

Trial Pits

Trial Pits were scheduled in fourteen specified locations and referenced TP01 to TP14. A tracked excavator was used under engineering supervision. Detailed records for each location are presented in Appendix III. These records note the soil stratification and record sampling and ground water details.

Topsoil surface was noted in each location generally overlying a zone of soft SILT/CLAY. Firm to stiff brown or grey gravelly CLAY was then encountered, this stratum typically containing cobbles and boulders.

The findings are consistent with the stratification noted in the boreholes.

Several trial pits were terminated on large boulders. The findings are summarised and presented as follows:

TABLE C

Ref No.	Topsoil	Soft SILT- CLAY	Stiff gravelly CLAY	Water
TP01	0 – 0.25	0.25 – 0.90	0.90 – 1.80	Dry
TP02	0 – 0.25	0.25 – 0.55	0.55 – 1.40	Dry
TP03	0 – 0.20	0.20 – 0.80	0.80 – 1.70	Dry
TP04	0 – 0.10	0.10 – 0.60	0.60 – 1.80	Dry
TP05	0 – 0.20	0.20 – 0.50	0.50 – 2.10	Dry
TP06	0 – 0.25	0.25 – 0.80	0.80 – 1.50	1.00
TP07	0 – 0.25	0.25 – 1.50	1.50 – 1.90	Dry
TP08	0 – 0.25	0.25 – 0.50	0.50 – 2.20	Dry
TP09	0 – 0.25	0.25 – 0.50	0.50 – 1.50	Dry
TP10	0 – 0.30	0.30 – 0.50	0.50 – 2.50	Dry
TP11	0 – 0.20	0.20 – 1.10	1.10 – 2.30	Dry
TP12	0 – 0.30	0.30 – 1.00	1.00 – 1.80	Dry
TP13	0 – 0.20	0.20 – 0.50	0.50 – 1.40	Dry
TP14	0 – 0.20	0.20 – 0.50	0.50 – 2.10	Dry

Trial Pits were backfilled with the excavated spoil, compacted in layers, the disturbed areas were levelled and coarse material was removed.

BRE Digest 365 Test

Infiltration testing was performed at four locations as specified in accordance with BRE Digest 365 'Soakaway Design'. Tests are referenced SA01 to SA04. Detailed data is presented in Appendix IV.

To obtain a measure of the infiltration rate of the sub-soils, water is poured into the test pit, and records taken of the fall in water level against time. The test is carried out over two cycles following initial soakage.

The infiltration rate is the volume of water dispersed per unit exposed area per unit of time, and is generally expressed as metres/minute. In these calculations the exposed area is the sum of the base area and the average internal area of the permeable stratum over the test duration. Design is based on the slowest infiltration rate, which has been calculated from the final cycle.

The stratification in the test area comprised Topsoil over gravelly sandy SILT/ CLAY.

Results are summarised as follows:

TABLE D

Test No.	Depth	Soil Type	Infiltration Rate (f) (Metres/ Minute)
SA 01	1.30	Gravelly CLAY	0.00173
SA02	1.60	Gravelly CLAY	0.00023
SA03	1.60	Gravelly CLAY	5.3E-05
SA04	1.30	Gravelly CLAY	0.0000

The results confirm low to very low permeability for the cohesive gravelly clay soils present on the site.

III. Testing

In Situ

Standard penetration tests were carried out at approximate 1.00 metre intervals in the geotechnical boreholes and at 1.50 metres in the Rotary Core Holes to measure relative in-situ soil strength. N values are noted in the right hand column of the individual records, representing the blow count required to drive the standard sampler 300mm into the soil, following initial seating blows. Where full test penetration was not achieved the blow count for a specific penetration is recorded, or refusal is indicated where appropriate. The results of the tests are summarised as follows:

STRATUM	N VALUE RANGE	COMMENT
Gravelly CLAY (Boulder Clay)		
1.00 m BGL	6 to 13	Soft to Firm
2.00 m BGL	10 to 29	Firm to Stiff
3.00 m BGL	26 to 50	Stiff to Hard
4.00 m BGL	> 50	Hard
4.00 to 15.00 m BGL (Rotary Holes)	40 to >50	Hard

Limited penetration SPT tests with refusal were recorded on numerous occasions, reflecting a high concentration of cobble / boulder material in the glacial till

Laboratory

A programme of laboratory testing was scheduled following completion of site operations. Geotechnical testing was carried out by IGSL in it's INAB-Accredited laboratory. Chemical and environmental testing was carried out in the UK by EUROFINS / CHEMTEST Ltd. The test programme included the following elements:

Liquid and Plastic Limits / Moisture Content	IGSL
PSD Grading by Wet Sieve and Hydrometer	IGSL
MCV	IGSL
CBR	IGSL
Compaction	IGSL
Organic Content	EUROFINS
Sulphate / Chloride / pH	EUROFINS
RILTA Suite Environmental	EUROFINS

All laboratory data is presented in Appendices Va and Vb and individual tests are discussed briefly as follows:

Index Properties / Natural Moisture Content

Classification tests have been carried out on samples of the cohesive soils from borehole and trial pit locations.

The glacial tills plot generally in the CI/CL zone of the standard Classification chart indicative of low plasticity gravelly CLAY matrix material. Natural Moisture Content ranges from 14 to 19 %.

Grading

Wet sieve and hydrometer analysis has been carried out on samples of the cohesive soils from both boreholes and trial pits. The graphs are typically straight line, grading from the fine clay to coarse gravel fraction. The pattern is very typical of glacial till or boulder clay deposition.

Organic Content

Six samples of the soils from the site had organic contents established. Samples were generally taken from shallow depths below the topsoil. Values of 1.0 to 2.5% were determined indicative of very low to negligible organic content.

MCV/CBR/Compaction

Six large composite samples were selected from Trial Pits 01 / 03 / 05 / 09 / 12 and 14 and a series of tests were scheduled to establish the soil characteristics relative to possible re-use during the new development.

The tests carried out included MCV (Moisture Condition Value), Natural Moisture Content, CBR (California Bearing Ratio), Dry Density / Moisture Content relationship.

The results are summarised as follows:

Ref No.	TP01	TP03	TP05	TP09	TP12	TP14
Depth	0.70	0.6	0.7	0.7	0.8	1.5
Natural MC (%)	15	13	13	13	10	14
MCV	6.6	7.3	6.8	6.8	6.7	7.8
CBR (%)	5.6	4.6	4.1	2.0	7.7	3.0
Max.Dry Density (mg/cu.m.)	1.90	1.86	1.86	1.88	1.89	1.85
Optimum Moisture (%)	11	12	12	12	12	14

Chemical Suite (Sulphate Chloride pH)

Six samples were sent for analysis to BRE Chemical Suite parameters.

Sulphate concentrations (SO₄ 2:1 extract) of <0.010 to 0.240 g/l were established with pH values ranging from 7.8 to 8.6. Chloride concentrations (<0.010 to 0.24 g/l) were also determined.

The results indicate a design class of DS-1 (ACEC Classification for Concrete) for sulphate concentrations below 0.5 g/l. No special precautions are necessary to protect below ground foundation concrete.

RILTA Environmental Suite

Six samples of the sub soils were sent to specialist environmental laboratory EUROFINS and testing was carried out in accordance with RILTA requirements to establish Landfill Waste Acceptance Criteria (WAC).

Detailed results are presented in Appendix V o. All samples tested fall into the INERT category with no elevated contaminant levels recorded.

Material excavated from this site can be safely disposed of either within the site boundary or off site to a suitably licensed Landfill Facility

Asbestos screening was carried out on all RILTA samples with no traces of Asbestos noted.

A comprehensive Waste Characterisation Assessment may be required by landfill operators. This can be prepared by specialist environmental consultants using the factual data from field and laboratory as presented in this report.

IV. Discussion:

A major development is being undertaken at this site in Monaghan. A new CIVIC CENTRE is to be constructed for Monaghan County Council.

A detailed investigation of subsoil and bedrock has been carried out under the direction of CORA Consulting Engineers in the area of development.

The exploratory locations are detailed on the site plan in Appendix VI.

The factual data from the field and laboratory is presented in Sections 1 to III of this report.

The site is grassed with some significant variation in ground level.

SUMMARY STRATIFICATION

TOPSOIL overlies soft to firm sandy SILT/CLAY. This upper material extends to depth between 0.50 and 1.50 metres as shown in TABLE A and TABLE B.

Stiff brown gravelly CLAY (brown BOULDER CLAY) is then encountered and continues to about 2.00 metres where it changes to very stiff to hard grey gravelly CLAY (grey black BOULDER CLAY). Proof core drilling confirmed that the GLACIAL TILL continues to at least 15 metres BGL. Bedrock was not established.

UPPER SILT/CLAY

The soils extending from surface to depths up to 1.50 metre are described as soft to firm sandy slightly gravelly SILT/CLAY. SPT values of N=6 to N=10 have been recorded at a depth of 1.00 metre.

BOULDER CLAY

GLACIAL TILL or BOULDER CLAY has been confirmed below approximately 1.50 metres, the stratum continues to at least 15.00 metres BGL. Visual inspection of trial pit excavations and results of in-situ Standard Penetration Tests are indicative of stiff to hard consistency.

The characteristics of the regional boulder clay or glacial till are very well documented and the findings from this detailed investigation are consistent with extensive published data.

ALLOWABLE BEARING PRESSURES

The soil strength has been assessed visually in the trial pits and confirmed by Standard Penetration Tests in boreholes and core holes. The allowable bearing pressures indicated by the field data are summarised as follows:

Depth	Average N Value	Allowable Bearing Pressure	
1.00	7	75 kPa	(Upper Silt/Clay)
2.00	20	200 kPa	(Boulder Clay)
3.00	35	300 kPa	
4.00	>50	400 kPa	

FOUNDATION RECOMMENDATIONS

The use of traditional reinforced foundations for the new Civic Offices development is proposed. Foundations to be placed on the stiff brown or grey boulder CLAY using the allowable bearing pressures indicated above.

We strongly recommend visual inspection of foundation excavations by experienced personnel to ensure uniformity and suitability of the founding medium. Any soft or suspect material should be removed and where necessary replaced with low-grade concrete. The glacial till soils are sensitive to moisture variation and should be protected by blinding following excavation.

The presence of extensive boulders should also be noted with possible over-break in excavation occurring.

The majority of boreholes and trial pits were dry with only occasional water seepages recorded. This may indicate isolated water bearing gravelly zones, typical of the heterogeneous nature of the regional Glacial Till.

SETTLEMENT

Settlement of the order of 5 to 10mm can be expected under the foundation loadings indicated above. Settlement should be quite uniform and differential movement is not anticipated.

EXCAVATION

Given the variations in site levels it is likely that significant cut and fill operations will be required. No major issues will arise with excavation, other than the presence of boulder obstructions and possibly water ingress if gravel zones are encountered.

A detailed programme of laboratory testing has been carried out to establish soil parameters relative to the suitability of excavated material for re-use as engineered fill.

The results reflect a high degree of consistency in the boulder clay over the site area and will allow the appointed contractor to design a suitable programme for earthworks on this site.

BRE DIGEST 365 TESTS

The test results reflect very low permeability characteristics in the gravelly CLAY soils. This is very typical of the cohesive material. Clay matrix material is generally unsuited to dispersion of storm or surface water and consideration should be given to the use of the Local Authority Drainage System for this development.

FOUNDATION CONCRETE

No special precautions are necessary for protection of below ground concrete.

ENVIRONMENTAL

Six samples have been tested to RILTA Suite Parameters and the results confirm an INERT classification for the soils. Excavated material can be safely used on the site or can be disposed of to a suitably licensed Landfill.

A waste Characterisation Assessment (WCA) may be necessary and should be carried out by environmental specialists. This WCA should be submitted to the relevant waste management facility, to confirm suitability for acceptance.

IGSL/JC
July 2023

Appendix I Boring Records



GEOTECHNICAL BORING RECORD

REPORT NUMBER

24665

CONTRACT Monaghan Active Travel - Main Site

BOREHOLE NO. BH01

CO-ORDINATES

RIG TYPE

Dando 2000

SHEET

Sheet 1 of 1

GROUND LEVEL (m AOD)

BOREHOLE DIAMETER (mm)

200

DATE COMMENCED 13/05/2023

BOREHOLE DEPTH (m)

3.00

DATE COMPLETED 13/05/2023

CLIENT Monaghan Co.Co.

SPT HAMMER REF. NO.

BORED BY P.Allan

ENGINEER DBFL

ENERGY RATIO (%)

PROCESSED BY

F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	TOPSOIL			0.30						
	Firm brown sandy SILT/CLAY with occasional gravel				AA192931	B	0.50			
				1.00						
1	Firm grey sandy SILT/CLAY			1.20	AA192932	B	1.00		N = 13 (2, 3, 2, 3, 4, 4)	
	Brown sandy gravelly CLAY with occasional cobbles									
2					AA192933	B	2.00		N = 17 (2, 2, 2, 4, 5, 6)	
				2.70						
3	Brown sandy gravelly CLAY with some cobble			3.00						
	Obstruction End of Borehole at 3.00 m								N = 50/75 mm (25, 25, 50)	
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

WATER STRIKE DETAILS

From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.8	3	1.5		3.00	3.00	No	1.50	20	Moderate

GROUNDWATER PROGRESS

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type	11-05-23	3.00	Nil	1.50	End of BH

REMARKS CAT scanned location and hand dug inspection pit was carried out .

Sample Legend

D - Small Disturbed (lub)

B - Bulk Disturbed

LB - Large Bulk Disturbed

Env - Environmental Sample (Jar + Vial + Tub)

UT - Undisturbed 100mm Diameter

Sample

P - Undisturbed Piston Sample

W - Water Sample

IGSL BH LOG 24665M.GPJ IGSL GDT 28/5/23