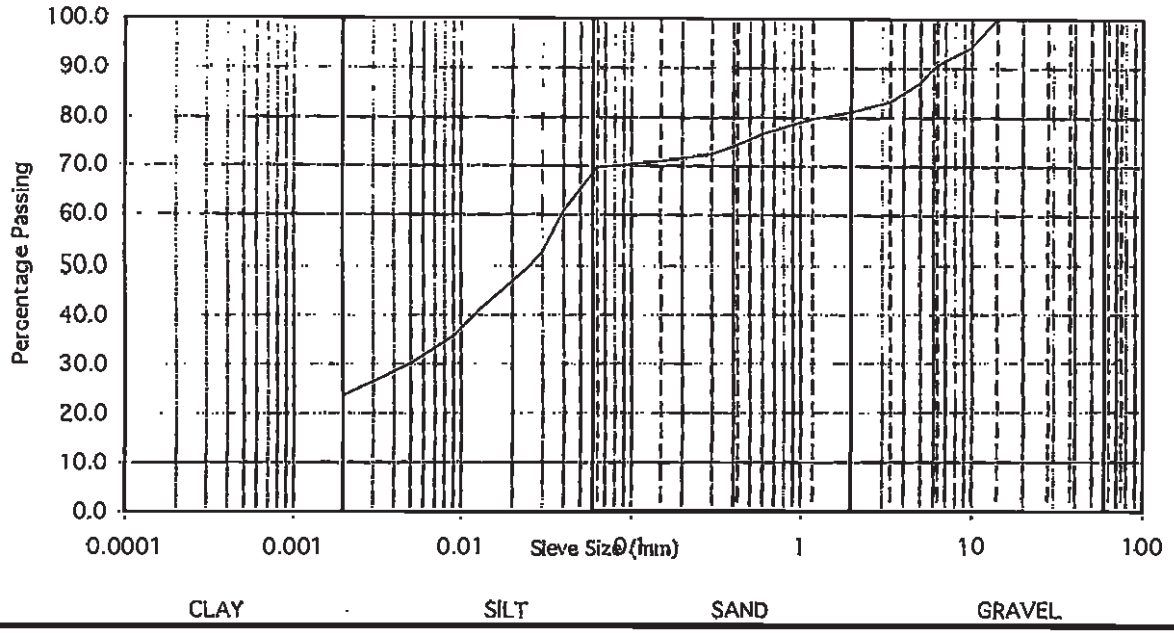
Compiled by:	Date:	Checked by:	Date:	Page no:
D CONNOLLY	12/02/02			

R5464

Report No.	PARTICLE SIZE ANALYSIS	I.G.S.L

CONTRACT: Space Projects Rathgar Dublin
BOREHOLE: 1
SAMPLE No. 6931
DEPTH (m) 2.00
TEST METHOD: Wet sieve and hydrometer
DESCRIPTION Brown sandy gravelly CLAY

particle size	%passing	
75	100.0	COBBLES
63	100.0	
50	100.0	
37.5	100.0	
28	100.0	
20	100.0	GRAVEL
14	100.0	
10	94.4	
6.3	90.8	
5	87.1	
3.35	83.3	
2	81.1	
1.18	79.8	
0.6	76.5	
0.425	74.3	SAND
0.3	72.4	
0.15	70.9	
0.063	69.6	
0.04	60.7	
0.03	52.3	
0.02	46.8	
0.013	41.2	SILT/CLAY
0.009	35.6	
0.005	30.1	
0.002	23.6	



R5464

Report No.	CLASSIFICATION TEST RESULTS								IGSL
Contract:	SPACE PROJECTS RATHGAR								
Location No.	Depth (M)	Reference No.	Description	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Water Content %	pH	Sulphate Content %
1	2.00	6931	Grey brown sandy gravelly CLAY	37	22	15	16.55		
1	3.00	6932	Grey black / Black very gravelly CLAY	33	20	13	11.5		

Summary of Classification Tests

BS1377:Part 2:1990, clauses 3.2, 4.3, 5.3 & 5.4

BH/TP No.	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425µm %	Preparation	Description	Classification
BH 1	4764	2.00	D	11.1	32	17	15	53.0	WS	Grey brown slightly sandy gravely CLAY with fill material	C L
BH 2	4760	4.00	D	13.2	30	16	14	45.0	WS	Grey slightly sandy gravely CLAY with fill material	C L

Notes: NAT - tested as received WS - Wet sieved (425µm) NP - Non Plastic

IGSL	Contract	BISHOPS STREET DUBLIN			Contract No. 11746
	Issued By	Date		Date	Page
		21/6/06			of

R6455

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	
50	100	
37.5	96	
28	90	
20	85	
14	83	GRAVEL
10	80	
6.3	75	
5	72	
3.35	68	
2	64	
1.18	60	
0.6	55	
0.425	53	SAND
0.3	50	
0.15	44	
0.063	39	
0.037	36	
0.026	33	
0.017	29	
0.010	24	SILT/CLAY
0.007	21	
0.004	18	
0.002	12	

Contract No: 11746

Contract: BISHOPS STREET DUBLIN

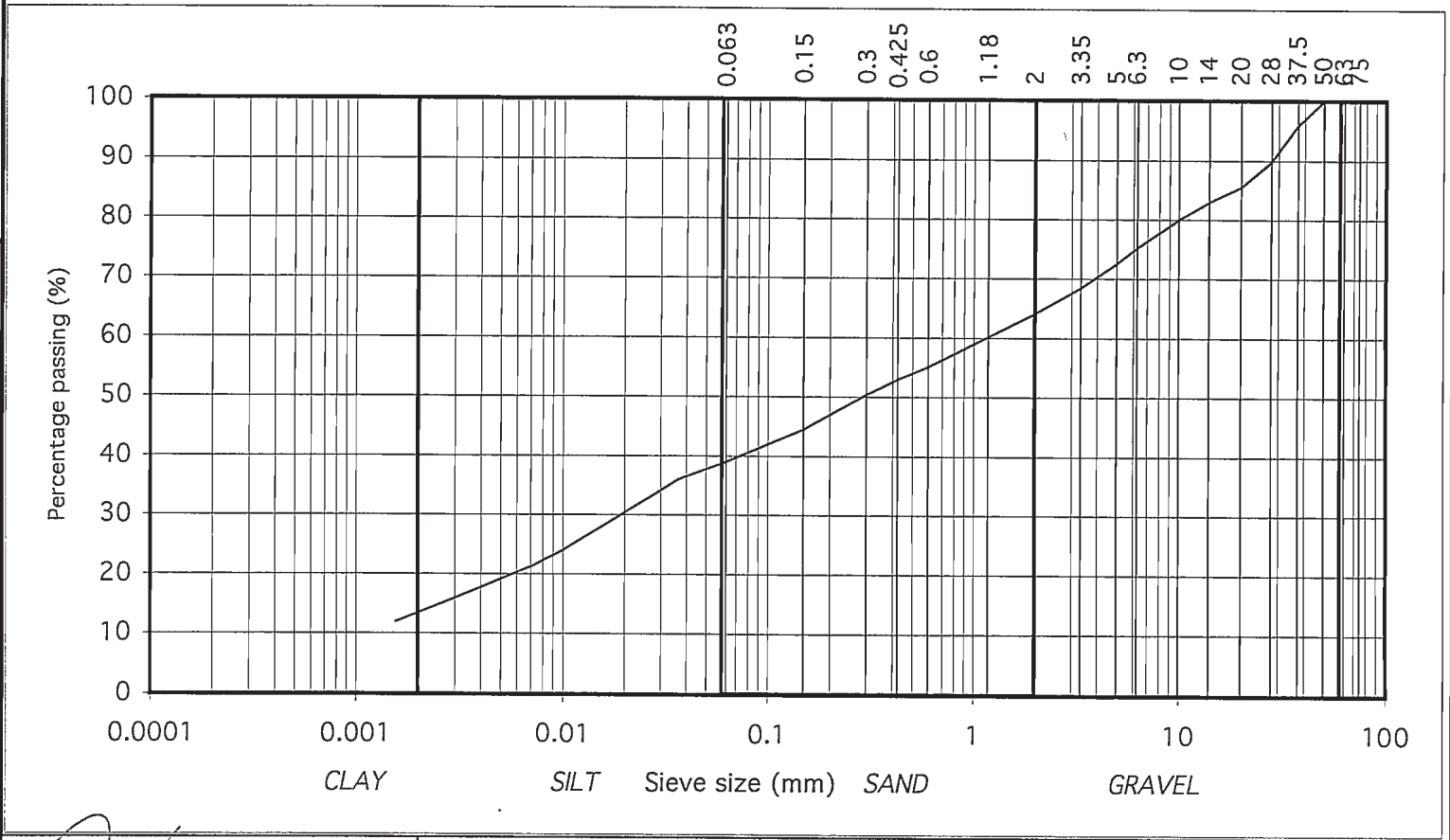
BH/TP No: BH 1

SAMPLE No.: 2303

DEPTH (m): 3.00

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Grey brown slightly sandy, gravelly, CLAY



R6455

IGSL

Issued By	Date:			Page no:
	21/6/06			

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	100	
28	92	
20	87	
14	83	
10	79	
6.3	73	
5	70	
3.35	66	
2	60	SAND
1.18	55	
0.6	48	
0.425	45	
0.3	42	
0.15	35	
0.063	31	SILT/CLAY
0.037	27	
0.027	24	
0.017	21	
0.010	17	
0.007	15	
0.004	12	
0.002	8	

Contract No: 11746

Contract: BISHOPS STREET DUBLIN

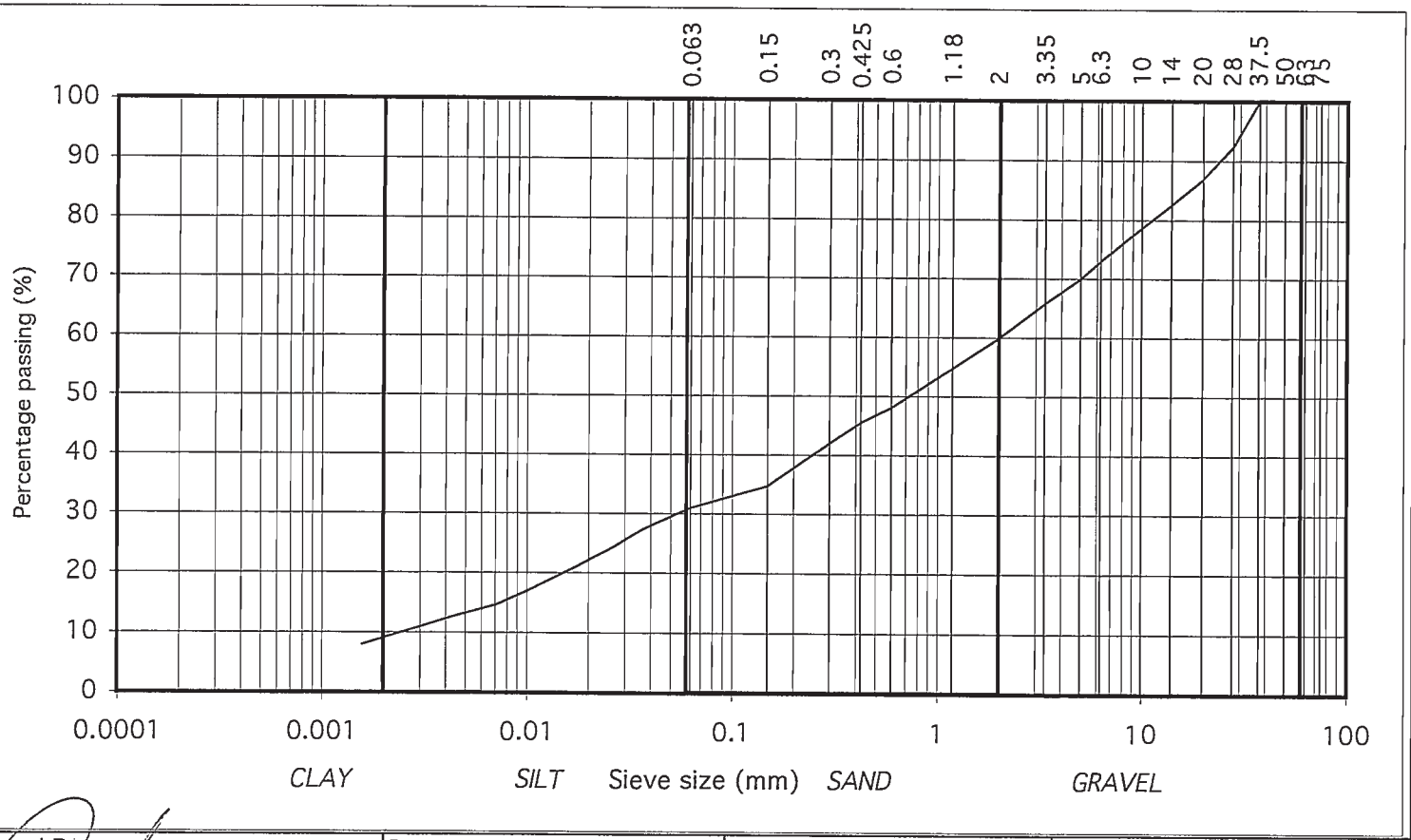
BH/TP No: BH 1

SAMPLE No.: 2304

DEPTH (m): 4.00

TEST METHOD: Wet sieve and hydrometer

DESCRIPTION: Grey slightly sandy, gravelly, CLAY



R6455

IGSL

Issued By	Date:			Page no:
	21/6/06			

Appendix F

Geotechnical Risk Register

F1

GEOTECHNICAL RISK REGISTER

Please refer to notes for more information

Rev.

JOB TITLE: Templeogue/ Rathfarnham to City Centre Core Bus Corridor

JOB NO: 268401-00

Particular Definitions

Hazard: Ground conditions and geotechnical related elements which have the potential to adversely impact on the project.

Risk: The consequence if a particular hazard was to occur or was left untreated.

ARUP

Ref.	Sub Ref.	Created By		Phase of Works and/or Source	Hazard			Risk		Risk / Opportunity	Pre-Mitigation Risk Analysis			Risk Control Mitigation Measures			Post-Mitigation Risk Analysis			Status
		Date	Initials		Hazard	Observation / Cause	Location of Hazard	Risk Exposure	Risk Impact Category		Likelihood L / M / H	Severity L / M / H	Risk L / M / H	Mitigation Measures	Phase of Application	Required by	Likelihood L / M / H	Severity L / M / H	Risk L / M / H	
1	(i)	15/07/2021	OA	Preliminary Design	Contamination	Encountering unexpected contaminated ground during construction.	Site Extent	Material present may be contaminated. This presents a health and safety risk during the construction.	Health & Safety	R	M	M	M	Further GI to be scheduled at detailed Design	Ground Investigation	Client	L	L	L	Active
2	(i)	15/07/2021	OA	Preliminary Design	Contamination	Presence of made ground	Site Extent	Material excavated during the works may not be suitable for reuse on site and require disposal to a licenced landfill.	Commercial	R	M	M	M	Further GI to be scheduled at detailed Design	Ground Investigation	Client	M	L	L	Active
3	(ii)	15/07/2021	OA	Preliminary Design	Unforeseen ground conditions	Less favourable ground material properties.	Geology	More excavation and replacement or ground treatment required.	Design	R	M	M	M	The detailed design should assess the proposed scheme elements and local ground conditions in accordance with Eurocode 7.	Detailed Design	Client	L	L	L	Active
4	(iii)	15/07/2021	OA	Preliminary Design	Settlement	Presence of alluvium material near rivers (based on GSI data base)	Geology	Material present may cause settlement.	Design	R	H	H	H	The detailed design should consider the soft material.	Detailed Design	Client	L	L	L	Active
6	(ii)	15/07/2021	OA	Preliminary Design	Unforeseen ground conditions	Low undrained shear strength and effective parameters of Made Ground	Geology	Material present may cause settlement and bearing resistance problems.	Design	R	H	M	H	Strength and physical properties of made ground should be investigated at site before the construction	Detailed Design	Contractor	L	L	L	Active
7	(iv)	15/07/2021	OA	Preliminary Design	Chemically reactive ground	Aggressive ground conditions	Geology	Chemical attack on buried concrete due to acid and/or sulphate in the soil or ground water.	Design	R	M	M	M	Limited sulphate and pH level testing indicates that aggressive ground is not present. Concrete class shall be chosen to ensure required durability.	Detailed Design	Contractor	L	L	L	Active
8	(i)	15/07/2021	OA	Preliminary Design	Contamination	Re-useability of the material	Geology	Material excavated during the works may not be suitable for reuse on site and require disposal to a licenced landfill or require suitable material to be imported.	Design	R	M	M	M	Further GI to be scheduled at detailed Design	Ground Investigation	Client	L	L	L	Active
9	(iii)	15/07/2021	OA	Preliminary Design	Settlement	Insufficient characterisation of the ground materials.	Geology	Unexpected or poor ground materials could lead to excessive deformation of the retaining walls if it is not assessed and considered during detailed design.	Design	R	M	M	M	Further GI to be scheduled at detailed Design	Detailed Design	Client	L	L	L	Active